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Disparate Effects of Disruptive Events on Children

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Disparate Effects of Disruptive Events on Children

ISSUE EDITORS
Jennie E. Brand, Jason Fletcher, and Florencia Torche

CONTENTS

Disparate Effects of Disruptive Events on Children

FLORENCIA TORCHE, JASON FLETCHER, AND JENNIE E. BRAND

Disruptive events such as economic recessions, natural disasters, job loss, and divorce are highly prevalent among American families. These events can have a long-lasting impact when experienced during childhood, potentially altering academic achievement, socioemotional well-being, health and development, and later life socioeconomic status. Much research has considered the overall impact of disruptive events on children's lives, but the consequences of disruption also vary across groups. The same event may have profound negative consequences for some groups, minor or no impact for others, and even be a generative or positive turning point for other groups. This issue focuses on the disparate consequences of disruptive events on children. We consider theoretical approaches accounting for effect heterogeneity and methodological challenges in identifying unequal impacts. We also review an emerging multidisciplinary literature accounting for variation in the impact of disruption across several widely studied domains that affect children's life chances, including economic, household, educational, health, and environmental events.

Keywords: Disruptive events, heterogeneity, socioeconomic disparities, social normativity, childhood, children's outcomes

Disruptive events can change the course of people's lives. These events can occur at the micro level, such as job loss, home loss, divorce or separation, incarceration, residential migration, or health shocks affecting individuals and families. Or they can occur at the macro level, such as economic recessions, pandemics, school closures, or natural disasters affecting

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large populations. These two levels are intertwined: for example, more job loss occurs during economic recessions and more illness occurs during a pandemic. Children are particularly vulnerable to disruptive events because shocks experienced in early life could alter their developmental trajectories and result in long-term consequences on their health, attainment, and well-being. Much literature documents that the risk of experiencing disruptive events is stratified by socioeconomic conditions. People with fewer resources are usually more likely to experience different kinds of disruption, ranging from economic and family instability to incarceration and health shocks. Yet a higher likelihood of experiencing disruption does not necessarily lead to a larger effect of disruption. As we argue, variation in the effects of disruptive events depends on different, and sometimes offsetting, mechanisms.

In this introduction, we focus on the impact of disruptive events on children and how the impact varies within the population. We provide a theoretical framework to consider the mechanisms accounting for variation across different groups. We then discuss methodological approaches and challenges in capturing heterogeneity in the effect of disruption. Finally, we describe variation in the impact of micro- and macro-level disruptions along several widely studied domains relevant for children's life chances, including economic, household, educational, health, and environmental.

THEORETICAL FRAMEWORK TO UNDERSTAND VARIATION IN THE EFFECTS OF DISRUPTION

The consequences of disruptive events vary across different groups of children. The literature suggests that the same disruptive event can have profound negative consequences for some groups, minor or no impact for others, and even present a generative or positive turning point for other groups. Aggregate effects can therefore mask substantial heterogeneity and miss dissimilar, and even opposite, effects across different subpopulations. We consider two broad theoretical approaches as to how the effects of disruptive events on children vary across groups. These approaches focus, respectively, on disparities in socioeconomic resources of those affected by disruption, and on variation in the normativity and predictability of shocks for different groups. These theoretical approaches systematize accumulated insights based on empirical work from several disciplines in the social sciences, including sociology, psychology, and economics. We recognize that other sources of heterogeneity exist, including differential susceptibility due to genetic or personality factors, or the age at which events occur. Even within these sources of variation, however, structural conditions governed by socioeconomic resources or social normativity account for substantial variation in the effects of disruption on children's lives (Aquino, Brand, and Torche 2022).

Structural Factors: Disparities in Socioeconomic Resources

Individuals and families with limited economic resources are often less equipped to reduce the risk of exposure and compensate for the negative consequences of disruptive events than their more advantaged peers. The limited resources of disadvantaged households, including lower levels of education, income, wealth, and other resources that could support a family safety net, render them less able to buffer negative shocks than more advantaged households. For example, the negative consequences of a recession on economic well-being are stronger for parents with fewer skills and assets not only because they are more likely to become unemployed but also because if they lose their jobs, they have a more limited ability to self-insure and take longer to return to employment (Heathcote, Perri, and Violante 2020; Krusell and Smith 1999; Mukoyama and Şahin 2006).

Research suggests that families with more resources can better compensate for the impact of early-life shocks than disadvantaged families. For example, in utero exposure to a natural disaster has a strong negative effect on children's cognitive development among disadvantaged families but no effect among more advantaged families (Torche 2018) and in utero exposure to radiation reduces educational achievement only among families of low socioeconomic status (SES) (Almond, Edlund, and Palme 2009). The consequences of disruptive

exposures when resources to cope are limited might be especially persistent if they occur in early childhood because early-life shocks can shape individual socioemotional and cognitive trajectories in ways that are increasingly difficult to modify over the life course, resulting in long-lasting effects (Cunha and Heckman 2007; Heckman 2006).

Several mechanisms might account for these socioeconomic gradients in the impact of disruption. In some cases, the lack of economic resources directly shapes the ability of families to invest in children to compensate for the influence of negative shocks. For example, more advantaged families can afford financial investments for their children in the form of lessons, tutoring, private school tuition, and enrichment activities (Schneider, Hastings, and LaBriola 2018). Socioeconomic gradients are also correlated with diverse kinds of psychological, social, and cultural resources that go beyond pecuniary assets and include time constraints, access to information, and availability of support networks (Hsin 2012; Torche 2018). The association between economic advantage and diverse resources is at least partially causal, as when financial scarcity imposes a cognitive load that reduces mental bandwidth (Mullainathan and Shafir 2013) or when poverty results in the inability to have a stable schedule, depleting people of valuable time and ability to plan their days (Edwards 2018). Additionally, socioeconomic stratification in interactional styles and familiarity with institutions could result in unequal responses to disruptive events that limit their negative effects for more advantaged families (Calarco 2018; Lareau 2011). Resources governing variation in the effect of disruption are not restricted to individuals or families; they might also be relevant for aggregate units such as schools, cities, or countries. For example, in this issue, Manuel Alcaino and Pablo Argote (2024) show that the negative impact of a strong earthquake in Chile on children's educational achievement varied across municipalities depending on the governing experience of the mayor. This finding suggests that experienced bureaucrats were able to procure and mobilize resources needed to compensate for the harmful effect of disruption.

Constraints disadvantaged families face emerge not just from having fewer resources in a single domain but also from various forms of disadvantage that might interact with each other and compound over the life course and across generations (Manduca and Sampson 2019). The cumulative advantage framework suggests that an initial favorable socioeconomic position produces further relative gains, widening gaps over time, a phenomenon known as the Matthew effect (DiPrete and Eirich 2006; Merton and Merton 1968). Although employment, family stability, and good health can accumulate advantages, disruptions in these domains may deplete families of socioeconomic resources and result in accumulated disadvantage for parents and their children (Evans, Li, and Whipple 2013; Maroto 2015; Western et al. 2012). Disruptive events such as divorce, job loss, and health shocks are more likely to be experienced jointly by disadvantaged families and can precipitate a period of economic insecurity and impact children's developmental and socioeconomic trajectories (Maroto 2015; McCloud and Dwyer 2011; Renzulli and Barr 2017). For example, decreased parental psychological health resulting from disruption can inhibit attention and emotional warmth toward children or even lead to erratic or punitive parenting practices (Conger, Conger, and Elder 1997; Elder 1974; Kessler, Turner, and House 1989; McLeod and Shanahan 1993; McLoyd 1998; McLoyd et al. 1994; McLoyd and Wilson 1990). Parents subject to disruptive events may also model and communicate despair to their children, such that children imitate the behavior (McLoyd and Wilson 1990). Decreased social involvement resulting from household disruption and residential mobility can disrupt children's networks, which can affect their social capital and socioeconomic status (Astone and McLanahan 1994; Coleman 1988, 1990; Furstenberg et al. 1999; Haveman, Wolfe, and Spaulding 1991; Leventhal and Brooks-Gunn 2000; McLanahan 1983; Sampson, Morenoff, and Earls 1999; Sandefur and Laumann 1998).

A cumulation of disruptive events can also result in high allostatic load, that is, "wear and tear" of the body emerging from repeated exposure to multiple stressors such as neighbor-

hood violence, housing instability, or economic precarity (Evans 2003; McEwen and Stellar 1993). Allostatic load may result in a heavier morbidity burden and strained mental health. The stress response triggered by repeated harmful exposures could also act as a predisposing factor for the influence of new exposures. As a result, subsequent adverse events cause more damage to those already debilitated by long-term multidimensional disadvantage (McEwen and McEwen 2017). For example, disadvantaged children are more likely to suffer from mental health issues from cumulative exposure to harsh or dangerous conditions, which could reduce their ability to cope with exposure to a novel disruptive event (Currie et al. 2010; Jans, Johansson, and Nilsson 2018).

Socioeconomic resources do not unambiguously compensate for disruption, however. Low-income families may be less vulnerable to the economic loss from disruptive events simply because they have less to lose in terms of economic well-being. This kind of floor effect is likely to be relevant for outcomes, such as college graduation, that are rarely achieved by low-income children even in the absence of disruption (Jackson and Holzman 2020). For example, research suggests that the income loss following parental divorce does not affect the probability that low-income children graduate from college given that their baseline chances of graduation are so low (Bernardi and Boertien 2016; Bernardi and Radl 2014; Kalmijn 2010). Families' socioeconomic resources also correlate with how normative and predictable disruptive events are for different groups. As we discuss in the next section, the normativity of disruptive events could induce variation in their impact in ways that depart and might even offset variation predicted by socioeconomic resources.

Contextual Factors: Normativity and Predictability of Disruptive Events

The impact of disruptive events on individuals and families may also depend on the social context, particularly on how prevalent and normative a disruptive event is in a particular social setting. The literature offers many examples. Becoming unemployed might be less detrimental for the psychological well-being of parents and children as the aggregate-level unemployment rate increases (Brand and Simon-Thomas 2014; Clark 2003). The loss of social connections following divorce is attenuated in regions where divorce is more accepted (Kalmijn and Uunk 2007). Similarly, the negative effect of a nonmarital birth on infant health declines as nonmarital fertility becomes more normative over time and across place (Torche and Abufhele 2021), and the impact of child death on intimate partner violence against the mother is more severe for mothers living in regions where this experience is uncommon (Weitzman and Smith-Greenaway 2020).

These diverse findings suggest a powerful contextual mechanism: as a negatively assessed event becomes more prevalent and normative in society, the stigma associated with it becomes less severe because the event represents a smaller deviation from the social norm. Declining stigmatization will reduce negative social responses such as labeling, isolation, status loss and discrimination and will ease the harm these responses cause to individual identity and self-worth (Burke 1991; Hatzenbuehler, Phelan, and Link 2013; Link and Phelan 2001).

The social normativity of disruptive events is closely associated with the likelihood that families or individuals experience them. For example, unemployment is likely more accepted and normative in communities where the possibility of becoming unemployed is high (Wilson 1996). Given the high level of network homophily (people who share networks are similar across race, age, SES, and other characteristics) and segregation in social networks, those unlikely to experience disruptive events are generally part of social networks where these events are non-normative.

Individuals with a low likelihood of disruption may experience disruptive events as an unexpected and unpredictable shock when they occur and may lack resources to cope with them. By contrast, people who are likely to experience adverse circumstances may be forced to develop protective mechanisms—a process variedly termed habituation, adaptation, and resilience—which could reduce their vulnerability to novel shocks (Feder, Nestler, and Charney 2009; Gump and Matthews 1999). For ex-

ample, research has suggested that job loss is not as consequential for psychological well-being among those accustomed to economic precarity as those accustomed to stability (Brand 2015; Brand and Simon-Thomas 2014). In this issue, Emily Rauscher and Xinyan Cao find the noxious impact of air pollution during pregnancy on infant health to be stronger among highly educated mothers than among those with less schooling. This pattern, the authors suggest, might emerge from limited coping mechanisms due to limited exposure among advantaged populations. Also in this issue, Stefanie DeLuca, Nicholas Papageorge, and Joseph Boselovic describe how adversity is part of the fabric of the lives of disadvantaged youth in some social settings. As youth grow accustomed to disruptive events, these exposures become less remarkable and impactful on their life outcomes. This is not to say that stress and anxiety are less prevalent among those with high levels of economic insecurity. In fact, disadvantaged populations tend to have higher levels of psychological distress. Instead, it is to say that groups with a high likelihood of disruption might develop coping mechanisms that reduce their reactivity to novel stressors (Aneshensel 1992; George 1993).

Even if the normativity of disruptive events is closely associated with the likelihood that individuals experience them, the conceptual distinction between the normativity of events and likelihood of their occurrence is important because it points at two distinct mechanisms. Stigmatization resulting from violating a social norm is a collective response by others. In contrast, the likelihood of experiencing a disruptive event is an individual-level attribute that shapes the expectation of disruption and the availability of coping mechanisms.

A related contextual factor likely to shape the effect of disruption on individual outcomes are institutions and policies intended to protect individuals from risks. For example, the probability of falling into poverty as a result of job loss and unemployment varies dramatically across countries depending on welfare state generosity (Brady, Finnigan, and Hübgen 2017), and the consequences of unemployment for mental and physical health depend on the availability of unemployment benefits (Cylus, Glymour, and Avendano 2015; Rodriguez, Lasch, and Mead 1997). In this issue, Alcaino and Argote highlight the relevance of political leadership as a mediator of environmental exposures on children's educational outcomes. They find that the decline in children's test scores was deeper and more persistent after a devastating earthquake in Chile in municipalities with first-term mayors than those with re-elected mayors, highlighting the relevance of political experience in the context of natural disasters. Policies intended to alleviate the negative impact of disruptive events on well-being are intimately connected to the normativity of such events. For example, the generosity of unemployment insurance is jointly determined with the extent to which unemployment is seen as breaking a social norm and stigmatized across places (Lindbeck, Nyberg, and Weibull 1999) and the generosity of unemployment benefits critically depends on how stigmatized unemployment is in different localities (Stutzer and Lalive 2004). Put simply, policies and institutions reflect normative agreements and those agreements in turn shape policy arrangements. Even though the rollout of specific policies can sometimes be treated as exogenous—for example, when a policy is implemented in some locations earlier than other locations due to arbitrary factors—in general normative and policy contexts are mutually constitutive.

The normativity-predictability approach and the resource disparities approach yield opposing predictions about the socioeconomic stratification of the impact of disruption. The resource disparities approach predicts that disadvantaged populations will experience more harmful and persistent consequences from disruption given their lack of compensatory resources and greater vulnerability to shocks. In contrast, the normativity and predictability approaches suggest that micro-level events such as divorce and unemployment will take a larger toll among advantaged groups because they are more likely to violate deep-seated social norms and to be experienced as unexpected shocks by highly resourced groups. Most likely, both mechanisms will be at play in shaping heterogeneity in the impact of micro-level disruptive events such as job loss or divorce. That is, effect heterogeneity will be a net result of forces that

might operate in different directions and might even offset each other. The articles in this issue reflect both patterns.

METHODOLOGICAL FRAMEWORK TO ASSESS VARIATION IN THE EFFECTS OF DISRUPTION

Assessing variation in the effect of disruptive events among children is a challenging methodological task. Researchers face standard methodological challenges in identifying and estimating causal effects at the aggregate level, including confounding and reverse causality. Additionally, researchers face common methodological issues that become more acute when assessing heterogeneity, including model specification (how to select the characteristics that demonstrate heterogeneity), sample size (power-to-detect effects across subgroups of the population), and different degrees of confounding across diverse axes of heterogeneity.

A main risk to the identification of causal effects is confounding, that is, the possibility that the effect attributed to disruption (the treatment) is actually due to unobserved factors correlated with but distinct from disruption. Children likely to experience disruptive events might be different from others in terms of their socioeconomic resources, personality factors, family relationships, and other characteristics. If these characteristics are not accounted for, researchers could mistakenly attribute the effect of these unobserved factors to the disruptive event, a problem variously called confounding, selection bias, nonignorability, and omitted variable bias.

Researchers are often concerned that they overestimate the true effect of disruption because the factors that cause some children to experience disruption may also limit their academic achievement, health, well-being, and other outcomes. However, another concerning source of selection bias could occur if the parents of children likely to be most harmed by an event make the strongest attempts to reduce their children's chances of experiencing it (that is, "selection on gains," see Heckman, Schmierer, and Urzua 2010). For example, parents who think their children will be harmed by their divorce may be more likely to seek alternatives such as counseling than parents who think their children will be less affected. If these parents are correct in their assessment, then we will not observe the most harmful consequences of divorce because a selected group of parents refrained from marital dissolution. As a result, the estimated effect of divorce on children will be an underestimate of its true causal effect, and of its variation. If researchers were able to measure parents' expectations about the harm that divorce would cause on their children and adjust for this factor in their statistical models, they would be able to address the issue. Unfortunately, it is usually impossible for researchers to observe all sources of possible selection bias in the associations they are interested in.

To reduce the risk of confounding, recent studies of the impact of disruption deploy standard econometric tools, including adjustment for covariates, regression discontinuity, difference-in-differences, fixed effects, and instrumental variables. For example, many types of natural disasters provide "natural experiments" whose impact does not precisely follow administrative borders or residential segregation based on socioeconomic status and other household characteristics. Similarly, researchers interested in the effect of parental job loss on children's outcomes might restrict attention to parents who lost jobs due to large-scale business closures, which reduce selection into job loss by individual characteristics. Alternatively, researchers may use a fixed-effects approach to compare children's outcomes before and after their parents lose jobs. By relying on within-individual change over time, this approach accounts for sources of unobserved selectivity of parents into job loss that do not change over time, providing a plausible causal strategy to assess the impact on children.

Correctly estimating an average causal effect across the population is only the first step for researchers interested in effect heterogeneity. Additionally, researchers require a framework to select domains of heterogeneity (and negate others), an analysis of power-to-detect effects across subgroups, and an assessment of whether the research design continues to be valid for each subgroup. Finally, scholars should be mindful as to whether differential effects reflect heterogeneity in treatment ef-

fects rather than heterogeneous treatments. In what follows we discuss these issues in turn.

The selection of domains of heterogeneity—for example, parental income, education, race and ethnicity, among others—is often marked by limited clarity. Many studies rely on a combination of vaguely conjured theory and common conventions in the literature to justify the selection of certain axes of heterogeneity (and the implicit nonselection of other candidate domains). By far the most common domain considered by researchers is measures of socioeconomic status, such as parental income and education; yet other demographic measurements may be included as well, such as race-ethnicity, age of exposure, and gender. These analyses often operate under the implicit assumption that variation in effects is driven by a resource disparities theoretical framework.

Some scholars have also explored how effects vary by the likelihood or "propensity" of experiencing disruptive events (Brand et al. 2019b; Brand and Simon-Thomas 2014; Turney 2017). Propensity-stratified models are particularly well suited for testing whether individuals who are more or less likely to experience events suffer larger effects (Brand and Simon Thomas 2013; Xie et al. 2012). Others have considered how effects vary across social contexts. For example, some studies of job displacement consider how the effect varies by local economic contexts and test the hypothesis that job loss might be less harmful when unemployment is widespread because it represents a smaller violation of social norms (Brand 2015; Clark 2003; Torche and Daviss 2022). These analyses may suggest patterns that support the normativity and predictability theoretical frameworks.

Selection of common domains, for example, by socioeconomic status or race, raises additional questions of what heterogeneity findings we are failing to uncover and how to interpret the effects we estimate. Examining family socioeconomic status as a key domain of heterogeneity may not sufficiently narrow the set of potential mechanisms driving that heterogeneity. For example, measures of parental education might capture differences in family economic resources but could also capture differences in children's access to information, social networks, cultural resources, or a combination of these assets. This is because the measure used is correlated with many other measures that are not used (or collected) and because most measures are not sharp enough to adjudicate between different mechanisms, such as types of resources or preferences. These challenges require that scholars make explicit the theoretical foundations of the axis of heterogeneity examined. One promising way to proceed is provided by the logic of preregistration, in which research hypotheses are articulated and disclosed before conducting the empirical research and additional hypotheses that emerge during the research process are discussed (Freese and Peterson 2020; Manago 2023).

Although hypothesis preregistration is a promising approach, in practice researchers often explore their data to determine which subgroups have the largest effect estimates and report the effect estimates of those that do (leading to *p*-hacking). If researchers select which interactions to report as a result of exploratory analyses, and do not draw on cross-validation procedures or multiple-testing adjustments, they are likely to incorrectly reject a true null hypothesis. Such ad hoc searches for responsive subgroups may in other words reflect noise within the data rather than true response variation and result in misleading conclusions. Undocumented manual specification search procedures also lack transparency and reproducibility (Freese and Peterson 2020).

Still, it may be difficult to know ex ante the subgroups most affected by disruptive events. An emerging methodological approach to study effect heterogeneity is to use tools from machine learning to uncover sets of factors and interactions between factors that account for effect variation rather than focusing on a narrow set of specified modifiers. Typically, this approach is supervised by the researcher by both choosing a specific method or set of methods for estimation and specifying the features (covariates) that the algorithm can use (and again disallowing others). In this sense, the machine learning approach does not amount to pure and unconstrained discovery. It provides a strategy to reduce arbitrariness in the axes of heterogeneity considered, reducing the influence of the researchers' priors. Potential

axes of heterogeneity may also be most informative when considered jointly, in complex and nonlinear ways (such as low-income children who report low social control). These approaches also reduce arbitrariness in researcher-specified functional forms estimated in the analysis, in that it is generally unclear which of the large number of possible covariate thresholds (such as parental income values) and interactions are best to consider. Machine learning has been rapidly gaining recognition in the social sciences for both prediction tasks and the possibility of discovery through integration with causal inference methods (Athey and Imbens 2019; Brand, Zhou, and Xie 2023; Lundberg, Brand, and Jeon 2022; Molina and Garip 2019; Wager and Athey 2018). Both emerging applications and continuing developments use these methods (Brand et al. 2021; Yu et al. 2021).

An additional challenge for researchers interested in heterogeneity in the effects of disruption is that the confounding problem could be worse for some subpopulations than for others (Zhou and Xie 2019). An observed pattern of variation in the effects of disruptive events could be due to variation in unobserved selection into those circumstances. For example, results may suggest that White workers are more negatively harmed by job displacement than Black workers. Yet if White workers are generally less likely to lose jobs than Black workers, displaced White workers may have unobserved characteristics that render them more negatively selected than their Black counterparts. Our analyses may not fully equalize some measure, such as unequal work conditions, for White and Black displaced workers. If so, our estimates of displacement effects for White workers could be larger than for Black workers not because Whites are harmed more by displacement, but because they were more negatively selected into displacement in the first place. Even when using plant-closing analyses of job loss, it could be that plant closings that displace White workers are in different industries, on average, than plant closings that displace Black workers because of racial segregation by occupation and industry. Consequently, outcome differences from displacement that appear to be differential by race could instead reflect industry-based variation in unemployment duration, vacancies, starting wages, and other factors.

Likewise, research focusing on intent-to-treat estimates, such as place and time demarcated measures of exposure (such as air pollution or other environmental factors) face the challenge that first-stage relationships between the distal exposure and intermediate outcome may vary by subgroup (if, for example, more advantaged groups are able to invest in household filtering systems to reduce domestic exposure to contaminants). Another way of describing the challenge is that the compliers may vary by important measured and unmeasured characteristics. Researchers should attend to differential selection in stratified effect estimates, be mindful of the potential for heterogeneity at various "steps" of the process between distal exposures and outcomes, and use sensitivity analyses of subgroups effects (Hainmueller, Mummolo, and Xu 2019). In this issue, Martha Bailey, Peter Lin, A. R. Shariq Mohammed, and Alexa Prettyman (2024) discuss the likelihood that the meaning of the Great Depression differed by place due to the mix of agricultural and industrial sectors in the local area prior to this macroeconomic event; the authors discuss their results in the context of considering whether the treatment of the Great Depression includes effect heterogeneity, treatment heterogeneity, or (most likely) both.

Scholars may also try to elucidate patterns of effect heterogeneity by focusing on theoretical mechanisms that link disruptive events to children's outcomes. For example, a study examining the impact of prenatal exposure to local homicides on infant health hypothesized that local violence shapes infant health by inducing a change in the use of prenatal care by mothers differently depending on the mother's level of schooling (Torche and Villarreal 2014). Testing this kind of mediation process is challenging because even if the initial exposure (local homicides in this example) might be considered exogenous, behavioral responses to it (use of prenatal care) are not. In another example, Jennie Brand and her colleagues (2019b) considered the role of parental income and children's psychological well-being after parental divorce as mechanisms linking divorce to

children's educational attainment. The causal mediation literature has emphasized careful attention to estimating valid mediating effects using a causal framework and laying out key identifying assumptions (Imai et al. 2011; VanderWeele 2016). That is, to define path-specific effects of disruptive events, we must address the possibility of confounding not only in the event-outcome relationship, but also in the event-mediator and mediator-outcome relationships. Recent work also applies flexible machine learning methods to uncover causal direct and indirect effects (Zhou and Yamamoto 2023).

Qualitative studies can also enhance our understanding of the complex pathways by which disruption impacts family well-being. Relying on individuals' accounts of the experience of disruption, and the rationale for any behavioral responses, studies based on interviews or ethnographic observations can explicate mechanisms accounting for disparities in the effect of disruption unobserved by quantitative approaches. For example, qualitative studies on the impact of unemployment uncover the guilt, shame, and isolation it produces among affected workers (Newman 1998) and the extent to which the experience and responses to unemployment vary by gender and socioeconomic standing (Damaske 2021; Rao 2020). In this issue, DeLuca, Papageorge, and Boselovic (2024) use semi-structured interviews to explore disruption and adversity among low-income Black youth in high-poverty neighborhoods. They describe variation in how these disadvantaged youth responded to disruptive events, attending to the resources and relationships that conditioned their heterogeneous response. Also in this issue, Kristin Turney, Amy Liu, and Estéfani Marín (2024) undertake an in-depth interview study to probe rich life course histories of exposure to paternal incarceration to show that children's responses of "stepping into" new responsibilities following a paternal incarceration event are strongly shaped by previous experiences with paternal incarceration.

Finally, patterns of variation in the observed effect of the treatment may reflect variation in the treatment condition itself. For instance, as Nazar Khalid, Jere Behrman, Emily Hannum, and Amrit Thapa (2024) show in this issue, severe floods in India have a stronger impact on the educational outcomes of children from marginalized communities—those from low socioeconomic status and lower caste. This pattern largely emerges because destruction and dislocation following the flood is more severe in disadvantaged communities, and only secondarily because the effect given exposure is stronger among disadvantaged children. In another example in this issue, Turney, Liu, and Marín show that children whose parents are unlikely to be incarcerated may experience worse outcomes from parental incarceration than those whose parents were more likely to experience this event. Yet the authors suggest that this pattern may reflect different lengths of parental incarceration (that is, different treatment conditions). In all these cases, findings of effect heterogeneity across groups reflect exposure to different treatments rather than variation in the effect of the same exposure. This issue has been widely recognized in the causal inference literature as a violation of the critical requirement that there cannot be multiple versions of the same treatment (Rubin 1980, 1986). Restricting inference to a single version of the treatment is a challenging task. Researchers interested in effect heterogeneity should continue to consider strategies to address this issue (see, for example, VanderWeele and Hernan 2013).

THE IMPACT OF DISRUPTIVE EVENTS ACROSS DOMAINS

We now turn to a review of the growing literature examining the impact of disruptive events on families and children. We discuss disruptions in the following domains: economic (job loss, recession), household and family (divorce, incarceration), education (school closures), health (illness, death), and environmental (floods, earthquakes). These domains were selected for multiple reasons. First, they identify exposures with a large, documented impact on children's life chances. Second, a robust body of evidence examining patterns and sources of heterogeneity exists in each of them. Third, in all these cases, we can distinguish micro-level events (for example, parental job loss) from macro-level events (for example, recessions), gaining theoretical insight on the plausibility

of the two theoretical frameworks we have outlined.

Economic Disruptions

We characterize economic disruptions as events that affect the economic standing of families. They can be micro events, such as job loss, bankruptcy, eviction, and foreclosure, or macro events affecting larger populations, such as economic recessions. These events generally affect children's parents or caregivers and then children as families adjust to new economic realities. Scholars have studied variation in the effects of these events along various axes, such as socioeconomic status indicators, race, and the probability that disruption occurs. Here we discuss some of the main patterns in the literature and how they fit into broader theoretical paradigms and methodological considerations.

Job Loss

Job loss (also known as job displacement) is a disruptive and often unexpected life event. Macroeconomic conditions and individual characteristics influence the likelihood of workers experiencing displacement, such as technological change, foreign trade, employment reorganization, and macroeconomic downturn (Farber 2010; Farley 1996; Kalleberg 2000, 2009). Displacement is higher during economic downturns. Less-educated workers and workers in jobs with low status and low tenure have a high risk of displacement (Brand 2006, 2015; Farber 1997, 2010). However, rates of job loss have increased for more advantaged groups (Farber 2011). Job loss typically leads to a period of unemployment and lower lifetime earnings (Brand 2015; Couch and Placzek 2010a; Couch, Jolly, and Placzek 2011; Davis and von Wachter 2012; Fallick 1996; Farber 2005; Kletzer 1998; Podgursky and Swaim 1987; Ruhm 1991). Some estimates suggest an immediate loss of about 30 percent of earnings and as much as a 20 percent cumulative reduction in earnings twenty years after the job loss event (Couch and Placzek 2010b; Davis and von Wachter 2012; von Wachter 2010). Job loss can also lead to bankruptcy or home loss by foreclosure or eviction (Dwyer 2018; Western et al. 2012). These losses associated with displacement present a considerable economic shock to families with children. A decrease in parental economic resources may restrict the ability to purchase goods critical for child development, such as schooling, housing, food, and cognitively enriching learning environments. Increases in job instability among displaced workers are also common, instigating continuing economic and social disruptions for families (von Wachter 2010).

Job loss disrupts not just economic and work conditions, but also the structure of daily life, psychological well-being, and family and social relationships (Brand 2015; Catalano et al. 2011; Brand and Burgard 2008; Deb et al. 2011; House 1987; Jahoda 1981, 1982; Paul and Moser 2009; Pearlin et al. 1981). The economic, psychological, and social effects of displacement impact family well-being and consequently children's social-psychological, educational, and socioeconomic outcomes (Brand and Simon-Thomas 2014; Johnson, Kalil, and Dunifon 2012; Kalil and Ziol-Guest 2005, 2008; Oreopoulos, Page, and Stevens 2008; Page, Stevens, and Lindo 2009). Job loss can also lead to additional disruptions to households, such as divorce or separation, which affect children's well-being, as described more fully later.

Research has shown that the effects of job loss vary by worker characteristics and social and economic context. Although economic losses are greater for more disadvantaged workers with limited human capital, some of the social and psychological consequences can be worse for more advantaged workers and their families who are less likely to experience disruptive events (Brand 2015). Although economic adversity is more normative among more disadvantaged families, displacement and socioeconomic decline may instigate an acute sense of deprivation among more advantaged families whose peers tend to be likewise advantaged and for whom displacement is a considerable shock (Brand and Simon-Thomas 2014; Clark, Georgellis, and Sanfey 2001; Dooley, Prause, and Ham-Rowbottom 2000). Brand and Juli Simon-Thomas (2014), for example, find the largest effects of job loss among children whose mothers had a low likelihood of displacement. This finding supports the social normativity and predictability framework.

Similarly, studies suggest that though the ef-

fects of displacement on economic well-being are worse in high unemployment contexts (von Wachter 2010), the effects on physical and mental health are worse in low unemployment contexts (Clark 2003; Cohn 1978; Platt and Kreitman 1984; Torche and Daviss 2022; Turner 1995). This pattern is consistent with the theoretical expectation that when unemployment becomes normative, the stigma and shame associated with losing one's job decreases. Rich qualitative work on contexts of concentrated disadvantage also finds that in communities where "work disappears," unemployment loses its social stigma (Wilson 1996). In this issue, Anna Baranowska-Rataj, Björn Högberg, and Jonas Voßemer (2024) consider whether parental job losses lead to worse children's health outcomes at birth when unemployment in Sweden is higher. They find little evidence that job loss affects children's birth outcomes, and no evidence of heterogeneity across areas with different rates of unemployment. Compared with findings from the United States (Torche and Daviss 2022), this finding may suggest cross-national heterogeneity: the effect of job loss may not be as severe in a context like Sweden given the strong role of the Swedish welfare state in protecting families from material hardship and supporting the transition to reemployment in the event of displacement (Bambra and Eikemo 2018).

Economic Recession

Economic recessions and downturns differ from job loss in that they are macro-level events affecting large populations at the national or local levels. In the case of economic recessions, most children in exposed communities are affected, not just those whose parents have lost jobs (Gassman-Pines, Gibson-Davis, and Ananat 2015). Economic downturns negatively affect children's psychological health and education (Ananat, Gassman-Pines, and Gibson-Davis 2011; Gassman-Pines, Gibson-Davis, and Ananat 2015) and their later outcomes (Noghanibehambari and Fletcher 2023; Schmitz and Duque 2022). Both displaced workers and continuously employed parents may experience earnings loss and psychological distress during economic downturns. Anna Gassman-Pines, Christina Gibson-Davis, and Elizabeth Ananat (2015) suggest that state-level economic contexts could influence how families are affected by downturn. In this issue, Bailey and colleagues consider the effects of the Great Depression on children's mobility. The authors find large differences by child gender, where the downturn had little effect on sons' mobility experiences but reduced daughters' intergenerational mobility outcomes and interpret these effects to reflect gendered differences in educational and occupational opportunities during the early twentieth century. The authors' focus aligns with the described resource disparities framework as a potential source of heterogeneity in responses to macro events, such as the Great Depression. That is, in examining social mobility, the authors' (at least implicit) focus on whether children from low-resource households are differently affected than children from high-resource households in attaining high status as adults. However, the finding of no social mobility differences for sons who were exposed to different levels of macroeconomic downturn from the Great Depression suggests that the impact of changing macroeconomic conditions on the socioeconomic outcomes of these sons did not vary by their family background.

Home Loss

Home loss via foreclosure or eviction can have a significant impact on family well-being. Foreclosure is associated with declines in mental health and increases in suicide, especially for White men (Downing 2016; Fowler et al. 2015; Houle and Light 2017), increased substance use (Burgard, Seefeldt, and Zelner 2012), and financial instability (Brevoort and Cooper 2013; Diamond, Guren, and Tan 2020), which can significantly affect family and child well-being. Rebecca Diamond, Adam Guren, and Rose Tan (2020) suggest that those on the margin of foreclosure, who tend to be families from more affluent neighborhoods, experience larger effects of foreclosure on the likelihood of divorce and mobility than families residing in less affluent neighborhoods. Because those on the margin of foreclosure have a relatively low likelihood of home loss, this finding supports the social normativity and predictability framework.

Home loss via eviction is associated with de-

creased psychological well-being (Desmond and Kimbro 2015; Fowler et al. 2015; McLaughlin et al. 2012), worse physical health (Hoke and Boen 2021; Leifheit et al. 2020; Nande et al. 2021), downward economic mobility (Desmond and Gershenson 2016), and homelessness (Rutan and Desmond 2021). Eviction disproportionately affects Black and Latino renters, especially Black women (Desmond 2012; Hepburn, Louis, and Desmond 2020), and those who live in areas with high rent burdens and low investment in welfare (Thomas et al. 2019). Heterogeneity in the effect of eviction is understudied. However, one study finds that Hispanic households were more likely to move again after eviction than other households (Desmond, Gershenson, and Kiviat 2015).

Household Disruptions

A large literature has established that family and household disruption decrease household income and economic security and influence the well-being and attainment of children. Here we focus on changes in family and household configuration, including parental divorce and separation and parental incarceration.

Divorce, Separation, and Household Change

A large literature suggests that parental divorce decreases children's socioemotional well-being and limits their educational attainment (Amato 2000; Brand et al. 2019a, 2019b; Cherlin, Chase-Lansdale, and McRae 1998; McLanahan, Tach, and Schneider 2013; Fletcher and Sindelar 2012). With the loss of a parent in the household, typically fathers, mothers generally have fewer economic resources, which can negatively affect children's attainment. Moreover, relationship transitions occur more frequently following parental divorce, and such instability disrupts children's lives (Lee and McLanahan 2015).

Research has found that parental divorce and other changes in family structure have heterogeneous effects, with the largest effects observed for advantaged children. Studies suggest larger effects for children with more educated parents than children with less-educated parents (Bernardi and Boertien 2016; Bernardi and Radl 2014; Martin 2012). Other studies find larger effects for White children than for non-White children (Brand et al. 2019b; Lee and McLanahan 2015; Perkins 2019; Wu and Thomson 2001). Brand and her colleagues (2019a) find that parental divorce resulted in lower educational attainment among children whose parents had a low likelihood of divorce but no effect among their counterparts with a higher probability of divorce. They argue that children of unstable marriages, who face many social disadvantages over childhood, anticipate or otherwise adapt to the dissolution of their parents' marriage. By contrast, divorce is an unexpected shock for more advantaged children with relatively fewer disruptive family circumstances. Additionally, the stronger adverse effects among advantaged groups may be partly due to the change in available resources before and after divorce: children from high-SES backgrounds experience a marked economic decline after a divorce. A high prevalence of family and socioeconomic instability among children of color, low-SES children, and children with a high expectation of family instability renders an additional disruptive family transition less impactful, and indeed, less disruptive (Cross 2020; Harvey and Fine 2011).

These findings support the social normativity and predictability theoretical framework. That is, response to parental divorce is greater for these more advantaged families because family disruption is less expected and constitutes a more stigmatizing deviation from norms in their social milieu. In this issue, Kristin Perkins (2024) assesses heterogeneous effects of household change involving extended families and nonrelatives on Black children's outcomes. Whereas prior research finds small or insignificant effects of household disruption on educational attainment for Black children, she finds that the effects are heterogeneous: Black children with a low propensity for disruption experience larger effects of household change on education than those with a high propensity for disruption. The finding also aligns with research suggesting the importance of social normativity and expectations of disruption but in this case among a population previously assumed to experience homogenous responses. Perkins's findings speak to the importance of clearly defining the treatment condition in studies of household disruption as

well as the complex processes of response variation among children.

Variation in the effect of disruptive events on individuals and families could also emerge from interactions between macro- and micro-level exposures. For example, as the prevalence of divorce in sub-Saharan Africa regions increases, parental divorce effects on children's health decreases (Smith-Greenaway and Clark 2017). This effect holds even for children who lived in higher SES households. Similarly, Florencia Torche and Alejandra Abufhele (2021) find that being born to unmarried parents causes worse infant health in contexts where most births occur within marriage. By contrast, after one accounts for socioeconomic differences between married and unmarried parents, being born to unmarried parents has limited or no effect in settings where nonmarital fertility is prevalent. These studies suggest that in contexts where events such as experiencing a marital disruption or having a child out of wedlock are unusual and non-normative, they can result in stigmatization, isolation, and depletion of resources with negative consequences for children.

Incarceration

The literature on parental incarceration reveals negative effects on children's academic achievement, socioemotional outcomes, and juvenile delinquency driven by multiple mechanisms, including physical and emotional absence, family strain, socioeconomic decline, stigma, and shame (Eddy and Poehlman 2012; Foster and Hagan 2015; Johnson and Easterling 2012; Turney and Wildeman 2013). Some research indicates that the consequences of parental incarceration depend on the likelihood of experiencing it. Children whose parents were less likely to be incarcerated experienced greater negative effects on educational attainment and well-being (Turney 2017). Similarly, children least likely to experience maternal incarceration experienced increased internalizing and externalizing problem behaviors and increased early juvenile delinquency (Turney and Wildeman 2015). The effects of parental incarceration also vary by contextual-level factors, including the normativity of the event at the neighborhood level. Scholars have shown weaker associations between parental incarceration and the likelihood that children live in disadvantaged neighborhoods as adults in contexts where parental incarceration is more prevalent (Finkeldey and Dennison 2020). In this issue, Turney and her coauthors find that parental incarceration alters children's emotional well-being and instrumental and financial responsibilities. However, their in-depth interview data also reveal that children vary in their response, with some children carrying considerable burden and others stepping away from responsibilities or even expressing relief when a father is incarcerated.

Educational Disruptions

Educational disruptions involve changes in the schooling experienced by children, emerging from partially expected events such as students' school transfers and absenteeism and from unexpected events such as school closures.

School Transfers

Student mobility across schools—that is, students changing schools throughout their educational career—is a widespread phenomenon with consequences for learning. The reasons for school transfers are diverse and include unplanned moves usually made in response to another disruptive event in the family and planned moves made to achieve a desired end such as a better residential situation.[1] Regardless of the reason, school transfers could have negative effects on children's educational outcomes due to disruption of learning environments, loss of social networks, and the need to adapt to new curriculums and teaching styles. School mobility could also impose negative externalities for nonmovers by altering the composition of peer groups, demanding resources that otherwise could be devoted to instruction, and inducing disruption in the

1. Some school mobility is determined by the structure of the educational system, such as the transition from elementary to middle school or middle school to high school. However, the mobility that we are concerned with is so-called nonstructural.

classroom (Hanushek, Kain, and Rivkin 2004; Raudenbush, Jean, and Art 2011; Rumberger et al. 1999).

Observational studies show that changing schools is usually associated with worse educational outcomes, including test scores, grade retention, and school dropout (Welsh 2017). In many cases, this negative association declines significantly or disappears after controlling for students' characteristics and achievement (Alexander, Entwisle, and Dauber 1996; Grigg 2012; Lleras and McKillip 2017; Strand 2002; Temple and Reynolds 1999). This suggests that students who are already struggling are more likely to move but that mobility itself might not have a separate negative impact.

Changing schools is much more prevalent among disadvantaged students, including racial and ethnic minority, low-income, and immigrant children residing in urban areas (Alexander, Entwisle, and Dauber 1996; Grigg 2012; Lleras and McKillip 2017; Strand 2002). Given their lower likelihood of changing schools, advantaged children may experience a larger impact of school transfers if it is more of an unexpected shock, particularly if they are moving to schools with fewer resources. Conversely, the potential negative impact of moving could be outweighed by transferring to a higher quality school among disadvantaged students. Research on the consequences of school mobility, however, has not systematically explored effect heterogeneity.

School Closures

The impact of school closures has gained importance in recent years given the widespread closures during the COVID pandemic. To prevent the spread of the virus, most governments worldwide closed schools for several weeks or months in the spring of 2020. After the initial reopening, additional waves of closures occurred in late 2020 and 2021. Studies have examined the impact of COVID-related school closures on students' educational outcomes around the world, largely with a focus on test scores. Most studies show a substantial negative effect with an average magnitude of approximately 0.1 standard deviations in both math and reading scores (Hammerstein et al. 2021; König and Frey 2022; Zierer 2021).

Given that COVID-related school closures were so widespread, we expect patterns of heterogeneity to align with a resource disparities framework rather than a normativity framework. Indeed, the literature consistently anticipated greater losses among students from low-income families, whose parents had low levels of schooling and who lived in poor neighborhoods (Agostinelli et al. 2020; Azevedo et al. 2020; Di Pietro et al. 2020; Fuchs-Schündeln et al. 2020; Kaffenberger 2021; Kuhfeld et al. 2020). Empirical analyses are consistent with these predictions about unequal effects, confirming that socioeconomically disadvantaged students experienced greater learning losses than their more advantaged peers. For example, Per Engzell, Arun Frey, and Mark Verhagen (2021) find learning losses up to 60 percent greater for children with parents with low levels of schooling than for more advantaged students in the Netherlands. Given that the Netherlands features low levels of income inequality and virtually universal broadband connectivity, this finding might provide a lower bound estimate of the disparities in the impact of school closures on learning. Similarly, Joana Maldonado and Kristof De Witte (2022) find substantial losses among students in the most socioeconomically disadvantaged schools in Belgium but no decline among children in advantaged schools. Vladimir Kogan and Stéphane Lavertu (2021) report postpandemic declines in test scores in Ohio that were more pronounced among racial minorities and economically disadvantaged groups. Rebecca Jack and her colleagues (2023) find that remote learning was more detrimental for districts with larger populations of Black students.

To assess heterogeneity in the effects of school closures, most studies focused on the differential ability of families to transition to online education, including differential access to remote instruction, differential parental responses, and loss of beneficial peer effects among disadvantaged groups. Families differ in their digital connectivity as well as ability to use technology for learning purposes. An early pandemic Education Trust (2020) survey reported that nearly 50 percent of low-income families and 42 percent of families of color reported lacking enough devices at home to ac-

cess distance learning. In the United States in 2021, only 59 percent of low-income households (those earning less than $30,000 a year) owned a computer and 57 percent had access to broadband. The comparable figure for households with incomes greater than $100,000 a year were 92 and 91 percent, respectively (Vogels 2021).

In addition to basic infrastructure barriers, several studies report socioeconomic disparities in time and resources devoted to at-home learning. For example, children in high-income households spent more time on home learning than those in poor families in England (Andrew et al. 2020) and socioeconomic gaps in digital learning widened in Denmark during the pandemic (Reimer et al. 2021). Similarly, the sharp increase in internet searches for online learning materials as schools closed in the United States was concentrated among households with higher income and better internet access (Bacher-Hicks, Goodman, and Mulhern 2021).

These studies direct attention to a demand-side response to the COVID shock by families. Disparities have also been observed on the supply side, that is, in the responses by schools and educators to the pandemic shock. In the United States, schools serving high-poverty populations were less likely to provide online learning and reported higher proportions of students completely absent. Similarly, disadvantaged children, including minorities and those with low parental schooling, living in single parent households, and receiving free meals, spent less time on schoolwork at home (Bayrakdar and Guveli 2023). This gap was due in large part to uneven school online learning provisions. The work by Douglas Harris and colleagues (2024) in this issue focuses on high school graduation and college entry and provides additional and novel findings of heterogeneity in the impact of the pandemic. They find an increase in high school graduation that was largest for socioeconomically disadvantaged and minoritized students, but a decline in college entry, the largest occurring in two-year colleges serving larger percentages of Black, Hispanic, and low-income students. Their evidence suggests that increased high school graduation is associated with the relaxation of graduation standards, whereas instructional mode appears to be a relevant driver of two-year college entry.

In sum, research on adverse effects of school closures triggered by the COVID pandemic suggests marked stratification consistent with the resource disparities approach. This process likely emerges from consecutive, cumulative forms of precarity: disadvantaged children are more likely to face connectivity and access barriers to digital education, and less likely to receive compensatory support from their parents and effective assistance from their schools.

When extrapolating findings from the COVID-induced school closures, it is important to consider several ways in which the pandemic is a unique and unprecedented exposure. First, the pandemic affected the entire population rather than being a group-specific risk. It was also an unexpected occurrence completely beyond individual control. Given these attributes, differences in the normativity of the disruptive event are unlikely to play a role in accounting for effect heterogeneity. Second, COVID school closures were long term, lasting from several weeks to several months, forcing families to make lasting adjustments. Given that families had the ability to substitute in-school education with home-based learning experiences that depend on differential economic, information, and time resources, substantial inequality in effects is to be expected. To the extent that schools play an equalizing role in learning, albeit a debated assertion (see, for example, Passaretta and Skopek 2021), the transition to home-based learning is expected to contribute to inequalities in outcomes. Finally, the COVID crisis altered virtually every dimension of life and well-being, not just educational contexts. As a result, the studies reviewed here have a limited ability to identify the unequal impact of school closures as distinct from the likely unequal impact of other measures intended to curb infection, and from the direct toll of infection itself.

Health Disruptions

Children's Health Shocks

The evidence is strong that child health shocks have lasting impacts as people age. Children in

poor households are more likely to be subject to health shocks (Currie and Stabile 2003). A common example of a health "shock" is low birth weight. Janet Currie and Rosemary Hyson (1999) consider the potential heterogeneity of birth weight on longer-term outcomes. They outline three theories on why birth weight matters and why heterogeneity by SES may be expected. First, they suggest that birth weight may shape the efficiency of child investments into later outcomes, with the implication that children in low-SES families will have worse outcomes than children in high-SES families because of higher incidence of "adverse environmental influences" (Watson et al. 1996). Second, they argue that heterogeneity is possible in behaviors and preferences between families, which shape the types or quantity of investments and inputs in children. If these behaviors and preferences are correlated with SES, we expect to then see heterogeneity in outcomes based on birth weight status of children between different families that could mimic SES differences but may not be responsive to income transfers or other social programs. Third, families stratified by SES have different levels of monetary constraints, such that low-SES families may not be able to undertake costly investments in their children that might otherwise compensate for the adverse effects of low birth weight (Becker and Tomes 1976).[2]

A broader literature expands the set of health shocks experienced during childhood but typically has a limited focus on heterogenous effects. ADHD has been one such expansion, where researchers have shown impacts on educational achievement and attainment (Currie et al. 2014; Currie and Stabile 2003; Fletcher and Wolfe 2008) and broader outcomes (Fletcher 2014; Fletcher and Wolfe 2009). The work by Jayanti Owens and Xinyan Cao (2024) in this issue extends this literature on childhood ADHD symptoms by considering variation in treatment and outcomes by race-ethnicity and other axes of heterogeneity. They find that heterogeneity in ADHD diagnosis varies by a complex combination of race-ethnicity and outcome domain, such that diagnosed Black children experience worse outcomes in teacher reports of school behavior, diagnosed White children experience worse outcomes in perceived school competence, and diagnosed Hispanic children experience worse outcomes in parental educational expectations. The authors present an important expansion of inquiry across domains of outcomes and axes of heterogeneity and highlight the empirical challenges of considering differential selection bias across the axes of examined heterogeneity.

Family Health Shocks

Although differential effects of children's own health shocks on their own outcomes contribute to a growing literature, a related literature focuses on the consequences of parental (or other family members') health shocks on children's outcomes. Both parental death and sibling death experiences during childhood are somewhat rare in developed countries in recent times, but occur in 5 to 10 percent of the population (Fletcher et al. 2012). Studies suggest these experiences negatively affect human capital outcomes (Fletcher et al. 2012; Fletcher, Vidal-Fernandez, and Wolfe 2018). Hints of potential heterogeneity aside, in general the low prevalence of these events and reduced sample sizes limit precise estimates.[3] Patterson et al.

2. Some analyses also consider heterogeneity of health shocks by sex. One motivating reason for these analyses is that sex, and the different biological and social mechanisms tied with it, fit into either a differential efficiency argument or in a differential preferences and behaviors argument in societies that discriminate by sex. Differential efficiency by sex could result from the average differences in body size by sex in early life, different average pathways/timing of organ/brain development, or other processes—in economic jargon, are the "production functions" that translate inputs (nutrition, medical interventions, and so forth) into outputs (birth weight, cognition) different by sex? Differential preferences/behaviors reflect differential treatment by sex that does not reflect the efficiency differences but instead is driven by societal/parental mechanisms that discriminate by sex of the child.

3. Registry-based studies outside of the U.S. have been able to pursue these questions in more detail. Yongfu Yu and colleagues (2017) show evidence of mortality effects on bereaved individuals who experienced loss of a

(Patterson, Verdery, and Daw 2020) show that experiencing the death of family members during childhood reduces educational attainment and the effects vary somewhat by decedent relationship, gender, and race-ethnicity.

The short-term direct health effects of the COVID pandemic on children appear not to be severe, and many children have been far more protected from the virus (for example, through school closings) than adults. However, ongoing work on the pandemic suggest some initial findings related to family health shocks. The average effects appear to be large, with substantial effect heterogeneity. Ashton Verdery and his colleagues (2020) estimate the large differences in children's exposures to deaths and health shocks of close family members, which differ enormously by socioeconomic status and race-ethnicity, mirroring the pandemic itself.

Environmental Disruptions

Environmental disruptions are macro-level events with both immediate and long-term consequences on families and communities. These sources of disruption include floods, earthquakes, hurricanes, tornadoes, winter storms, and wildfires. The short-term effects of environmental disruptions involve death and injury, destruction of residences and infrastructure, economic losses, and residential dislocation. In the long term, processes of return, relocation, and redevelopment also have consequences on the well-being of families and communities. The unequal impact of environmental disruptions has gained relevance in the recent past given the evidence linking climate change with severity of extreme weather events and the likelihood that these events will increase in frequency and devastation in the future (Boustan et al. 2020; Diffenbaugh et al. 2017).

Research on the consequences of environmental disruptions has explicitly considered and theorized heterogeneity in both exposure and effects, linking the very notion of a disaster to prior social conditions and sources of inequality. The literature conceptualizes weather disruptions as triggering events with diverse capacity to cause harm depending on social conditions such as environmental degradation, settlement patterns, and protective systems across regions (Blaikie et al. 1994).

Environmental shocks have been found to expose and magnify existing sources of socioeconomic disparities. Several factors account for the multiplicative effect of disasters on disparities, including the stratification of the consequences of the disaster, institutional and social responses that tend to benefit advantaged groups most, and differential opportunity to benefit from redevelopment opportunities (Birkmann et al. 2010; Olshansky et al. 2008; Vale and Campanella 2005). Factors such as minoritized status, gender, and age shape differential preparation for disaster and vulnerability to damage (Bolin and Kurtz 2007; Fothergill and Peek 2004; Peacock, Morrow, and Gladwin 1997; Tierney 2001). Indeed, the expectation that negative effects from natural disasters will be stronger among vulnerable groups is so widespread that Clark Gray and Valerie Mueller (2012) refer to it as the "conventional narrative" in the natural disaster field of study. Examples abound and show the diverse set of mechanisms—including differential access to social connections, insurance, political influence, ability to negotiate with bureaucratic institutions, among others—linking socioeconomic resources to unequal outcomes. Torche (2018) finds marked heterogeneity in the effect of prenatal exposure to a strong earthquake on children's cognitive ability. Prenatal exposure to this environmental stressor had a strong negative effect on children's cognitive performance and no effect among more advantaged families. Socioeconomic heterogeneity was likely driven by differential parental responses: advantaged families could mobilize resources to compensate for observed impacts or delays among affected children.

The vulnerability approach also highlights interacting sources of vulnerability. For example, Alice Fothergill and Lori Peek (2015) document cumulative vulnerability to the consequences of Hurricane Katrina among children. Children in unstable family structures were

sibling during childhood and find some heterogeneity based on sex, the siblings' age difference, and sibship composition.

more likely to lose their peer networks due to dislocation and to experience further housing instability than children in more stable family structures. Given that weather events are geographic, the interaction between individual-level and community-level sources of vulnerability is particularly important. For example, in part because of long-lasting housing policies, poor or minority children who have a higher likelihood of suffering from asthma (a kind of health vulnerability) tend to live in areas with higher land-surface temperatures than adjacent neighborhoods, which increases risk of asthma-inducing events (Hoffman, Shandas, and Pendleton 2020).

In some instances, however, relocation forced by disasters could create beneficial opportunities especially for populations living in disadvantaged areas even if they disrupt individuals' lives. For example, Bruce Sacerdote (2012) finds that, after a short-term decline in test scores among students who evacuated after hurricanes Katrina and Rita, their test scores improved. Gains were concentrated among students in the bottom half of the test score distribution, probably driven by benefits of moving to better schools.

An important way in which disasters magnify inequalities is through recovery and redevelopment efforts (Arcaya, Raker, and Waters 2020; Bolin and Stanford 1998; Dash et al. 2007; Fothergill and Peek 2004; Tierney 2007). Disaster aid and recovery has been characterized as a Matthew effect process in which "benefits accrue to those who possess wealth and social and cultural capital, while larger proportional losses are borne by the poor and marginalized" (Tierney 2006, 210). Rebuilding is an unequal process in which the interests of disadvantaged groups are usually displaced by coalitions of business interests, powerful organizations, and political actors favoring more advantaged residents (Dash et al. 2007; Pais and Elliott 2008; Peacock, Morrow, and Gladwin 1997). Unequal development is particularly noticeable in housing recovery. Disasters tend to damage rental and low-income properties the most, and this type of housing is built more slowly than owner-occupied housing (Bolin and Stanford 1998; Fothergill and Peek 2004; Fussell 2015; Peacock et al. 2014; Zhang and Peacock 2009).

Environmental and weather-related events also induce stratified migration responses. The literature offers two hypotheses about patterns of heterogeneity in post-disaster population trajectories. The "unequal displacement" hypothesis (the literature refers to it as the displacement approach only, we add unequal to emphasize predicted heterogeneity in effects) suggests that disadvantaged populations are more likely to be displaced than advantaged ones after a disaster because the poor reside in dwellings that are more likely to suffer damage (Peacock et al. 2014), have limited financial resources to rebuild, and face more difficulties accessing disaster support and assistance (Bolin and Stanford 1998; Cochrane 1975; Elliott and Pais 2006; Fothergill and Peek 2004; Hewitt 1997).

In contrast, the "segmented resilience" hypothesis suggests a post-disaster *in*crease in the proportion of disadvantaged residents precisely due to their inability to leave, which "trap them in place" (Logan, Issar, and Xu 2016). Considering the impact of thirty-two hurricanes in the Gulf Coast between 1970 and 2005, John Logan, Sukriti Issar, and Zengwang Xu (2016) find that White residents and young adults were more likely to move away after hurricanes than Black residents and the elderly. Similarly, Elizabeth Fussell (2015) finds that in the case of Katrina, disadvantaged populations (minorities, elderly, low-income) were less able to evacuate due to lack of transportation, need of assistance, and different perception of risk.

Interestingly, these two divergent approaches invoke the same mechanism—lack of socioeconomic resources—as the main driver of heterogeneity. Although the unequal displacement emphasizes constraints to rebuild, the segmented resilience focuses on constraints to escape harm and relocate. The divergence in expectations highlights the importance, when examining heterogeneous effects of macro-level shocks, to consider multiple conditions under which people remain in place or relocate and that socioeconomic resources might invoke different context-specific mechanisms (Elliott and Pais 2010; Fussell et al. 2017).

CONCLUSION

This introduction outlines conceptual considerations and recent findings of differential effects of disruptions during childhood across many domains of exposure, a variety of outcomes, and numerous methodological approaches. Indeed, we view heterogenous effects from disruption to be a near-universal feature of children's trajectories across a variety of domains and time points—a feature researchers should regularly consider in their analyses. However, uncovering the potential axes of this heterogeneity is a challenging task, given that few models are precise enough to allow strong directives of domains to include and to exclude in hypothesis tests. Instead, we view much of the literature as relying on somewhat vague theories, research conventions, and ad hoc functional form assumptions to elicit sources of heterogeneity. This issue seeks to outline promising approaches and showcase new results to further motivate examination of heterogeneity.

This issue, while advancing new ideas and results, is not comprehensive. We primarily focus on U.S. contexts and only briefly summarize the literature across a subset of exposures, domains, and axes of heterogeneity. The literature we draw from, though, and the new studies in this issue largely approach these questions using an overlapping set of viewpoints, interests, and insights, if not a specific disciplinary perspective and methodological conventions. We summarize the literature's focus on socioeconomic sources of heterogeneity. Scholars often theorize that highly resourced households will buffer or absorb the impacts of disruptive events during childhood. Other common tests of heterogeneity focus on demographic subgroups, such as age, gender, and race-ethnicity. Theories here are a bit more disparate, including differences in preferences, culture, or developmental periods that affect how children react to negative shocks.

We add to these popular foci an interest in considering intersections between micro- and macro-level events. These intersections point to theories of social normativity to understand the diverse consequences of disruptive events. For example, the stress from unemployment might be higher in an area with low levels of job loss relative to an area with high unemployment because of the stigma, shame, and guilt from being unemployed in the former context. Linkages between macro and micro contexts also encourage further consideration of prior experiences with other disruptive shocks and, alternatively, being unprepared for or unaccustomed to disruption in households with high levels of resources. Indeed, we see a notable pattern in which those unlikely to experience disruption, possibly because they expect stability in their lives, may be most profoundly affected by a disruptive event.

In addition to summarizing and integrating conceptual approaches and findings from the prior literature, we focus on the methodological challenges involved in identifying heterogeneous effects. Estimating credible main effects are often hard enough without attempting to uncover variation in these effects across subpopulations. Many conventional tools we use focus on getting the best estimates for the main effects and have less to say about their variation. We also face the issue that in assessing heterogeneous treatment effects (of a single treatment) we may in fact be capturing effects of heterogenous treatments. Moreover, we need to expand our toolkits to consider new axes of heterogeneity. To move beyond long-standing theories and conventions in quantitative social science, we should further integrate findings from qualitative studies and novel approaches using machine learning. Machine learning depends on researchers to select what is measured (and therefore what can be tested for heterogeneity) yet can direct our attention to promising axes of heterogeneity we may not have considered. These approaches could provide a powerful strategy against the current practice of, implicitly, assuming away many key sources of heterogeneity.

Considering heterogeneity in the impact of disruption on children's lives and trajectories is an important social-scientific task. Researchers across disciplines are increasingly undertaking this task, yet at times with limited theoretical foundations and analytic strategies. We hope this issue provides a useful resource to the research community and that it contributes

to the systematic understanding of potentially vast variation in the consequences of disruption, especially in early life.

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PART I

Economic Disruptions

The Effects of the Great Depression on Children's Intergenerational Mobility

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This article examines the role of the Great Depression in shaping the intergenerational mobility of some of the most upwardly mobile cohorts of the twentieth century. Using newly linked census and vital records from the Longitudinal, Intergenerational Family Electronic Micro-database, we examine the occupational and educational mobility of more than 265,000 sons and daughters born in Ohio and North Carolina. We find that the deepest and most protracted downturn in U.S. history had limited effects on sons' intergenerational mobility but reduced daughters' intergenerational mobility.

Keywords: children, Great Depression, intergenerational mobility

The Great Depression was the deepest and most protracted downturn in U.S. history. Between 1929 and 1933, industrial production fell by 37 percent and gross national product by 30 percent as unemployment soared to 25 percent (Temin 2000). Although the economy began to recover after 1933, unemployment remained around 15 percent for the remainder of the decade. Despite these hardships, children of the Great Depression were resilient, resourceful, and some of the most upwardly mobile cohorts of the twentieth century (Mulvey 1992; Elder 1999; Chetty et al. 2017; Jacomé, Kuziemko, and Naidu 2021).

This article examines the role of the Great Depression in shaping relative and absolute up-

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ward intergenerational mobility both across cohorts and within cohorts across space. Relative intergenerational mobility measures how an individual's outcomes relate to their parents' outcomes and captures the fluidity of social class. Absolute upward mobility measures whether children's outcomes surpass those of their parents. The effects of the Great Depression on intergenerational mobility depend on a variety of factors, including the available socioeconomic resources (Torche, Fletcher, and Brand 2024, this issue). On the one hand, the Great Depression reduced family incomes, which may have had more adverse consequences for families with fewer socioeconomic resources before the Depression. If strained family resources among more disadvantaged families resulted in lower investments in children, the intergenerational persistence (the inverse of mobility) of socioeconomic disadvantage would increase and thus reduce mobility. On the other hand, the Great Depression may have leveled the playing field for children in different social classes by having larger absolute and relative negative effects on families with more resources to lose (Elder 1999), which could reduce the intergenerational persistence of socioeconomic advantage and increase intergenerational mobility.

Newly linked censuses and vital records from the Longitudinal, Intergenerational Family Electronic Micro-database (LIFE-M) allow the examination of occupational mobility for more than 165,000 sons and 101,000 daughters born in Ohio and North Carolina from 1900 to 1920—a sample seventy times larger for daughters than existing studies.[1] We measure occupational mobility for sons by relating their occupational income scores to those of their fathers. For daughters, we examine the association of their husbands' occupations with the occupations of their fathers, because married women rarely participated in the labor market and their economic status was largely determined by their husbands (Goldin 1983; Elder 1999; Craig, Eriksson, and Niemesh 2019). For educational mobility, our samples are still large but smaller than for occupation with around ninety thousand sons and almost seventy thousand daughters. A feature of using education is that we can directly link the educational attainment of both daughters and sons to their fathers' attainment.

Large sample sizes allow us to characterize heterogeneity in the effects of the Great Depression by birth cohort, which sheds light on some of the mechanisms underlying changes in intergenerational mobility. For example, individuals on the cusp of completing their education, entering the labor market, or getting married when the Depression hit may have faced immediate resource constraints. Teens may have dropped out of school to look for work or care for their younger siblings while their parents worked, limiting their upward mobility. However, young children may have been exposed to marital conflict (Liker and Elder 1982), school closures, and more limited resources for a longer stretch of their developmental years, which could have had large cumulative effects on their opportunities and social mobility.

As a first step, our analysis benchmarks the levels of intergenerational mobility for sons in our sample against those estimates in other studies. Our estimate of rank-based occupational persistence among sons born in Ohio and North Carolina between 1900 to 1920 is 0.47, and our estimate for educational persistence is 0.44—both consistent with other estimates for the period.[2] A novel contribution of our study is the characterization of intergen-

1. James Feigenbaum (2015) uses from 4,730 to 4,952 father-son pairs in his analyses of ninety-nine U.S. cities. Elisa Jacomé, Ilyana Kuziemko, and Suresh Naidu (2021) report a total sample of father-son and father-daughter pairs of 5,207 in their sample, born during the 1910s. Although they do not report the number of women born in the 1910s, Jacomé and colleagues' sample sizes in tables 2 and 3 suggest that they use around 1,400 women. Dylan Connor and Michael Storper (2020) use a linked sample of 1.3 million father-son pairs based on 1920 to 1940 linkages. Finally, Hui Ren Tan (2023) uses a linked sample of 4.2 million native-born White boys up to the age of eighteen from the 1910 to the 1940 census.

2. Occupational scores and occupational ranks can be constructed in a variety of ways. We develop occupational scores following William Collins and Marianne Wanamaker (2022), and thus our estimates for occupational

erational occupational and educational mobility for daughters born in the early twentieth century. Interestingly, we find similar rates of intergenerational occupational and educational mobility for daughters as we document for sons.

Next, our analysis examines how the Great Depression disrupted patterns of intergenerational mobility, either by limiting opportunities among poorer families or by leveling the playing field. To measure the severity of the Great Depression at the county level, we follow the literature and use the decline in per capita retail sales between 1929 and 1933 (Fishback, Haines, and Kantor 2001; Fishback, Horrace, and Kantor 2005; Fishback, Horrace, and Kantor 2006; Fishback, Haines, and Kantor 2007; Fishback, Johnson, and Kantor 2010). In our sample of counties from Ohio and North Carolina, the severity of the Great Depression ranged from an 11 to 69 percent decline in per capita retail sales. Yet these differences in severity are not reflected in differences in sons' relative intergenerational occupational or educational mobility. In contrast, a more severe Depression reduced relative occupational mobility for teen daughters and resulted in differences in absolute educational mobility of both sons and daughters who were teens at the time the Great Depression began. Curiously, the effects on intergenerational mobility for teens differed in magnitude and sign for boys and girls. Teen sons with less-educated fathers in counties with a more severe Depression experienced more educational mobility, whereas teen daughters experienced less. These opposing effects may reflect the fact that different changes in educational opportunities and constraints affected boys and girls at these critical ages as well as different effects of the Depression on marital matching. We find little evidence that the Great Depression affected the occupational or educational mobility of younger children.

Our large sample sizes also allow us to explore heterogeneity across two states as well as by other community and individual-level characteristics. These analyses inform an understanding of the disparate impacts of the Great Depression on intergenerational mobility and provide insights into their potential mechanisms. We find differences in the effects of the Great Depression on intergenerational mobility across states and communities, potentially driven by differences in federal recovery grants and schooling opportunities. Internal migration across states or counties mitigated negative effects of the Great Depression on occupational mobility but not educational mobility for sons—a finding consistent with James Feigenbaum (2015). Daughters with more siblings were more negatively affected than daughters with fewer siblings, which could reflect different factors. Teen daughters' education may have been more responsive to family resource constraints if families expected the returns to these degrees (in terms of marital matching or in the labor market) to be lower. Consequently, teen daughters appear to have been more likely to drop out of school during the Great Depression to take on domestic roles, such as caring for siblings or supporting their working mothers (Elder 1999; Ress 2014). Last, we find suggestive evidence that Black Americans' mobility fell more in response to a more severe Depression than White Americans' mobility did. This article's descriptive findings suggest multiple avenues for future research.

INTERGENERATIONAL MOBILITY IN THE UNITED STATES OVER TIME

Creating economic opportunity for all, regardless of sex, race, ethnic origin, or socioeconomic status is fundamental to maintaining economic growth and a functioning democracy. This idea was the bedrock of policies that made the United States an international leader in education in the late nineteenth and early twentieth century, giving rise to one of the most educated populations in the world

persistence are similar to theirs (0.43 for White sons and 0.67 for Black sons). When we use occupational scores provided by IPUMS, our estimate for occupational persistence is lower, at 0.36, which falls between levels in Feigenbaum (2018) and Jacomé, Kuziemko, and Naidu (2021), 0.17 to 0.40 depending on sex and cohort. Our estimates for educational persistence are higher than those in Feigenbaum (2018) and Fletcher (2019), 0.21 to 0.34 for sons.

(Goldin and Katz 2008). These educational gains set the stage for historically low rates of income inequality by the middle of the twentieth century (Goldin and Margo 1992).

In the last fifty years, income and wealth inequality in the United States have soared to their highest levels since 1917 (Piketty and Saez 2003; Kopczuk, Saez, and Song 2010). Michael Hout (1988) uses occupation data from the General Social Survey to show that mobility increased during the 1970s and 1980s, but upward mobility during the 1980s exceeded downward mobility by less than it did in the 1970s. Influential work using administrative tax data has shown that intergenerational mobility has remained steady from 1996 to 2010, or for cohorts born between 1971 and 1986 (Chetty, Hendren, Kline, Saez, and Turner 2014), although economic mobility varied considerably across place (Chetty, Hendren, Kline, and Saez 2014). In particular, residential segregation, income inequality, lower social capital, family instability, and worse primary schools are associated with lower rates of economic mobility today.

Measures of educational mobility show similar variation across space, with the South exhibiting the lowest rates of mobility (Fletcher and Han 2019). The stability of economic mobility is surprising for those familiar with the late Alan Krueger's Great Gatsby Curve, which shows that countries with higher income inequality have lower rates of economic mobility (Corak 2013). It is also surprising given that the growing gap in college enrollment and completion is highly correlated with parents' incomes (Bailey and Dynarski 2011).

Until recently, an understanding of the long-term evolution of intergenerational mobility over the twentieth century at a national level as well as its local correlates had been severely constrained by data availability (Aaronson and Mazumder 2008). Before turning to the question of how the Great Depression affected intergenerational mobility, we first describe what recent studies tell us about intergenerational mobility in the early twentieth century.

How High Was Intergenerational Mobility in the Past?

Joseph Ferrie's pioneering research explores occupational mobility at the national level by linking the 1850 Census to men who were ten years and older in the 1860 Census (Ferrie 1996).[3] This work was not only among the earliest to link individuals across censuses using automated methods, it also produced some of the first estimates of men's occupational mobility predating modern surveys and administrative data.[4] Ferrie created a sample of 4,938 men—9 percent of the male population in 1850, and 19 percent of the population of men with uncommon names.

Because Ferrie examines intergenerational mobility in a period without income or education measures, his work focused on occupational mobility as captured by the Altham statistic (Altham and Ferrie 2007).[5] In an article summing up the state of knowledge on the subject, he writes, "Nineteenth-century observers were right: the United States was in fact more mobile both socially and physically than other places at that time, and this remarkable fluidity persisted at least through the cohort that reached their thirties by 1920" (Ferrie 2005, 214). Jason Long and Joseph Ferrie (2013) extended this work across countries to compare the historical United States with nineteenth-century British fathers and sons. They find both that U.S. mobility declined over time and that U.S. men were more mobile than their Brit-

3. For earlier approaches to linking at the subnational level, see Malin 1935; Curti 1959; Bogue 1963; Thernstrom 1964; Guest 1987; and Steckel 1988.

4. For an overview of methods used to link census data, see Bailey et al. 2020.

5. This approach first groups fathers and sons into one of four broad occupational categories: unskilled labor, skilled and semiskilled labor, white-collar workers, and farmers. A matrix captures the transition rates of sons into the four categories according to their father's occupation. To examine changes in occupational mobility over time, Ferrie computes the Altham statistic to measure the strength of association between both the rows and columns of a transition matrix in two periods. Depending on one's point of view, the fact that this approach avoids ranking occupations according to socioeconomic status may be a feature or a bug.

ish counterparts.[6] Yu Xie and Alexandra Killewald (2013) challenge Long and Ferrie's findings of a decline in social mobility in the United States from 1880 and 1973, showing that their analysis was driven by transitions from farming to other occupations. Xi Song and colleagues (2020) account for the relatively high mobility of the children of farmers and conclude that occupational mobility was high in the nineteenth century and has been stable for cohorts born after 1900.

More recently, Claudia Olivetti and Daniel Paserman (2015) cleverly leverage the socioeconomic information contained in first names, and exploit this fact by looking at father-son and father-daughter intergenerational elasticities in status. Mechanically, their approach replaces the log earnings of an individual father in a standard intergenerational elasticity regression with the average log earnings of fathers of children named *j*—a generated regressor approach that uses one sample to create a proxy for an unobserved regressor in a second sample. Olivetti and Paserman document intergenerational father-son elasticities in occupational income between 1870 and 1940. These name-based measures of persistence increased from 0.35 in 1870 to 0.50 in 1920 for sons and daughters. However, from 1920 to 1940, these trends reversed, with name-based measures of persistence falling to around 0.43 for sons and 0.37 for daughters.

How these name-based measures correspond to Ferrie's occupational transitions remained an open question until Feigenbaum (2018) linked the 1915 Iowa Census to the 1940 Federal Census to construct multiple measures of intergenerational mobility. In addition to information about occupations, the 1915 Iowa Census is the first in U.S. history to include information on educational attainment and wage income—neither of which were collected in the federal census until 1940. To compare his findings with the historical and modern literature, Feigenbaum calculated Ferrie's Altham statistic (Altham and Ferrie 2007), Olivetti and Paserman's name-based statistic (Olivetti and Paserman 2015), as well as intergenerational elasticity parameters and rank-rank correlations (Chetty, Hendren, Kline, and Saez 2014). Looking across all measures considered, Feigenbaum concludes that based on earnings, education, occupation and the socioeconomic content of names, early twentieth-century Iowa was a period of high mobility.

More recent literature, then, extends analyses to a broader set of groups. Notably, the earliest historical samples were primarily for White men, either as an explicit sample restriction or because Black men were hard to link across census years.[7] William Collins and Marianne Wanamaker (2022) document intergenerational mobility for Black and White American men from 1880 to 2000 and document large disparities by race. They find that White children were much more likely than Black children to be upwardly mobile from the lowest socioeconomic positions of society in every generation. Zach Ward (2021) further shows that accounting for both the over- or exclusive representation of White men in studies of intergenerational mobility and measurement error in occupational income in historical samples (due to life cycle, transitory, or linking errors) may reverse the conclusion of a more mobile past. Linking census data between 1850 and 1950 and using an instrumental variable approach to account for measurement error (Solon 1999), Ward (2021) finds that intergenerational persistence may have been twice as high in the past as previously believed and that mobility and economic opportunity are higher in the population today than historically. Another recent study similarly reverses the conventional wisdom about U.S. mobility being high historically. Elisa Jacomé, Ilyana Kuziemko, and Suresh Naidu (2021) use retrospective surveys containing information about fathers' occupations and household income to create intergenerational mobility estimates for native-born men born between 1910 and 1979. The novelty of this study over previous work is that it relies on retrospective survey data rather than linked data, which allows them to charac-

6. In addition, Long and Ferrie (2018) find that fathers' occupations influenced their grandsons' occupations.

7. This reflects the fact that Black men are more likely to have shorter names, more common names, and also names that are spelled differently over time (Bailey et al. 2020).

terize intergenerational mobility for a more representative sample of Americans. Like Ward (2021), Jacomé, Kuziemko, and Naidu (2021) find a U-shaped pattern, with intergenerational mobility being much lower in the early twentieth century than in the middle of the century, and intergenerational mobility decreasing again in the most recent period.

Intergenerational mobility for women has been studied less than for men, primarily because name changes at marriage make women difficult to follow across time in historical data. Recent papers have also worked to fill this gap in the literature. Jacqueline Craig, Katherine Eriksson, and Gregory Niemesh (2019) use women's birth ("maiden") and married names on Massachusetts marriage certificates between 1850 and 1910 to link in census data, which allows them to study intergenerational occupational mobility of women for two cohorts. Comparing the occupations of women's fathers and husbands, they estimate the persistence in occupational rank of 0.192 for 1850 to 1880 and 0.173 for 1880 to 1910. By contrast, the same parameters for fathers and sons were 0.248 and 0.181 in the same data, suggesting that women were more mobile than men in the 1850 to 1880 period but similarly mobile in the later period. Jacomé, Kuziemko, and Naidu (2021) also document trends in intergenerational mobility for native-born women born between 1910 and 1979. Again they find a U-shaped pattern, with intergenerational mobility being much lower in the early and late twentieth century than in the middle of the century. They also find that intergenerational mobility for women tended to be lower than for men for the entire period.

What Were the Correlates of Intergenerational Mobility in the Past?

Small sample sizes have also limited historical research into the geographic correlates of intergenerational mobility. A closely related study by Feigenbaum (2015) investigates the impact of the Great Depression on intergenerational mobility of men in ninety-nine U.S. cities. His analysis links the 1918–1919 Bureau of Labor Statistics Cost of Living Survey with the 1920 and 1940 censuses. Observing the earnings and occupations of fathers in 1920 and sons in 1940, Feigenbaum (2015) documents how intergenerational income and occupational mobility varied with sons' exposure to the severity of the Great Depression. In particular, he finds that experiencing a more severe Depression lowered intergenerational mobility among sons. Interestingly Feigenbaum (2015) does not find evidence of education as a mechanism, even though exposure to better quality primary schools has been found to be an important correlate of upward mobility in the modern period (Chetty, Hendren, Kline, and Saez 2014).

David Card, Ciprian Domnisoru, and Lowell Taylor (2022) study upward mobility in terms of education for men and women co-residing with at least one parent in the 1940 Census, where upward educational mobility is defined as completing ninth grade, conditional on parents having five to eight years of education. Men in their sample are ages fourteen through eighteen and women sixteen through eighteen in 1940. Using variation in teacher salary across states as a proxy for school quality, the authors find evidence that upward educational mobility is strongly associated with teacher salary at the state level as well as when comparing similar cross-border counties that offered different teacher salaries due to variation in state minimum salary laws.

More recently, Hui Ren Tan (2023) examines the geography of upward mobility for White sons in the early twentieth century. Using multiple linking methods, Tan (2023) links individuals between the 1910 and 1940 Censuses and finds that the mobility map differs from today's mobility map. Men in coastal and industrial regions were considerably more upwardly mobile than today. In a related article, Dylan Connor and Michael Storper (2020) link individuals between 1920 and 1940 Censuses and compare the geography of intergenerational mobility from the early twentieth century with that in the modern period. The authors document declines in social mobility in the Midwest and persistent low mobility in the South. Interestingly, given that economic activity has shifted away from the Midwest and increased in the South, these findings suggest that an increase in economic activity may not always translate into higher mobility.

This Study's Contribution

This study contributes to the literature in several ways. First, we investigate occupation and education-based estimates of intergenerational mobility for North Carolina and Ohio for both daughters and sons. North Carolina and Ohio are interesting to study for several reasons. North Carolina was an agricultural state specializing in tobacco and cotton with some textile industry, and Ohio was a booming and quickly industrializing state in the thriving Midwest. North Carolina had a large Black population (29 percent relative to 9.7 percent in the United States overall), whereas Ohio was a destination of the Great Migration and for immigrants seeking jobs.[8] Second, this article examines the relationship of the Great Depression and intergenerational mobility for large samples, which allows considerably more precision than previous analyses as well as the consideration of heterogeneous effects using a rich set of community- and individual-level characteristics as well as New Deal policies in moderating these effects.

LIFE-M DATA AND ANALYTIC SAMPLES

This article relies on data from the Longitudinal Intergenerational Family Electronic Microdatabase project (Bailey et al. 2022). The data are public and can be downloaded from ICPSR. LIFE-M links millions of vital records (birth, death, and marriage records) in Ohio and North Carolina to historical full count censuses (Ruggles et al. 2021). The combination of census and vital records traces an individual's residential location across time, which allows us to determine an individual's exposure to the Great Depression in childhood—regardless of where they live later in life. In addition, the LIFE-M data link a large number of children and their parents, which facilitates our analyses of intergenerational mobility. A third feature of the LIFE-M data is that they have very low rates of linking errors. LIFE-M uses carefully vetted hand-linked data to train supervised machine-learning algorithms that target a linking error rate of no higher than 3 percent. The actual error rate is further reduced by a process of extensive cross-checking and validation to cull incorrect links.[9] LIFE-M, therefore, provides highly accurate, large samples of father-son and father-daughter pairs, for which we observe both outcomes of fathers and children in adulthood as well as their county of residence by the Depression.

Construction of Analytic Samples

The LIFE-M database includes approximately 2.4 million individuals linked to the 1940 Census.[10] Among these individuals, we limit our analytic samples to children based on four criteria: (1) those born between 1900 and 1920, (2) whose outcomes of interest were nonmissing in the 1940 Census,[11] (3) whose fathers' out-

8. Table A.1, in the online appendix (https://www.rsfjournal.org/content/10/1/32/tab-supplemental), reports mean demographic and economic characteristics of the Ohio and North Carolina population, as well as the mean characteristics of the U.S. population in the 1930 Census. Relative to the national average of the share of workers in agriculture (22 percent), the share of employment in agriculture in North Carolina and Ohio was 43 and 13 percent, respectively. Conversely, the share of workers in manufacturing employment averaged 22 percent in the United States, but 30 and 21 percent in Ohio and North Carolina, respectively.

9. As an independent validity check on data quality, the Family History and Technology Lab at Brigham Young University (BYU) compared 1,043 LIFE-M links with those already on the FamilySearch.org Family Tree. (FamilySearch.org tree links are created by genealogists and users of FamilySearch.org, who are independent of the LIFE-M process.) For 1,043 birth certificates linked to the 1940 Census by LIFE-M and FamilySearch.org users, LIFE-M links agreed with FamilySearch.org users 96.7 percent of the time. Under the assumption that the FamilySearch.org Tree is always correct, this implies a LIFE-M error rate of 3.3 percent. The true rate is lower given that some observations on the Family Tree are incorrect.

10. LIFE-M achieves link rates to the 1940 Census ranging from 12 to 28 percent, depending on state and gender (for detail, see Bailey et al. 2023, table 4).

11. For analyses of women's occupational mobility, husbands' occupations must be nonmissing.

Table 1. Construction of Analytical Sample

	Men	Women
A. People born between 1900 and 1920 in 1940 Census		
Analogous census population	1,615,764	1,654,724
LIFE-M links	327,992	307,023
% Population linked	20.3%	18.6%
B. Sample for occupational mobility		
Panel (A) + nonmissing occupation (or coresiding with husband reporting nonmissing occupation)		
Analogous census population	1,492,128	1,080,700
LIFE-M links	307,284	222,652
% Population linked	20.6%	20.6%
LIFE-M links and nonmissing father's occupation before 1930	183,181	112,476
% Population linked	12.3%	10.4%
LIFE-M links, nonmissing father's occupation before 1930, and known location before the Great Depression	165,768	101,855
% Population linked	11.1%	9.4%
C. Sample for educational mobility		
Panel (A) + reporting nonmissing education		
Analogous census population	1,577,755	1,619,518
LIFE-M links	323,093	302,844
% Population linked	20.5%	18.7%
LIFE-M links and nonmissing father's education	96,600	76,244
% Population linked	6.1%	4.7%
LIFE-M links, nonmissing father's education, and known location before the Great Depression	90,081	69,617
% Population linked	5.7%	4.3%

Source: Authors' tabulation using the LIFE-M data (Bailey et al. 2022) and the 1920–1940 Decennial Censuses (Ruggles et al. 2021).
Note: The table reports the size of the LIFE-M linked sample for women and men born in North Carolina or Ohio, as well as the analogous population in the 1940 Census. For the LIFE-M sample, the locations before the Great Depression are obtained from the children's county of residence closest to 1930, which could come from the residence county in the 1930 Census, birth county, marriage county, or residence county in the 1920 Census. If none are available for the child, then this location is obtained from the father's county of residence closest to 1930 from the same sources.

comes of interest are nonmissing,[12] and (4) whose county of residence prior to the Great Depression is observed.[13]

Table 1 describes the samples for our analysis of occupational and educational mobility. We start with 327,992 sons and 307,023 daughters who are born between 1900 and 1920 and linked to the 1940 Census in the LIFE-M dataset (panel A). They represent around 20.3 percent and 18.6 percent of men and women, respec-

12. We require fathers' links to censuses before 1930 to obtain their occupations. We measure fathers' economic standing based on their occupational income scores or the occupational rank in national distribution. LIFE-M does not link people directly to the 1930 Census.

13. We determine an individual's county of residence prior to the Great Depression as follows. We collect an individual's location from all linked vital and census records between 1920 to 1930. If an individual was under

tively, in the same cohort in the 1940 Census. For our analysis of occupational mobility, requiring both nonmissing children's occupations (nonmissing husband occupation for women) in the 1940 Census, nonmissing fathers' occupations in at least one census by 1930, and a nonmissing county of residence prior to the Great Depression results in a sample of 165,768 sons and 101,855 daughters (panel B). The sample comprises 11.1 percent and 9.4 percent of men and women whose occupations or husbands' occupations were nonmissing in the 1940 Census. For our analysis of educational mobility, requiring both children and fathers' years of schooling in the 1940 Census, as well as county of residence prior to the Great Depression, reduces sample sizes to 90,081 sons (5.7 percent) and 69,617 daughters (4.3 percent) (see panel C).

Sample Representativeness

Historical linked samples tend not to be representative of the corresponding population (Bailey, Cole, and Massey 2019; Bailey et al. 2020). Table 2 shows this is also true in our study. Demographic and socioeconomic variables for our analytic samples differ significantly from the 1900–1920 born populations in the 1940 Census, both at the national level (column 1) and for Ohio and North Carolina (column 2). Comparing the unweighted statistics for the LIFE-M analytic sample (column 3) with the analogous population born in Ohio and North Carolina in the 1940 Census (column 2), LIFE-M overrepresents individuals who are male, White, more educated, less likely to migrate, and more likely to be employed. The analytic sample is also more likely to include individuals with longer first and last names and less-common last names.

To improve the representativeness of our sample, we use the procedure detailed by Bailey, Connor Cole, and Catherine Massey (2019) to create inverse propensity score weights. These weights are designed to balance major demographic and socioeconomic characteristics in the linked sample and in the reference population. This approach down-weights individuals with overrepresented characteristics and up-weights individuals with underrepresented characteristics. Column 4 of table 2 shows mean characteristics after applying these weights in column 4. Using the weights, the differences between the linked sample in 1940 and the target population is very small, both in absolute (column 5) and percentage terms (column 6). Moreover, none of the differences in the weighted sample is significantly different from zero (column 7).

Measuring the Great Depression's Severity

We measure the local severity of the Great Depression using the change (typically a decline, therefore negative) in retail sales per capita between 1929 and 1933. Although this is an imperfect measure, other measures of economic downturns, such as changes in the unemployment rate or GDP per capita, are not available at the county level during the 1930s. So, the county-level change in retail sales is the most commonly used measure of the Depression's severity in the literature (Fishback, Haines, and Kantor 2001; Fishback, Horrace, and Kantor 2005; Fishback, Horrace, and Kantor 2006; Fishback, Haines, and Kantor 2007; Fishback, Johnson, and Kantor 2010). In addition, retail sales continue to be strongly correlated with economic fluctuations today (for instance, during the COVID-19 pandemic, Chetty et al. 2020).

Figure 1 maps variation in the severity of the Great Depression by county (darker colors indicate a more severe downturn). The magnitude of the economic downturn varied greatly across states but also across counties within Ohio and North Carolina. From 1929 to 1933, the log changes in retail sales per capita in these states ranged from −0.69 to −0.11 and −1.51 to 0.14, respectively. Although the average severity of the Depression was similar in Ohio and North Carolina, the county-level variation in North Carolina (mean = −0.42, standard deviation = 0.23) was more than twice that in Ohio (mean = −0.43, standard deviation = 0.10). The mountain and coastal regions of North Caro-

age fifteen between 1920 and 1930, we also collect the father's location from vital and census records. Among all collected locations, we choose the location temporally closest to 1930; children's locations are preferred if the father's location was observed in the same year.

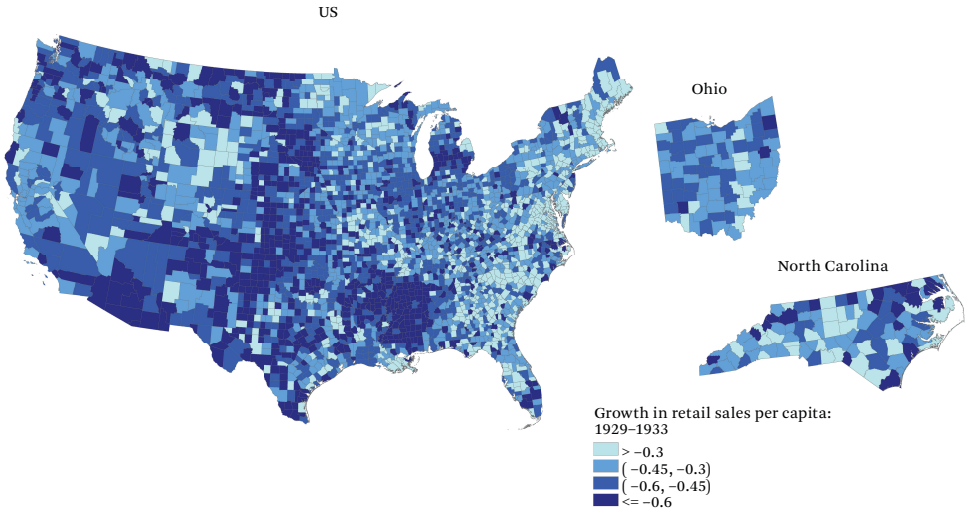
Table 2. External Validity and Representativeness of LIFE-M Sample

	1940 Census U.S.-Born Population	1940 Census Sample	LIFE-M Sample (Unweighted)	LIFE-M Sample (Weighted)	Difference (4)-(2)	Difference/Mean (5) / (4)	*P*-value of Difference in (5)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Male	0.493	0.494	0.568	0.494	−0.000478	−0.0969%	0.900
Age in 1940	29.3	29.2	28.9	29.3	0.0747	0.255%	0.141
Black	0.106	0.134	0.0177	0.134	0.000124	0.0926%	0.978
Urban	0.581	0.556	0.565	0.555	−0.000239	−0.043%	0.950
Farm	0.202	0.226	0.218	0.228	0.00281	1.23%	0.483
Ever married	0.694	0.703	0.695	0.704	0.00134	0.190%	0.683
Graduated high school	0.356	0.364	0.462	0.368	0.00322	0.874%	0.367
Five-year migration	0.0779	0.0591	0.0402	0.058	−0.00107	−1.84%	0.444
Has occupation	0.636	0.639	0.656	0.644	0.00459	0.713%	0.134
Occupational income score	14.3	14.3	15.8	14.3	−0.0466	−0.327%	0.477
Length of first name	5.61	5.57	5.75	5.56	−0.0172	−0.310%	0.484
Length of last name	6.42	6.32	6.52	6.32	0.00142	0.0225%	0.884
First name commonality	0.776	0.779	0.793	0.776	−0.00247	−0.318%	0.113
Last name commonality	0.596	0.612	0.541	0.615	0.00284	0.461%	0.123

Source: Authors' tabulation using LIFE-M data (Bailey et al. 2022) and the 1940 Decennial Census (Ruggles et al. 2021).

Note: This table reports means of selected demographic and economic variables for the LIFE-M analytic samples of those born in Ohio and North Carolina and the reference population in the 1940 Census. Column 1 reports means for each variable for the full population born in the U.S. between 1900 and 1920; column 2 reports means for individuals born in Ohio and North Carolina between 1900 and 1920; column 3 and 4 report means for individuals in the LIFE-M analytic samples, either unweighted or weighted, respectively; column 5 reports the difference between weighted means for LIFE-M sample and the means for the population in column 2; column 6 reports the mean difference as a percentage of the weighted mean reported in column 4; column 7 reports the *p*-value of a hypothesis test for equality of the mean between column 4 and 2.

Figure 1. Geographic Distribution of Great Depression's Severity as Measured by the Growth in Retail Sales, 1929–1933



Source: Authors' tabulation using Fishback et al. 2005.
Note: The growth rates in retail sales per capita are calculated by differences between the per capita retail sales in 1929 and 1933.

lina were hardest hit, whereas the severity of the Depression was more evenly distributed across counties in Ohio.

The causes of the Depression's severity are elusive, but some correlates are known. For instance, the Depression was more severe in the mountain states and less severe in the upper South (Rosenbloom and Sundstrom 1999), where industry focused on natural resource extraction (Wallis 1989). Carol Heim (1998) suggests that states specializing in tobacco, such as North Carolina, had a less severe Depression, owing to fairly inelastic demand for tobacco products. Finally, Feigenbaum (2015) shows that the severity of the Depression is correlated with the share of workers in heavy manufacturing, booms in manufacturing employment in the 1920s, and the rate of bank failures in ninety-nine cities across the United States.[14]

EMPIRICAL ANALYSIS

Following the literature (Black and Devereux 2011; Solon 1999), we estimate relative intergenerational persistence (the inverse of mobility) using the following regression specification:

$$Y_i = \alpha + \beta Y_i^f + X_i\Phi + \varepsilon_i \quad (1)$$

where the variable, Y_i, is the outcome of child i, and Y_i^f is the same outcome for the child's father. For our measure of occupational mobility, we use the occupational ranks of children or fathers as described below. For education, we use the level of years of schooling (rather than log years of schooling) to include individuals reporting zero years of schooling (Hertz et al. 2008; Azam and Bhatt 2015; Feigenbaum 2018). The model also includes a quartic function of the child's age in the 1940 Census. For our anal-

14. Table A.2 shows similar patterns in Ohio and North Carolina. Within these states, the severity of the Great Depression is correlated with the share of manufacturing employees in Ohio and North Carolina, although in opposite directions. In the eighty-eight Ohio counties, the share of manufacturing employees in 1929 is positively correlated with the severity of the Depression (or negatively correlated with the growth in retail sales between 1929 and 1933, column 3). In the one hundred North Carolina counties, the reverse is true. The share of manufacturing employees in 1929 is negatively correlated with the severity of the Depression (column 5), but this negative relationship evaporates in regressions including per capita New Deal grants for the Agricultural Adjustment Administration and Public Works and Relief.

ysis of occupational persistence, we also control for a quartic function in the father's age when his occupation is observed to help account for life cycle bias (Dahl and DeLeire 2008; Black and Devereux 2011; Bhattacharya and Mazumder 2011; Chetty, Hendren, Kline, and Saez 2014). The coefficient, β, captures the intergenerational persistence in the outcome between a child and father. A lower β implies a lower level of persistence and, therefore, a higher level of intergenerational mobility.

Expanding equation (1) to allow the intergenerational mobility to vary across children's birth years b yields the following statistical model:

$$Y_{ib} = \alpha + \sum\nolimits_b \delta_b (D_{b(i)} \times Y_i^f) + X_i \Phi + \varepsilon_{ib} \qquad (2)$$

where $D_{b(i)}$ is a set of indicators for birth year b and δ_b is the cohort-specific estimate of intergenerational persistence. All other variables are defined as in equation (1).

Measures of Socioeconomic Status

Intergenerational mobility in socioeconomic status is measured in a variety of ways in economics and sociology (such as income, occupation, educational attainment, wealth), but limitations in historical data sources dictate our focus on two outcomes: occupational income ranks and years of education. These measures have several features in this historical setting. First, occupation is consistently reported in historical censuses before 1940. Second, both occupation and education have the advantage of being more stable and less subject to life-cycle biases and transitory shocks.

Occupational ranks are determined by ordering occupational income scores for sons within the same birth cohort following Collins and Wanamaker (2022). These occupational income scores are based on the mean income at the occupation, race, region level reported in the 1940 Census and adjusted for farmers' income. Because most women did not participate in the labor market and, as a result, did not report an occupation in the early twentieth century, we follow the literature and use husbands' occupational income scores as the basis for determining women's occupational rank within the national distribution (Goldin 1983; Elder 1999; Craig, Eriksson, and Niemesh 2019; Olivetti and Paserman 2015). Using husbands' occupation limits our sample to married daughters coresiding with their husbands. We calculate fathers' occupational income rank prior to the Great Depression with reference to all fathers of children in a given birth cohort. For instance, to determine fathers' occupational ranks for children born from 1900 to 1910, we rank all fathers of children in the birth cohort in the 1910 Census. Similarly, to determine fathers' occupational ranks for children born from 1911 through 1920, we rank all fathers of children within a cohort in the 1920 Census.

The second outcome we examine is years of education. An advantage of education as a measure of socioeconomic status is that it is available for both daughters and sons, which circumvents the need to use husbands' education as a proxy for daughters' SES. However, years of schooling is only observed in the 1940 Census, which limits our sample to individuals with fathers also linked to the 1940 Census.

Measuring the Disruptive Effects of the Great Depression on Intergenerational Mobility

We test for the effects of the Great Depression on relative intergenerational mobility using the following statistical model,

$$\begin{aligned} Y_{igc} = {} & \alpha + \beta Y_i^f + \gamma Y_i^f \times GD_c + \sum_{g\in(1,2)} \delta_g (D_{g(i)} \times Y_i^f) \\ & + \sum_{g\in(1,2)} \psi_g (D_{g(i)} \times GD_c) + \sum_{g\in(1,2)} \lambda_g (D_{g(i)} \times Y_i^f \\ & \times GD_c) + X_i \Phi + \theta_g + \rho_c + \varepsilon_{igc} \end{aligned} \qquad (3)$$

where the dependent variable Y_{igc} is the outcome of child i, who was in birth cohort group g and lived in county c before the Great Depression. Y_i^f is the father's outcome prior to the Great Depression. GD_c measures the Great Depression's severity in county c and is defined as the number of standard deviations in the national average growth rate of retail sales per capita between 1929 and 1933. Note that a larger positive GD number implies a smaller decline in per capita retail sales. In the model for occupational mobility analysis, we also control for a quartic function of the child's age and the father's age when their occupations were observed (represented by X_i). We also include

fixed effects for birth cohort groups (θ_g) and county of residence (ρ_c) to account for differences across cohort and time-invariant county differences.

$D_{g(i)}$ includes indicators for birth cohort groups, including individuals born between 1900 and 1911 ($g = 0$), 1912 and 1914 ($g = 1$), and 1915 and 1920 ($g = 2$). Children born between 1900 and 1911 were ages eighteen to twenty-nine at the onset of the Great Depression, had largely completed their schooling, and had already entered the labor market; therefore, they should be less affected than the two younger cohorts. The Depression may have had a large cumulative effect on the occupational or educational mobility of children ages nine to fourteen in 1929. Similarly, it may have affected the educational and occupational mobility of children of high school age (fifteen to seventeen). The coefficients of interest, $\lambda_{g\in(1,2)}$, capture the different effects of the Great Depression on the intergenerational persistence for children in those younger cohort groups.

A key assumption underlying equation (3) is that no other omitted county-level factors are correlated with the severity of the Great Depression and also affect intergenerational mobility differently across cohorts. This assumption is supported by research. In a set of cities, Feigenbaum (2015) shows no ex ante association in the severity of the Great Depression and intergenerational mobility for men born between 1900 and 1920. Because we expect the Depression to have little effect on the education and occupational training of the oldest group, we use that cohort as an additional control group in the analysis to account for pre-existing, unobserved differences between the Great Depression and intergenerational mobility.

A final set of results examines heterogeneity in the effects by county or individual characteristics. To do this, we extend the model in equation (3) by interacting each term with the individual or county characteristics of interest. These characteristics are defined as dummy variables for an individual or community characteristic, which we discuss in more detail later.

Absolute Intergenerational Mobility Estimates

In addition to relative mobility, we document the effect of the Great Depression on absolute upward mobility. We estimate a model for children born to fathers who were ranked in the lowest quartile of national distribution in terms of the occupational income score. For our educational analysis, we focus on the children born to fathers with six or fewer years of schooling.

$$Y_{igc} = \alpha \sum_{g\in(1,2)} \psi_g (D_{g(i)} \times GD_c) + X_i\Phi + \theta_g + \rho_c + \varepsilon_{igc} \quad (4)$$

The coefficient of interest ψ_g captures the impact of exposure to the Depression on a child's occupational rank or years of schooling for children in the two younger cohort groups, g, relative to the oldest cohort group.

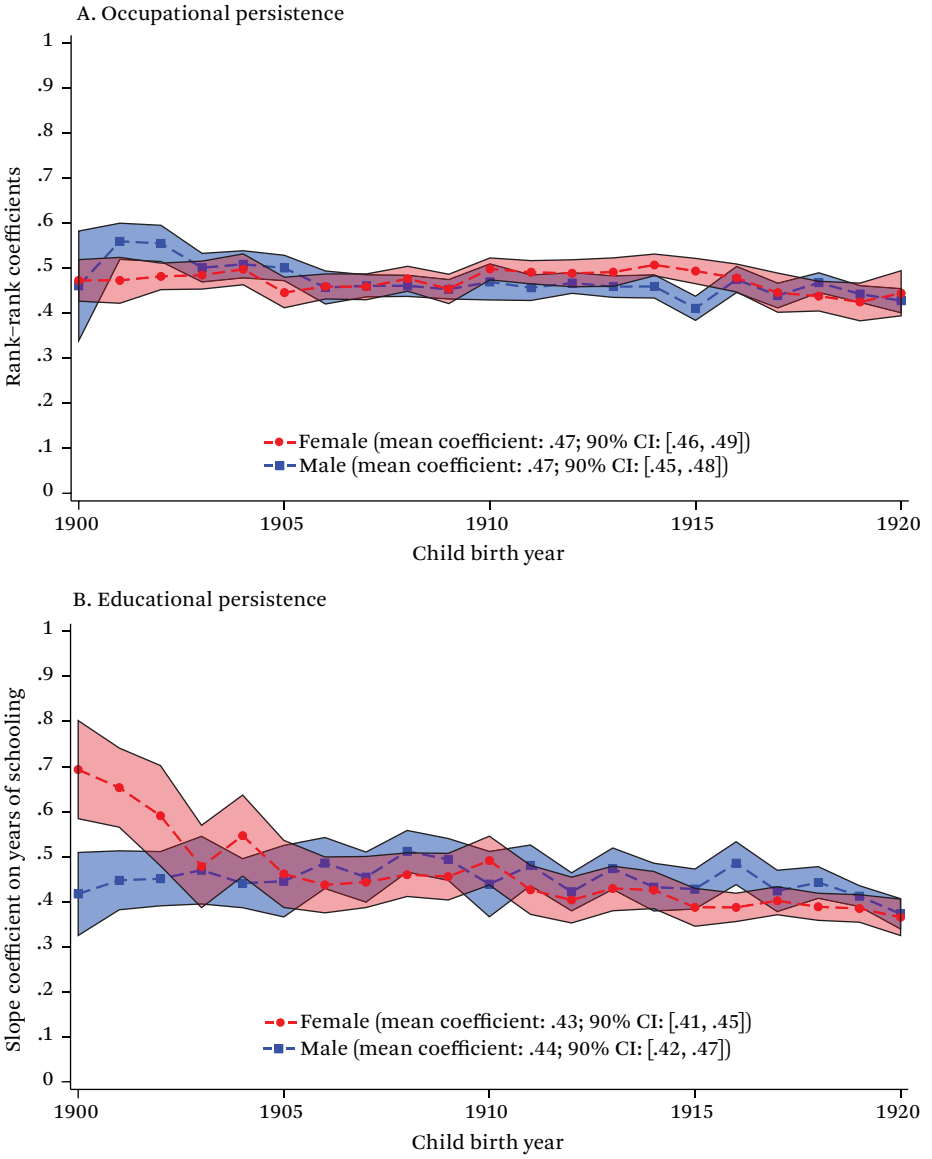
RESULTS

We begin by benchmarking rates of intergenerational mobility in the LIFE-M data to the rates in the literature. Figure 2 shows that occupational persistence for sons born between 1900 and 1920 is around 0.47, and educational persistence is around 0.44. In addition, we find little evidence of differences in mobility by sons' birth year. A unique feature of our analysis is that the LIFE-M data also permit an examination of daughters' intergenerational mobility. Because many women did not work for pay or report an occupation in the early twentieth century, we examine daughters' occupational mobility based on husbands' and fathers' occupational ranks. We find that occupational and educational mobility for daughters is almost identical to that of sons.[15]

Because our analysis of occupational mobility for daughters is limited to married women

15. The coefficients of intergenerational occupational and educational persistence are plotted in figure 2. Hypothesis tests for equal coefficients for daughters and sons yield an F-statistic of 0.22 for occupational persistence ($p = .64$) and an F-statistic of 0.37 ($p = .54$). We cannot reject the null hypothesis that the persistence coefficients for daughters and sons are equal at any statistical significance.

Figure 2. Intergenerational Persistence Estimates, by Birth Cohort and Sex



Source: Authors' tabulation using LIFE-M data (Bailey et al. 2022).
Note: This figure plots intergenerational occupational and educational mobility by child's birth year. In panel A, we estimate intergenerational occupational mobility by regressing a child's occupational rank (husband's occupational rank, if women) on father's occupational rank and allow the rank-rank coefficient to change by child's birth year. Occupational ranks are based on the national distribution of occupational income scores created by Collins and Wanamaker (2022). In panel B, we estimate educational mobility by regressing a child's years of schooling on father's years of schooling and also allow the slope coefficients to change by child's birth year. Regressions are weighted by the inverse propensity scores, and 90 percent confidence intervals are shown as well as the point estimates. To smooth the trend by birth year, we drop two people with large weights causing large standard errors. To see similar plots by state, see figures A.1 and A.2.

residing with their husbands, a natural question is whether findings are sensitive to this sample restriction. Although we cannot observe husband's occupation for unmarried women, we check differences in educational mobility based on all daughters versus married daughters. Reassuringly, educational mobility for married daughters is not statistically different,[16] suggesting that our findings for daughters' occupational mobility are not driven by this data limitation.

The Disruptive Effects of the Great Depression

We next examine the effects of the Great Depression on occupational and educational intergenerational mobility. Recall, the Great Depression could have two opposing effects. First, it could stretch the resources of families and limit educational attainment, leading to more limited opportunities and decreasing intergenerational mobility. Alternatively, the Great Depression could level the playing field for children in different social classes and reduce the role of parental socioeconomic status in determining children's outcomes, leading to an increase in mobility.

Table 3, panel A, reports the main results for relative mobility. First, we find little evidence that the Great Depression affected sons' relative occupational and educational mobility, regardless of marital status (columns 1–2 and columns 4–5) and age at the time the Depression began (rows 5–6). However, the Great Depression appears to have limited daughters' intergenerational mobility. For daughters born between 1912 and 1914 (ages fifteen to seventeen at the onset of the Depression), we find negative and statistically significant coefficients on the interaction term between fathers' outcomes, the Great Depression's severity, and birth cohort groups (columns 3, 6, and 7). Being exposed to a decline in retail sales of one standard deviation led to a sizable decline in the occupational mobility of daughters who were teens at the start of the Depression. Moreover, the effect is large at −0.075 relative to the intergenerational persistence of 0.30 for the oldest group of cohorts, those who were eighteen to twenty-nine years old when the Depression began (column 3). Similarly, a more severe Depression decreased educational mobility for teen daughters by 0.16 relative to the daughters older than eighteen at the start of the Depression (column 6)—a 40 percent increase in educational persistence (0.16/0.40). This negative effect is larger for married daughters residing with their husbands (column 7).

Absolute upward educational mobility of daughters and sons who were ages fifteen to seventeen at the time of the Depression's onset was also affected. Consistent with our relative educational mobility findings, daughters ages fifteen to seventeen at the time experienced reduced mobility, relative to daughters ages eighteen and older (panel B, column 6). In contrast, for comparable sons, we find that a more severe economic downturn increased educational mobility. The absence of effects on occupational mobility for sons, however, suggests that changes in education had little effect on occupational choice.

Heterogeneous Effects by Individual and Community Characteristics

A second set of results examines whether the Depression's effects differed across state, county characteristics, and individual circumstances and characteristics. Effect sizes may have varied across these dimensions for many reasons. County-level or individual effect heterogeneity may reflect differences in treatment (for example, difference in the severity of the Depression by community or across individuals) or effects of the same treatment (for example, that people respond differently to the same severity of the Depression due to different circumstances or constraints).

We explore whether the impact of the Great Depression differed in North Carolina, where the dominant sector was agriculture. We also explore whether the Great Depression's effects on intergenerational mobility were moderated by the major programs of the New Deal. In addition, we explore how the local economy (such as retail sales and manufacturing employment)

16. Coefficients are reported in table 3 in row 1, columns 6 and 7. We formally test the equality of coefficients under the null hypothesis that the two coefficients are equal, which we fail to reject (F-statistic = .68, p = .41).

Table 3. Intergenerational Persistence in Ohio and North Carolina, by Sex and Birth Cohort

	Occupation All Men (1)	Occupation Married Men (2)	Occupation Married Women (3)	Education All Men (4)	Education Married Men (5)	Education All Women (6)	Education Married Women (7)
A. Relative Mobility							
Father's outcome	0.319***	0.323***	0.295***	0.365***	0.360***	0.398***	0.356***
	(0.0156)	(0.0170)	(0.0190)	(0.0251)	(0.0271)	(0.0278)	(0.0188)
Father's outcome x GD	−0.00333	0.00821	0.0325	0.0215	0.0234	0.0290	0.0736
	(0.0207)	(0.0257)	(0.0298)	(0.0401)	(0.0471)	(0.0581)	(0.0514)
Father's outcome x 1 (born from 1912 to 1914)	−0.0270**	−0.0460***	0.0259	0.00132	−0.0419	0.0338	0.100*
	(0.0132)	(0.0152)	(0.0232)	(0.0366)	(0.0261)	(0.0535)	(0.0602)
Father's outcome x 1 (born from 1915 to 1920)	−0.0437***	−0.0667***	−0.0225	−0.0281	−0.124***	−0.0712**	−0.0300
	(0.0128)	(0.0165)	(0.0260)	(0.0287)	(0.0349)	(0.0292)	(0.0301)
Father's outcome x GD x 1 (born from 1912 to 1914)	0.0328	−0.00265	−0.0753*	0.0673	0.0552	−0.157**	−0.270***
	(0.0231)	(0.0254)	(0.0406)	(0.0559)	(0.0441)	(0.0664)	(0.0695)
Father's outcome x GD x 1 (born from 1915 to 1920)	−0.00305	−0.0450	0.0141	−0.000162	−0.0169	0.00895	−0.0438
	(0.0246)	(0.0386)	(0.0472)	(0.0477)	(0.0579)	(0.0562)	(0.0594)
N	164,302	105,826	101,354	90,014	43,847	69,580	40,393
B. Absolute Upward Mobility							
1 (born from 1912 to 1914)	−1.206	−2.555	−2.413	0.305	0.462***	−0.0330	−0.0151
	(1.514)	(2.885)	(3.269)	(0.193)	(0.147)	(0.272)	(0.278)
1 (born from 1915 to 1920)	−3.783	−2.173	−6.497	0.476***	0.475***	0.421**	0.303**
	(2.578)	(3.364)	(4.642)	(0.129)	(0.148)	(0.168)	(0.129)

(*continued*)

Table 3. (*continued*)

	Occupation All Men (1)	Occupation Married Men (2)	Occupation Married Women (3)	Education All Men (4)	Education Married Men (5)	Education All Women (6)	Education Married Women (7)
GD x 1 (born from 1912 to 1914)	−0.523	−0.226	2.980	−0.447**	−0.366**	0.540*	0.653**
	(1.934)	(2.342)	(2.635)	(0.215)	(0.177)	(0.285)	(0.269)
GD x 1 (born from 1915 to 1920)	1.739*	2.746	1.955	0.0683	0.154	0.0165	0.0489
	(0.964)	(1.907)	(2.496)	(0.152)	(0.199)	(0.252)	(0.172)
N	24,119	15,701	15,954	24,674	12,382	18,812	11,322

Source: Authors' tabulation using LIFE-M data (Bailey et al. 2022) and the 1940 Decennial Census (Ruggles et al. 2021).
Note: This table reports the estimated effects of the Great Depression on intergenerational persistence (mobility is the opposite) in occupation and education. The dependent variables in columns 1 through 3 are occupational ranks in a national distribution, based on the occupational scores (Collins and Wanamaker 2022). The occupational scores are based on average earned income by occupation, race, and region and adjusted for farmers' incomes according to farm size. For married women in column 3, we use their husbands' occupational ranks as the dependent variable. The dependent variables in columns 4 through 7 are children's years of schooling, which is based on the highest grades completed in the 1940 Census. Father's outcome is father's occupational rank for columns 1 through 3 and father's years of schooling in columns 4 through 7. In panel A, we estimate the effects of the Great Depression on relative intergenerational persistence by regressing children's outcomes on interaction terms between severity of the Great Depression, father's outcome, and children's birth cohorts. The severity of the Great Depression is measured by the growth rates in retail sales per capita between 1929 and 1933 (Fishback et al. 2005). We rescale the raw growth rates and measure it by the number of standard deviations different from the national average. A positive value means a faster growth of per capita retail sales than the national average, therefore, a less severe economic downturn. Children are grouped in three cohorts: (1) born between 1900 and 1911, who were older than eighteen by 1929; (2) born between 1912 and 1914, who were about high school age by 1929; (3) born between 1915 and 1920, who were younger than high school age by 1929. We use cohorts from 1900 to 1911 as our base group. In columns 1 through 3, we control for a quartic function of children and fathers' ages when their occupations were observed. In panel B, we estimate the effects of the Great Depression on absolute upward mobility by regressing children's outcomes on the interaction between the severity of the Great Depression and the children's birth cohorts, only for children in the bottom of the distribution for fathers' outcomes. For occupational analysis in columns 1 through 3, we focus on the children with fathers ranked below the 25th percentile in the national occupational distribution. For education analysis in columns 4 through 7, we focus on the children with fathers who have six or fewer years of schooling. For all specifications, we control for county fixed effects, birth cohort group fixed effects, the dual interactions between father's outcome and severity of the Great Depression, and the dual interaction between father's outcome and children's birth cohorts. A positive coefficient on the triple interaction terms in panel A implies that a less severe economic downturn increases intergenerational persistence (or a more severe economic downturn increases mobility) for individuals in the specified cohort, relative to the base cohorts (1900 to 1911). A positive coefficient on the interaction terms in panel B implies that a less severe economic downturn increases children's outcome (or a more severe economic downturn decreases children's outcome) in the specified cohorts, relative to the base cohorts (1900 to 1911). Standard errors are clustered at the county level.
* $p < .10$; ** $p < .05$; *** $p < .01$

and culture (such as political and religious) might have led to different effects. For example, a stronger economy and community might have been able to mitigate the negative impacts of the Great Depression. Finally, we explore differences in the effects by individual-level characteristics including, race, residence type (urban or farm), immigration status, migration, and family size and composition. Black Americans were excluded from many of the benefits of the New Deal policies (Lieberman 2001; Murphy 2020); some people might have been able to move to better opportunities (Feigenbaum 2015); and larger families with young children may have experienced more financial stress than smaller families.

Figure 3 plots heterogeneous effects of the Great Depression on intergenerational mobility by a set of county and individual characteristics. We display the results by different combinations of outcomes and sex. The plotted coefficients are from the interaction terms between father's outcome, the Great Depression's severity, indicator for a specified cohort group, and the county or individual characteristic of interest. These coefficients describe how the effects of the Great Depression on intergenerational mobility differ for individuals with and without a specified characteristic. A positive coefficient means that a less severe economic downturn increases intergenerational persistence (or a more severe economic downturn increases mobility) for children with the specified attribute or living in a county with that attribute. We also report the sample size underlying the estimates for each attribute as the availability of information varies.

Although many estimates are imprecise and not statistically different from zero, a closer look highlights some interesting heterogeneity that is masked in the aggregated results. For sons age fifteen to seventeen in 1929, we find reduced occupational mobility in communities with above median Public Works spending ($p = .03$), but increased mobility for those who moved counties or states ($p = .07$). However, none of these associations remain statistically significant after using the Bonferroni method to account for seven within-domain independent tests (the multiple-test corrected p-value for significance at the 10-percent level is .014). We find that negative effects of the Great Depression on sons' educational mobility are especially pronounced among Black boys ($p = .03$) and in communities with above median retail sales ($p = .03$), Public Works spending ($p = .002$), and church membership ($p = .003$), but positive effects on mobility appear for boys in locations with more manufacturing employment ($p = .04$). Only the associations with Public Works spending and church membership remain statistically significant after using the Bonferroni method to account for multiple tests.

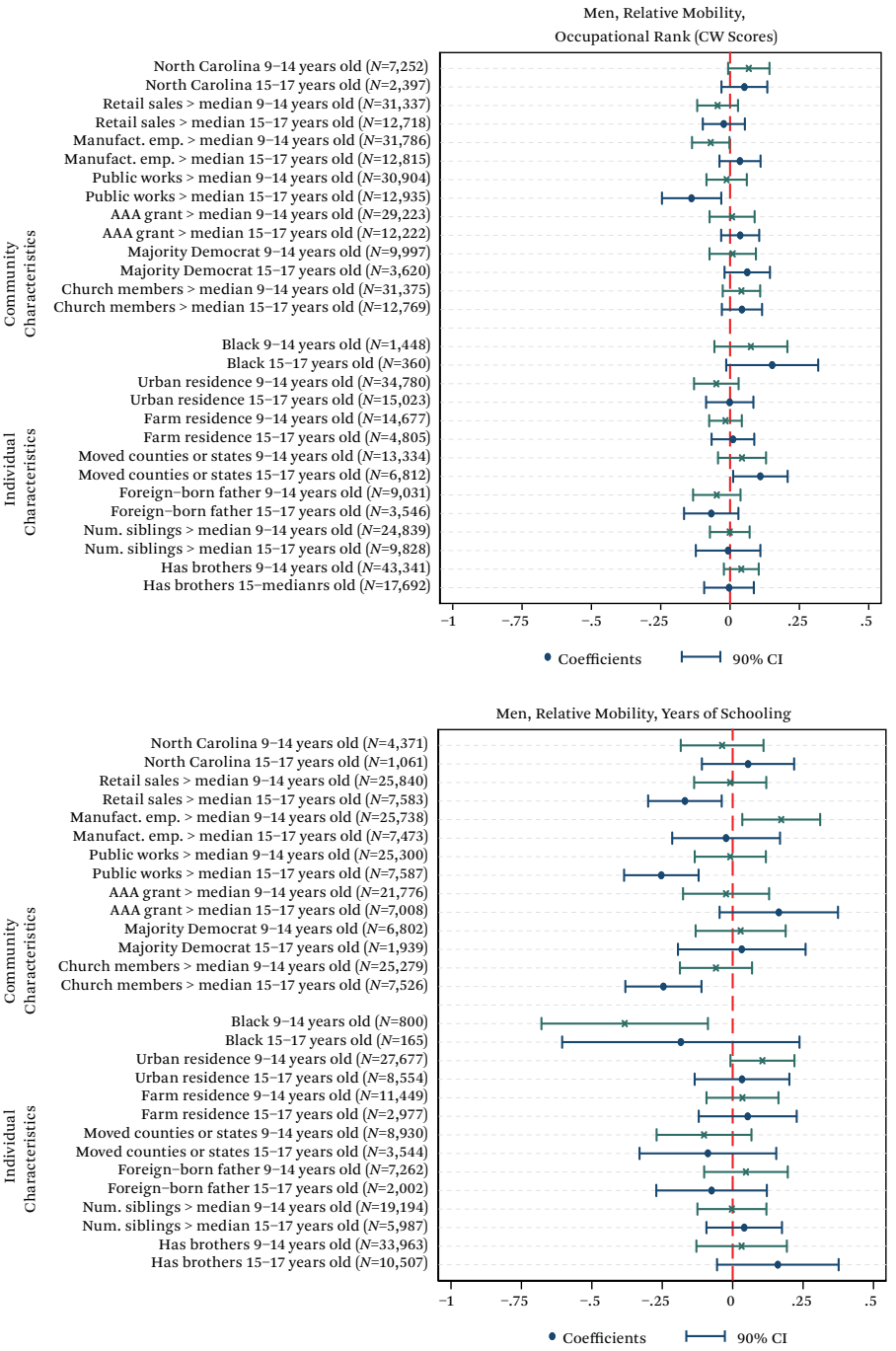
Similarly, we find that negative effects of the Great Depression on daughters' educational mobility are especially pronounced among Black girls ($p = .07$) and for girls in families with more siblings ($p = .013$). The latter finding remains statistically significant after correcting p-values for multiple tests and could reflect family constraints, favoring daughters dropping out of school to find work or help care for their siblings (while their parents worked) in counties that were more severely affected by the Great Depression. We also find that, among daughters age fifteen to seventeen in 1929, the negative impacts are driven by daughters in North Carolina, as opposed to Ohio.

DISCUSSION AND CONCLUSION

Our novel, large-scale historical LIFE-M dataset produces estimates of intergenerational occupational mobility that track with other studies of the period for sons. LIFE-M also facilitates the exploration of occupational and educational mobility of daughters and suggests their intergenerational mobility was similar to that of sons in this period. Large samples allow detailed investigation into the role of the severity of the Great Depression in shaping intergenerational mobility across various characteristics.

Despite the magnitude and variation in the Depression's severity, we find little evidence that it negatively affected the relative intergenerational mobility of sons. In fact, sons with less-educated fathers achieved more absolute upward mobility in educational attainment. Perhaps sons from deprived households during the Great Depression learned how to work hard and hustle (Elder 1999; Furstenberg 1975) or

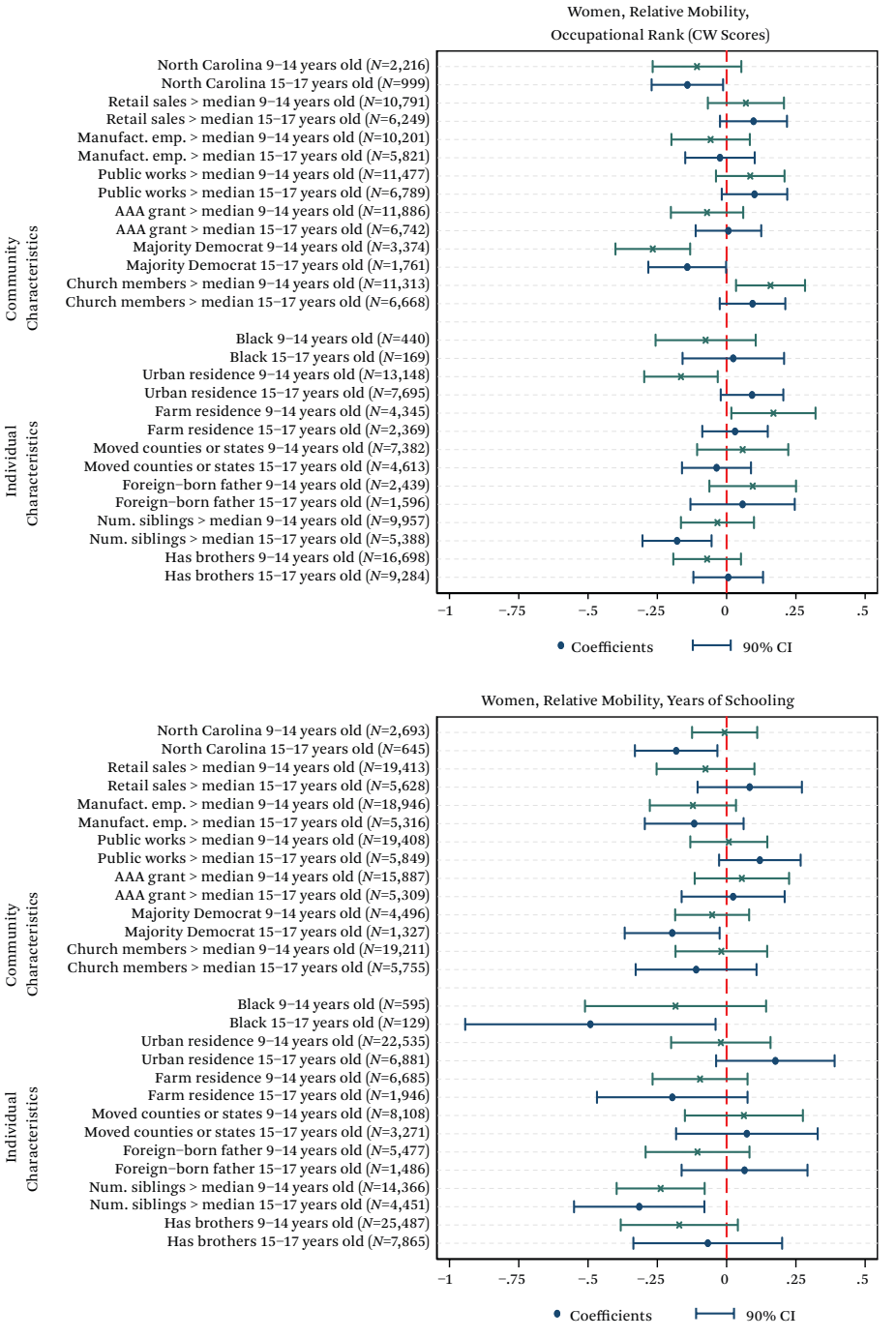
Figure 3. Heterogeneous Effects of Great Depression on Intergenerational Mobility, by Individual and County Characteristics



Source: Authors' tabulation using the LIFE-M data (Bailey et al. 2022).

Notes: This figure plots heterogeneous effects by various community and individual-level attributes. A positive coefficient in this figure indicates that a more severe economic downturn increases mobility for individuals with the specified attributes or living in a community with that attribute, compared to the individual without that attribute. Results are similar if we use continuous measures for applicable attributes. The median values of retail sales, manufacturing employment, public works funding, etc.,

Figure 3. (*continued*)



are listed in table A.3. We also report the number of people satisfying the specified attribute in parentheses. For example, in the occupational analysis, there are 7,252 men in North Carolina ages nine to fourteen by 1929. The confidence intervals have not been adjusted for multiple hypothesis testing. See text for discussion of *p*-values applying the Bonferroni correction (Dunn 1961). To see similar plots by state, see figure A.3.

benefited from government policies and work programs, like the Civilian Conservation Corps and Works Progress Administration (Fishback 2017). Consistent with this story, we find evidence that, among sons born to fathers with less than six years of education, educational attainment increased more in counties with a more severe Great Depression. Perhaps sons from disadvantaged families in less severely hit counties saw forgoing education and participating in the labor market as an agreeable trade-off. Interestingly, not detecting any improvement in sons' intergenerational occupational mobility suggests that the jobs the sons took forgoing education did not improve their occupational standing.

Alternatively, daughters' intergenerational educational mobility was negatively affected, and more so for those high school age and those living in North Carolina. Our heterogeneity analysis on siblings indicates that the Depression's severity had larger negative effects on girls' mobility for large families. This is consistent with the hypothesis that daughters of the Great Depression were more likely to forgo their education to stay home and take on domestic roles (Elder 1999; Furstenberg 1975). Another hypothesis is that daughters lost more due to Depression-era school closings through two channels: reduced own educational attainment could also affect daughters' own occupations (such as clerical work) as well as their marriage prospects. For example, related research shows that Black women gained more than Black men from newly constructed Rosenwald schools in terms of educational attainment and subsequently their labor-force participation and occupational standing (Mohammed and Mohnen 2023). Our analyses also show that teen daughters' intergenerational occupational mobility, as measured by their husband's occupation, also declined in more severely hit counties, perhaps due to worse marital matches.

In addition to county-level variation in the severity of the Depression, the recovery from the Depression also differed. More New Deal spending contributed to higher per capita income growth (Garrett and Wheelock 2006), but spending varied across states and counties, making recovery efforts unequal across space (Fishback, Kantor, and Wallis, 2003). Recovery efforts also varied by program and across people. For example, increased spending in public works and relief programs aided in recovery, whereas increased spending on Agricultural Adjustment Act (AAA) grants had a negative impact (Fishback, Horrace, and Kantor 2005). These differences may arise because of whom these programs benefited. Public works and relief programs targeted the unemployed, whereas AAA grants targeted landowners. However, we also find little evidence that public works spending and AAA grants mitigated the negative impacts of the Great Depression on intergenerational mobility. Occupational and educational mobility for daughters appears unaffected by these recovery efforts, and occupational and educational mobility for sons age fifteen to seventeen in 1929 was negatively affected by the public works spending.[17]

Finally, Black Americans were more negatively affected by a more severe Depression. One explanation is that Black Americans were more economically disadvantaged than White Americans and faced substantial institutional discrimination in the early twentieth century. In addition, Black Americans lacked access to many of the New Deal programs.

Understanding how much each of these explanations mitigated or exacerbated the hardships of the Depression is a promising area of future research to help shed light on how contemporary disruptive events and economic crises and mitigation efforts affect the arc of children's lives.

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17. Anna Baranowska-Rataj, Björn Högberg, and Jonas Voßemer (2023, this issue) find that Sweden's robust safety net effectively mitigates negative birth outcomes from job loss. We find, however, that perhaps this unemployment support did not provide promising pathways toward mobility.

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Do Consequences of Parental Job Displacement for Infant Health Vary Across Local Economic Contexts?

ANNA BARANOWSKA-RATAJ, BJÖRN HÖGBERG, AND JONAS VOßEMER

This study examines the consequences of parental job displacement for birth outcomes and investigates how the effects vary with regional unemployment rates. We use Swedish register data and exploit plausibly exogenous variation caused by workplace closure to reduce the bias related to reverse causality and confounding. The differences in birth outcomes between children of parents who experienced job displacement and children of parents who were not displaced turn out to be quite modest. Even in the most disadvantaged regions, with the highest unemployment rates, parental job displacement is not harmful for health at birth. We relate these findings to the institutional setting in Sweden and discuss policy implications for the United States.

Keywords: job displacement, birth outcomes, crossover effects, register-based research

Job displacement has detrimental consequences for health not only within but also across generations. Although much of the literature on the "long arm" of children's health at birth discusses its role in the intergenerational transmission of socioeconomic disadvantage (Almond, Currie, and Duque 2018; Currie 2011), few studies have investigated how parental job displacement affects outcomes such as birth weight, low birth weight, preterm birth, or being small for gestational age. Moreover, knowledge is scant on how these effects vary across contexts, such as regions or countries. This article fills this gap in the literature by examining the effects of parental job displacement due to workplace closure on a range of birth outcomes in Sweden and investigates how these effects vary across regions. It also

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discusses the results from the Swedish context, which is characterized by a generous and universal welfare state, in the light of findings from previous research that focused on the United States, a country in which the unemployed and families with children receive much less support than in Sweden overall and where geographic variation in socioeconomic opportunities reinforces health inequalities (Chetty et al. 2014; Galster and Sharkey 2017).

Associations between the parental labor-market situation and birth outcomes of children have long been studied based on cross-sectional designs and small samples, but few studies have followed parents over time. Thus, overall, the literature is too restricted to draw causal conclusions (Catalano et al. 2011). To the best of our knowledge, only a few studies have used longitudinal data and adopted methods for causal inference: three focusing on unemployment and two on job loss. The findings presented by Helen Scharber (2014) suggest reduced average birthweights and increased risk of low birth weight among children whose mothers were unemployed at birth, though no such effects were found by Björn Högberg, Anna Baranowska-Rataj, and Jonas Voßemer (2023). David Dooley and Joann Prause (2005) show that maternal transitions from employment to unemployment reduced birth weight, while the effects on the risk of low birth weight were not statistically significant. Jason Lindo (2011) finds that fathers' job loss reduced children's weight at birth but did not significantly increase the risk of low birth weight. Although most previous studies examined the United States, Samantha Gailey and her colleagues (2021) focus on Denmark and find that a father's unexpected job loss during pregnancy increased the risk of low birth weight, but not preterm birth among male infants. A separate but related line of inquiry focused on health outcomes observed among adolescents. These studies indicate that in the U.S. context parental job losses lead to worsened physical and mental health of adolescents (Brand and Simon-Thomas 2014; Kalil and Ziol-Guest 2005; Schaller and Zerpa 2019). However, it is important to consider infant health because this early life outcome is a predictor of health in adolescence and later in life and thus a potential mechanism behind the effects identified in previous research. Altogether, these mixed findings call for more in-depth investigations, using samples that are large enough to study relatively rare adverse birth outcomes, and that allow researchers to go beyond assessments of how parental job displacement affects children "on average." Further, more research on infant health—one of the key predictors of life chances (Ruiz-Valenzuela 2021)—is needed from contexts outside the United States to be able to understand whether the effects substantially differ between it and countries that have more generous and universal welfare states.

The consequences of parental job displacement may vary substantially not only across countries with different institutional settings, but also across regions with diverging unemployment rates. On the one hand, stronger competition for scarce jobs may cause elevated stress among parents-to-be and lead to stronger negative effects of job displacements. On the other, according to the social norm of unemployment literature, when job losses are common, social stigma is reduced and the experience of becoming unemployed is less distressful. Despite these contradictory theoretical arguments, we are not aware of any studies that solve this puzzle and examine whether regional unemployment rates alter the consequences of parental job displacement for infant health. Previous research on regional heterogeneity in the effects of job loss or unemployment has focused on the health outcomes of adults (Buffel, Missinne, and Bracke 2017; Clark, Knabe, and Rätzel 2010; Oesch and Lipps 2013; Stutzer and Lalive 2004). This study fills this gap by comparing how parental job displacements affect infant health in privileged and in economically disadvantaged regions.

Our study makes several contributions to the literature. First, whereas the literature on the health effects of job loss and unemployment has primarily focused on the individuals who are directly affected (Brand 2015), this study provides evidence of how the consequences of job loss may cross over between family members across generations. This topic is important for broader debates on the inter-

generational transmission of disadvantage in the United States, a country that historically used to stand out with high intergenerational mobility rates (Bailey et al. 2024), but in which the life chances of new generations today strongly depend on the socioeconomic success of their families of origin (Bratberg et al. 2017).

Second, thanks to the employer-employee links in Swedish registers, our data provide the opportunity to focus on parents who experienced job displacement due to workplace closure. This approach handles potential bias due to issues of reverse causality and confounding. Associations between job loss and infant health may capture both the genuine effects of losing a job on birth outcomes and any effects of health-related problems of children or mothers that may emerge even before or during a pregnancy, which also affect the labor market opportunities of parents. However, when an entire workplace closes it is unlikely that job loss will have occurred due to health-related issues in an employee's family.

Third, our large sample based on register data provides an opportunity to scrutinize regional effect heterogeneity for even rare events such as adverse birth outcomes. This is crucial because the previous literature highlights several distinct theoretical mechanisms on how geographical context might alter the effects of unemployment on health, and aggregate estimated effects might miss dissimilar or opposite effects across contexts (Aquino, Brand, and Torche 2022; Torche, Fletcher, and Brand 2022). Using register data with detailed information about the place of residence of parents, we have the opportunity to distinguish between specific theory-driven mechanisms that result in the moderating impact of regional unemployment rates at the level of the so-called functional regions. The concept of functional regions corresponds to commuting zones in the United States and concerns spatial entities that do not generally follow the administrative division of regions, but instead reflect the behavior of workers toward their places of residence and the location of their employment.

Fourth, previous research mostly sheds light on the consequences of parental unemployment and job loss in the United States (Dooley and Prause 2005; Lindo 2011; Scharber 2014). Little is known, however, about the effects of job displacement in countries whose social policies improve social and living conditions in a more comprehensive way than in the United States. Providing research evidence from outside the United States is crucial for improving the design of its policies. Learning from the experiences of other well-developed countries can offer insights into heterogeneous effects across geographic contexts and is far less expensive than hypothetical large-scale intervention studies within the United States. As this article describes and quantitatively shows, job displacement in Sweden has very different implications for families than it does in the United States. Due to a relatively well-developed social safety net, Swedish workers' incomes are protected during a period of unemployment, and policies that enhance opportunities for reemployment reduce loss of earnings (Bertheau et al. 2022). Because health insurance is universal, opportunities for parents to benefit from health care during or after pregnancy are not tied to employment. These aspects of the institutional setting in Sweden stand in stark contrast to those in the United States, where the social safety net is much less generous and the health and well-being of children therefore depend on parental economic resources. Thus Sweden is an interesting case to study because it provides insights into how families are affected by job loss in a universal and comparatively generous welfare state, which may also reduce the differences across regions. Hence, the insights from our study contribute to the debates on social policies that could address the problem of social inequalities within and across regions in the United States.

THEORY AND HYPOTHESES

The Effects of Parental Job Loss on Birth Outcomes

Parental job loss may expose a family to the risk of unemployment and may therefore have lasting effects on family income, resulting in restrictions on accessing tangible and intangible goods such as nutritious foods, favorable housing conditions, and safe neighborhoods with green areas (Brand 2015). When these negative events occur around the time of pregnancy, the

impact of parental job loss on children's health operate mainly through parents' reactions to job loss rather than children's own reaction to parents losing jobs. Job loss carries social stigma, lowers self-esteem, and triggers stress and anxiety, particularly if it results in an extended period of unemployment (Jahoda 1981; Pearlin et al. 1981). By putting parents under severe strain, a job loss may affect a pregnancy, resulting in a poorer birth outcome. In addition, unemployment-related stress might trigger unhealthy behaviors such as smoking and alcohol consumption, also during pregnancy (De Cao, McCormick, and Nicodemo 2022; Everding and Marcus 2020; Nizalova and Norton 2021). Such unhealthy behaviors are forms of relaxation that regulate mood (Pampel, Krueger, and Denney 2010) and may be more easily accessible for disadvantaged social groups compared to other forms of coping such as physical exercise. The resulting exposure to toxic substances can, in turn, inhibit fetal growth and reduce gestational length. Following these insights, we propose the following hypothesis:

> H1: Maternal and paternal job displacement due to workplace closure have a negative effect on birth outcomes.

The consequences of parental job losses for children have long been of interest for social science research, not least since the Glen Elder's classic study on the consequences of parental economic struggles for family-level processes and child development (Elder 2018). However, the focus of this literature has so far been on outcomes such as skills, school grades, and educational achievements (Kalil and Ziol-Guest 2008; Peter 2016; Rege, Telle, and Votruba 2011; Stevens and Schaller 2011). Literature reviews highlight that health outcomes of children remain understudied (Ruiz-Valenzuela 2021; Brand 2015). Infant health is particularly relevant in this regard because human capital-related outcomes observed early in life may be antecedents of poorer outcomes observed later in childhood. This underscores the importance of examining how parental job losses affect infant health, which constitutes a potential driver of the effects identified in previous research.

Effect Heterogeneity by Regional Unemployment Rates

Previous research offers competing hypotheses regarding the magnitude of the effects of job loss across regional contexts with varying levels of economic disadvantage (Aquino, Brand, and Torche 2022; Torche, Fletcher, and Brand 2022). In the following, we outline two mechanisms related to the moderating role of unemployment rates, namely, the expected chances of parental reemployment and the social norm of unemployment. These mechanisms are theoretically expected to operate at the level of functional regions.

Unemployment rates may affect the magnitude of the effects of parental job loss due to the reduced chances of parental reemployment, which entails extended periods of unemployment. Higher regional unemployment rates mean stronger competition for scarce new jobs. Facing competition with many unemployed peers for few new jobs, parents may anticipate more difficulties with reemployment and longer periods of unemployment. This may contribute to higher levels of stress and anxiety (Ananat, Gassman-Pines, and Gibson-Davis 2008) and ultimately result in poorer birth outcomes. These arguments call for considering unemployment rates at the geographical scale of job search of the unemployed, that is, in functional regions. After a job loss, an unemployed person typically searches for a new job not only in their area of residence, but also in neighboring locations within commuting distance. These arguments lead to a hypothesis:

> H2: The negative effects of job displacement due to workplace closure on birth outcomes are larger in functional regions with high levels of aggregate unemployment.

Although the mechanisms pertaining to low opportunities for reemployment in functional regions suggest that higher unemployment rates aggravate the effects of parental job loss, a contradictory prediction can be derived from the literature on the social norm of unemployment (Clark 2003; Clark, Knabe, and Rätzel 2010). The experience of a job loss may be less stressful when it is shared with others in an in-

dividual's immediate community. Previous research has long recognized that people construct or interpret their economic situation and social status by comparing themselves with "relevant others" (Festinger 1954), and social comparison theory has been very influential for research on the social determinants of health (Buunk and Gibbons 2007). Although job loss might be strongly stigmatizing in contexts of nearly full employment, social attitudes toward the unemployed might be less negative in regions in which a lack of work is more common. In addition, long-lasting harsh living conditions and multiple burdens in disadvantaged regions may lead to adaptation and to the development of protective strategies (Brand 2015; Torche, Fletcher, and Brand 2022). As a result, families in such regions may be less heavily affected by parental job loss. These theoretical ideas motivate the following hypothesis:

> H3: The negative effects of job displacement due to workplace closure on birth outcomes are larger in functional regions with low levels of aggregate unemployment.

INSTITUTIONAL BACKGROUND

To contextualize this study, we describe some key aspects of the institutional background in Sweden relative to the United States. This aids the interpretation of our main findings and opens a debate on how countries with different institutional configurations may learn from each other in order to improve social and living conditions. As Thomas DiPrete and Patricia McManus (2000, 364) argue, the total consequences of a job loss on income are a function of the direct effect of lost earnings and the compensating effect of public support. Studies show that both of these effects are weaker in Sweden than in the United States, with potential benefits for the health of infants among parents who experience job loss. This is likely not only because Sweden and the United States differ in terms of general levels of social spending on health, welfare, and insurance against adverse outcomes. Indeed, comparative analyses also show that Sweden's social welfare expenditures were 28 percent relative to GDP, 12.2 percentage points higher than U.S. public spending (Fishback 2022). Even more important, however, the two countries are on opposite ends of the spectrum of governmental provision of the support and services for their populations. As a result, although Swedish social policies tend to be universal, the U.S. safety net is more porous, creating more uncertainly among vulnerable population subgroups.

In Sweden, the replacement rates of unemployment benefits are higher, and qualification criteria are less strict than in the United States. The average replacement rates of unemployment benefits over the years covered by our study amounted to 73 percent in Sweden versus 59 percent in the United States, and the duration of entitlement to unemployment benefits excluding times of means-tested assistance amounted to sixty weeks in Sweden and forty weeks in the United States (Scruggs, Jahn, and Kuitto 2017). Accordingly, the risk of poverty following unemployment is twice as high in the United States as in Sweden. As David Brady, Ryan Finnigan, and Savine Hübgen (2017) show, the risk of falling into poverty following unemployment in the United States is one of the highest in the Organization for Economic Cooperation and Development (OECD), more than 42 percentage points, whereas in Sweden it is 20 percentage points; this difference can be partly explained by discrepancies in welfare generosity as well as by coverage of unemployment insurance programs across these two countries.

Although the generosity of unemployment benefits and related forms of financial support in Sweden protect displaced workers and their families from negative financial consequences of job loss or unemployment in the short term, in the long term, policy measures that increase the chances of reemployment and shorten the duration of unemployment are also relevant. Reemployment rates after job displacement are approximately 20 percentage points higher in Sweden than in the United States, and short- and long-term earnings losses are less than half as large (OECD 2019). As Antoine Bertheau and his colleagues (2022) show, thanks to prompt reemployment, only a limited number of Swedish workers who become displaced from their jobs experience long-term earning losses and their earnings are only around 10 percent lower than those ob-

served pre-displacement. By comparison, in the United States, two years after a worker's displacement, earnings decline on average by 21 percent (Lachowska, Mas, and Woodbury 2020; Quintini and Venn 2013). As explained, the duration of unemployment and the earning losses may have consequences not just for parents, but also for the health of their children.

Other institutional differences between Sweden and the United States that are relevant concern the organization of health-care services. Public health-care services in Sweden are universal and comprehensive, resulting in low levels of socioeconomic inequality in the use of health care. Thus, even though the United States ranks second highest among OECD countries when it comes to out-of-pocket per-capita spending on health care (OECD 2019), these direct household expenditures are much lower in Sweden. Estimates of financial hardship associated with out-of-pocket health-care payments, the so-called incidence of catastrophic spending on health, show that in the United States this incidence amounts to 7.4 percent, in Sweden it amounts to 1.8 percent, putting Sweden at the bottom of this ranking. Sweden also has a comprehensive institutional system that offers a range of services for parents, including parental education, family counseling, and maternity centers, and these services are not conditional on employment or earnings.

Overall, the greater generosity, universalism, and public subsidization of services in Sweden than in the United States means that Swedish families depend less on employment for access to essential goods and services. In the United States, both monetary benefits and nonmonetary services are often tied to employment through (subsidized) corporate fringe benefits, whereas in Sweden they are largely tax financed and provided to all citizens as a social right. This means that job loss has broader implications for the health and well-being of American families. Moreover, the monetary value of subsidized services is far greater for low-income (such as jobless) families, and these services are more generous in Sweden. All of this suggests that the key proximate determinants of infant health—such as income and access to health and prenatal care—are less affected by job loss in Sweden than in the United States.

Against this background, it could be assumed that the effects of job displacement in Sweden for individual health may be generally limited. However, previous research suggests otherwise. Involuntary job loss increases the risk of hospitalization due to alcohol-related conditions, traffic accidents and self-harm, as well as shortened life expectancy (Eliason 2014; Eliason and Storrie 2009a, 2009b, 2010). However, an important and still unanswered question remains as to whether the consequences of job loss cross over to the next generation.

DATA AND METHODS

We use Swedish longitudinal register data available at Umeå SIMSAM Lab (Lindgren et al. 2016). These data combine information from the Medical Birth register, which contains health-related information on births in Sweden, the Longitudinal Integrated Database for Health Insurance and Labor Market Studies (LISA), comprising annual educational and labor-market data, and the Business and Workplace register (FAD), including information on workplaces. Unique personal identifiers allow us to link the data from the different registers and the records of children and parents.

For our study, these data have several advantages. First, in contrast to self-reported birth weights used in previous studies (Dooley and Prause 2005; Lindo 2011), the Medical Birth register provides high-quality data on birth outcomes that are reported by professional obstetricians and midwives (Källén and Källén 2003). Second, LISA data allow us to link workers to workplaces, enabling us to objectively define job displacement due to workplace closure based on vanishing workplace identifiers and worker flows (Fackler, Müller, and Stegmaier 2018), which represents an improvement over previous studies that used self-reported indicators of job loss (Lindo 2011) or examined transitions from employment to unemployment (Dooley and Prause 2005). Third, our data include geographic coordinates, which allows us to consider unemployment rates at the level of functional regions. We construct functional regions connecting families' regions of residence and employment to reflect opportunities to

commute and link them to official data on unemployment rates (Karlsson and Olsson 2006). This is an important advantage given that administrative boundaries do not necessarily overlap with geographic boundaries of commuting to work. Moreover, unlike in surveys, bias due to sample attrition, losing a follow-up for individuals who changed the place of residence or nonresponse, is not a problem in our data.

We selected an analytic sample of children born between 1997 and 2017, the maximum observation period for which data are available for all the covariates. The focus on workers with children implies that our sample is conditional on (future) parents only. This means that we cannot consider the health of infants who were not born for reasons related to parental job displacement. This issue is addressed by choosing an appropriate time window of the analyses and further discussed in the final section. If job displacement causes postponement of childbearing, and these postponement effects are stronger among parents whose children's health would be potentially more strongly affected by a job displacement, our results understate the genuine negative impact of job displacement on birth outcomes. For children to be included, at least one parent must be in paid employment during the year before birth. This ensures that the parent is at risk of job displacement and that workplace closure does not reflect the closure of the parent's business. We separately analyze the effects of job displacement of mothers and fathers. The sample of children with complete data is 1,520,473 births for maternal job displacement and 1,491,592 births for paternal job displacement. It is somewhat larger for the former because it includes single mothers who are not married, partnered, or cohabiting or cases where no information is available on the father. In other words, we estimate the effects of both maternal and paternal job loss in couples, but only the effect of maternal job loss if the mother is single. Overall, we observe 13,595 and 17,305 job displacements of mothers and fathers, respectively. For more detail, see table A.1 and the online supplement: S1 provides detail on the construction of the sample; S2 compares birth outcomes in different components of our analytical sample.[1]

Birth Outcomes

The Medical Birth register contains a set of relevant indicators of health at birth. In addition to birth weight (in grams), we define indicators of low birth weight (< 2,500 grams), preterm birth (< thirty-seven weeks) and being small for gestational age (SGA), a proxy measure of fetal growth restriction, as our outcomes. The latter refers to a birth weight that deviates more than 2 standard deviations from what would be expected given gestational length. The outcomes we study in this article are interrelated. Thus, studying multiple outcomes within one study provides a more comprehensive picture. However, to some extent these outcomes also have differential etiologies (Torche 2011). Adverse life course events such as a job displacement experienced by a parent are related to maternal stress, which may initiate a chain of events leading to premature birth (Hobel 2004). For instance, maternal stress leads to the production of hormones such as cortisol. These hormones are produced in both the mother and in the fetus, and they are related to premature birth (Goldenberg et al. 2008). Overall, this means that job displacement is directly related to the risk of a preterm birth. They may also lead to a chain of behavioral and biological changes such as foregoing prenatal health care and adopting less healthy behaviors, which inhibit fetal growth. Fetal growth, in turn, affects gestational age, and prematurity can result in low birth weight. Thus, job displacement can be indirectly related to low birth weight. However, some stressors also reduce birth weight independently of gestational age by reducing maternal and fetal weight gain during pregnancy. Thus, low birth weight may be a function of prematurity, growth restriction, or both, but the proximate biological pathways behind prematurity and growth restriction also partly differ. Research highlights the role of immunological processes for prematurity, and the role of placental blood flow and fetal nutrition for growth restriction (Torche and Rauf 2021).

1. For the online supplement, see https://www.rsfjournal.org/content/10/1/57/tab-supplemental.

Maternal and Paternal Job Displacement Due to Workplace Closure

Our key treatment is parental job displacement due to workplace closure. Research shows differential mechanisms driving the effects of maternal and paternal job losses, and although a majority of studies suggest that fathers' job losses are more detrimental (Ruiz-Valenzuela 2021), some studies suggest the opposite (Carneiro et al. 2022). To make sure that our estimates do not mask underlying differences across parental gender, we estimate separate models corresponding to maternal and paternal job losses. A focus on job displacement due to workplace closure reduces issues of reverse causality and confounding. Children's health at birth does not lead to workplace closure. Regarding confounding, parental characteristics that affect birth outcomes (such as a parent's chronic illness) are unlikely to affect the risk of experiencing workplace closure (Brand 2015). In accordance with established definitions (Fackler, Müller, and Stegmaier 2018), we consider a workplace with four or more workers to be closed in one year if its identifier disappears by the next year and the maximum clustered outflow (MCO) of workers across years is less than 30 percent of the original workforce. Clustered outflows refer to groups of workers who move from one workplace to another over two consecutive years, and the MCO is the largest outflow. This condition ensures that workers in a workplace that disappears do not move together to a new workplace in large numbers, which would indicate, for example, a merger rather than a closure. An MCO is not meaningful for workplaces with fewer than four workers, but because most workplaces that disappear belong to this category, we follow Daniel Fackler, Steffen Müller, and Jens Stegmaier (2018) for our main analysis and consider these workplaces closed if all workers move to new workplaces or if the new workplace has more workers than the closed one. In the sensitivity analyses, we examine whether our results differ if we exclude workplaces with fewer than four workers to account for the fact that the assumption that job displacement is beyond the control of the individual worker may be less plausible for small workplaces. In addition, workplace identifiers that disappeared from one year to the next may reappear in later years in our data (see table S3 online). Although we are confident that our definition, which combines a disappearing workplace identifier with worker flow criteria, identifies workplace closures, in our sensitivity analyses, we combine it with that of Marie Gartell, Ann-Christin Jans, and Helena Persson (2010) and consider workplaces closed only if, in addition to our previous criteria, their identifier remains absent for two additional consecutive years. Based on these definitions, our key treatments—maternal or paternal job displacement in the year before birth (t-1)—equal one if the respective parent was employed at a closing workplace and zero if they were not. This means that the control group includes children of workers who separate from their job for other reasons and is not restricted to children of workers who remain continuously employed. Thus we avoid bias due to conditioning on future outcomes (Krolikowski 2018). We have annual data on workplace identifiers and identify workplace closure as a workplace identifier disappearing from one year to the next, that is, between year t-1 and t-0, with t-0 being the year of birth. This means that it is possible that a job displacement occurred, or a worker was notified of the coming displacement, before conception. Nevertheless, the window to postpone childbearing is not large, and therefore the selection bias should not be substantial.

Regional Unemployment Rates

Our data include identifiers for between sixty and seventy-two functional regions, which correspond to U.S. commuting zones. The choice of this unit of aggregation is motivated theoretically by arguments on the spatial nature of job search (Bilal 2021; Eriksson, Hane-Weijman, and Henning 2018; Kuhn, Manovskii, and Qiu 2021) as well as by empirical research showing that the effects of aggregate economic conditions for health outcomes tend to be more substantial at the more aggregate level (Lindo 2015). The identifiers of functional regions are linked to data from the Swedish Public Employment Agency, which refer to the total number of individuals in each functional region and year that they are registered as unemployed and seeking work at the Swedish Public Em-

ployment Agency (van den Berg, Paul, and Reinhold 2020). Based on these data, we calculated proportions of the unemployed in the total population in the functional region.

Most studies on the moderating role of regional unemployment use it as a continuous variable and assumed linear interaction effects and common support (Hainmueller, Mummolo, and Xu 2019). Instead, we use a more flexible approach and categorize regional unemployment rates measured in year (t-1) into quintiles. Regional unemployment rates range from 0.58 and 12.87 percent for municipalities to 1.28 and 12.87 percent for functional regions (for the ranges of the quintiles, see table S4 online). This enables us to conduct separate analyses for five subgroups to show how parental job displacement affects children's birth outcomes depending on regional unemployment rates. Given the absence of theoretical arguments for a specific categorization, we base our subgroups on the empirical distribution of regional unemployment rates. We use quintiles because they balance the need for a sufficiently refined distinction of regional unemployment and allow for enough treated and control observations within each subgroup, enabling us to precisely estimate the conditional average treatment effects on the treated (CATT). In sensitivity analysis elsewhere, we test coarser (terciles) or more refined (septiles) categorizations (see tables S5 and S6 online).

Theoretical and Empirical Estimands of Causal Effects

Our goal is to estimate the causal effects of parental job displacement due to workplace closure on birth outcomes of children. Using the notation for potential outcomes (Rubin 1974), our theoretical estimand (Lundberg et al. 2021) for hypothesis H1 can be more precisely defined by averaging (1) the unit-specific causal effect $\delta_i = Y_i(1) - Y_i(0)$, that is, the difference in child i's birth outcome Y_i in year t if its mother or father had been displaced ($D_i = 1$) instead of not displaced ($D_i = 0$) in the year before the child's birth (t-1), over (2) the target population of interest. The latter includes all children born in Sweden from 1997 to 2017 who had a mother or father who experienced job displacement due to workplace closure. This corresponds to the average treatment effect on the treated (ATT) $\tau_1 = E(Y_i(1) - Y_i(0)|D_i = 1)$. A simple way to estimate the ATT of parental job displacement would be to calculate the difference in means of the observed birth outcomes of children born to displaced and nondisplaced parents. However, these estimates would only be unbiased if the potential outcomes $Y_i(0)$ were unconditionally independent of job displacement D_i. Although this assumption is more plausible when focusing on job displacement due to workplace closure rather than to job loss in general (Lindo 2011), or relative to transitions from employment to unemployment (Dooley and Prause 2005), child, parental, and workplace characteristics remain that may causally affect the risk of experiencing workplace closure as well as potential birth outcomes (Brand 2015), thereby violating the assumption.

To address this issue of confounding, we use entropy balancing combined with linear regression adjustment on the balanced sample as our estimation strategy (Hainmueller 2012), relying on the conditional independence assumption (CIA), that is, $Y_i(0)$ being independent of D_i after conditioning on covariates X_i. Similar to other reweighting methods, such as propensity score matching (PSM), entropy balancing reweights the control group observations to balance the treatment and control group on covariates. Unlike PSM, however, it does not require the repeated cycle of (re)specifying and (re)estimating the propensity score (model), selecting a matching algorithm, and checking for balance (Hainmueller 2012, 25), as it computes balancing weights to meet prespecified targets. In our main analysis, we require a balancing tolerance of 0.01 for all covariates in terms of mean, variance, and skewness. Moreover, entropy balancing does not result in a redefinition of the parameter of interest because no method for defining and restricting common support has been established. We perform entropy balancing separately for the job displacement of mothers and fathers and match the children of displaced and nondisplaced parents exactly by birth year to account for confounding due to the time period affecting the risk of job displacement and birth outcomes. After entropy balancing, we estimate linear regression models with covariates X_i on the bal-

anced sample with standard errors clustered at the level of mothers to account for any dependencies between siblings. This does not change the estimate of the ATT because the covariates are mean independent of the treatment, but it may further reduce the standard errors. Entropy balancing is implemented using the -kmatch- ado in Stata 17.1 (Jann 2017).

A crucial step in estimating causal effects using a conditioning estimator is to select the covariates needed to satisfy the CIA (Morgan and Winship 2015). Drawing on insights from causal graphs, our adjustment set included child, parental, and workplace characteristics measured in (t-2) that we assume to be confounders, that is, to affect the risk of job displacement and birth outcomes (Elwert and Winship 2014). We also took care to avoid possible bad controls such as infant sex, which may be a mediator that is influenced by maternal stress due to parental job displacement and may itself affect birth outcomes (Catalano and Bruckner 2005). All variables including those covariates considered confounders are presented in table S9 in the online supplement. Possible confounders include child characteristics such as birth order, which may influence parental risk of job displacement as well as birth outcomes; parental characteristics, taking into account, for example, parents' educational and labor market biographies or family structure; and workplace characteristics such as age, which affect the risk of workplace closure and also performance (Coad 2018) and may therefore indirectly affect birth outcomes through parents' stress levels. A more detailed rationale for the adjustment set and each covariate is provided in appendix 3 in the online supplement. Any causal interpretation of our results is based on the assumption that after adjustment for these covariates, the CIA is satisfied or, equivalently, that no further confounding is measured. Most continuous covariates were included as such, but because functional form specifications are difficult to justify theoretically, in the sensitivity analyses we also tested a more flexible categorical specification (see tables S7 and S8 online).

To test hypotheses 2 and 3, we rely on the same steps as outlined, but focus on the conditional average treatment effects on the treated (CATT) $\tau_2 = E(Y_i(1) - Y_i(0)|D_i = 1, U_i = u_i)$ where U_i indicates the quintile of the regional unemployment rate in year (t-1). Entropy balancing and regression adjustment are performed as previously, but now separately for each quintile of the regional unemployment rate. We focus on how effects differ between subgroups of children defined by regional unemployment rates rather than on the treatment effect of a joint intervention on D_i and U_i, implying that any effect heterogeneity we estimate may be either due to a joint effect of job displacement and regional unemployment or to noncausal reasons for effect heterogeneity. For example, if children whose parents were displaced in regions with a high level of unemployment have worse birth outcomes than children in regions with a low level, the discrepancy may be due to a causal effect of the regional unemployment rates or other characteristics that cause a high level of regional unemployment and affect birth outcomes.

RESULTS

We start with a description of the sample used for the analyses in order to have an overview of the socioeconomic profile of children with parents who experienced job displacement (the treatment group) and the way they differ from children whose parents did not experience job displacement (the control group) in table 1. Regarding birth outcomes, the differences between the treatment and control group were rather modest. For instance, the incidence of low birth weight was 4.1 percent among children whose mothers experienced job displacement and 3.9 percent in the control group. The proportions corresponding to paternal job displacement were 4.2 percent versus 4.0 percent in the treatment and control group, respectively. The proportion of preterm births amounted to 6.0 percent among children whose mothers experienced job displacement and was only 0.4 percentage points lower in the control group. The proportions for paternal job displacement were 6.1 percent versus 5.6 percent in the treatment and control group, respectively. Regarding small for gestational age, among children whose mothers experienced job displacement incidence was not elevated,

and among children whose fathers experienced job displacement the increase was only 0.3 percent.

The descriptive evidence presented in table 1 also provides us with the sociodemographic profiles of the treatment and control groups for selected covariates. Children in the treatment group were more likely to be born by mothers younger than twenty-five, from an immigrant background, and with less educational attainment. We can also observe that the treatment and control groups differ in terms of maternal labor-market difficulties, as reflected in a higher number of days of unemployment, as well as in a higher amount of unemployment benefits and social assistance received prior to job displacement. Mothers of children from the treatment group also had lower employment-related incomes and disposable incomes two years prior to birth and were more likely to have experienced previous job displacement and to be in poorer health, as indicated by more days of sick leave. The treatment group includes relatively more children with mothers whose firms were younger, smaller, and mainly operating in the wholesale and retail trade, transportation and storage or accommodation and food service activities. Only limited differences are found in the regional unemployment rate in the year of birth between treated and untreated mothers.

Among children whose fathers experienced job displacement, we find similar sociodemographic differences in terms of country of birth, level of educational attainment, and prior labor market experience. Similar to mothers, fathers from the treatment group were disadvantaged in terms of incomes two years before birth, previous displacement, as well as sickness days. Differences between fathers from the treatment and control group regarding firm and workplace characteristics and regional unemployment rates were similar to those observed for mothers.

Apart from balancing the characteristics of the focal parent losing a job, we also balanced for the characteristics of the spouses of these persons. For the sake of brevity, these and some other variables are not presented in table 1 as the differences largely reflect the sociodemographic profile of the focal parents with the same gender. Table S9 in the online supplement shows the complete version of table 1.

The pre-displacement characteristics presented were used for entropy balancing to render the children of displaced and nondisplaced parents comparable. Before moving to the main results, we briefly comment on how income-related characteristics changed in the year of job displacement to provide an illustration of what job displacement meant for the parental labor-market situation and incomes. The following results concern job displacement of parents during the entire period from 1996 to 2017 rather than just on displacement in the year before birth. Even though our research questions do not focus on career outcomes after job displacement for all parents, we consider this description a form of empirical validation of our analyses. According to the evidence provided in table S10 in the online supplement, the risk of unemployment and the number of days of unemployment increased substantially among mothers in the treatment group. This was accompanied by a drop in earnings and an increase in the income from unemployment benefits. However, disposable income did not drop, probably partially because of the substitutional role of unemployment benefits. Fathers who experienced job displacement saw even more substantial increases in the risk of unemployment than mothers, but a similarly small decline in earnings. At the same time, income from unemployment benefits almost doubled in this group. We also observed some increases in the income from self-employment. Overall, somewhat surprisingly, displaced fathers showed an increase in disposable income. These results are consistent with the key points from the institutional background section, in which we argue that a job displacement in Sweden does not entail such a significant reduction in family income as in the United States.

In the next step, we applied entropy balancing procedures to estimate the average treatment effects on the treated of maternal and paternal job displacement on birth outcomes and test hypothesis H1. The results from the analysis of these average effects in Sweden are presented in figure 1. They show that parental job displacement has, on average, zero or small ef-

Table 1. Descriptive Statistics on Outcomes and Selected Covariates for Treatment and Control Groups Before Balancing

			Maternal Sample		Paternal Sample	
Variable	Year	Categories	Control Group	Treatment Group	Control Group	Treatment Group
Child data						
Birth weight	t-0		3,543	3,524	3,549	3,538
LBW	t-0		0.040	0.044	0.039	0.040
PTB	t-0		0.058	0.061	0.057	0.061
SGA	t-0		0.019	0.020	0.019	0.018
Birth order of child	t-0	1	0.445	0.449		
		2	0.380	0.367	0.396	0.379
		3	0.134	0.129	0.140	0.148
		>3	0.041	0.055	0.048	0.066
Parent data						
Age category	t-2	<21	0.034	0.065	0.011	0.015
		21–25	0.199	0.250	0.123	0.134
		26–30	0.387	0.347	0.329	0.312
		31–35	0.285	0.246	0.322	0.308
		36–40	0.088	0.083	0.151	0.154
		>40	0.008	0.009	0.064	0.077
Country of birth	—	Sweden	0.886	0.837	0.874	0.806
		EU	0.034	0.040	0.034	0.044
		Other	0.081	0.122	0.092	0.150
Household status	t-2	Single	0.444	0.473	0.403	0.398
Civil status	t-2	Married	0.315	0.303	0.340	0.370
		Divorced or widowed	0.035	0.045	0.034	0.046
		Never married	0.651	0.651	0.626	0.584
NUTS region	t-2	11	0.257	0.303	0.239	0.296
		12	0.159	0.153	0.164	0.152
		21	0.084	0.067	0.087	0.065
		22	0.135	0.131	0.136	0.140
		23	0.205	0.186	0.205	0.180
		31	0.074	0.078	0.078	0.077
		32	0.036	0.036	0.037	0.039
		33	0.051	0.046	0.053	0.050
Education level	t-2	ISCED<3	0.073	0.149	0.094	0.156
		ISCED 3-4	0.419	0.515	0.500	0.523
		ISCED>4	0.508	0.336	0.406	0.321
Registered unemployed	t-2		0.187	0.307	0.137	0.251
Days registered unemployed	t-2		12.7	25.1	12.9	27.7
Job displacement	t-2		0.009	0.025	0.013	0.036
Employment status	t-2	Not employed	0.044	0.094	0.023	0.059
		Employed	0.952	0.886	0.971	0.904
		Self-employed	0.003	0.021	0.006	0.037
Total employment-related income, in SEK	t-2		182,068	150,142	264,707	223,231
Wage earnings, in SEK	t-2		154,089	118,157	252,028	200,251

Table 1. (*continued*)

Variable	Year	Categories	Maternal Sample		Paternal Sample	
			Control Group	Treatment Group	Control Group	Treatment Group
Business income, in SEK	t-2		502	2,715	1,365	6,813
Unemployment benefits, in SEK	t-2		3,666	6,441	3,449	6,792
Social assistance, in SEK	t-2		478	1,181	488	1,396
Disposable income, in SEK	t-2		150,413	130,863	203,431	177,741
Sickness days	t-2		6.65	8.97	3.21	4.86
Parental leave days	t-2		44.34	40.33	10.37	7.80
Industry sector (ISIC code)	t-1	A	0.005	0.015	0.012	0.028
		B, C, D, E	0.091	0.061	0.244	0.108
		F	0.008	0.014	0.060	0.078
		G, H, I	0.195	0.343	0.249	0.327
		J	0.030	0.038	0.063	0.067
		K	0.032	0.022	0.031	0.022
		L	0.008	0.015	0.008	0.016
		M, N	0.206	0.256	0.190	0.265
		O, P, Q	0.382	0.144	0.112	0.038
		R, S, T, U	0.043	0.092	0.031	0.052
Age of plant, in years	t-1		14.1	4.9	13.6	4.6
Age of firm, in years	t-1		13.1	4.1	11.3	3.4
No. of workers at plant	t-1		531	70	426	40
Regional unemployment rate	t-1		3.78	3.95	3.82	3.94

Source: Authors' tabulation.

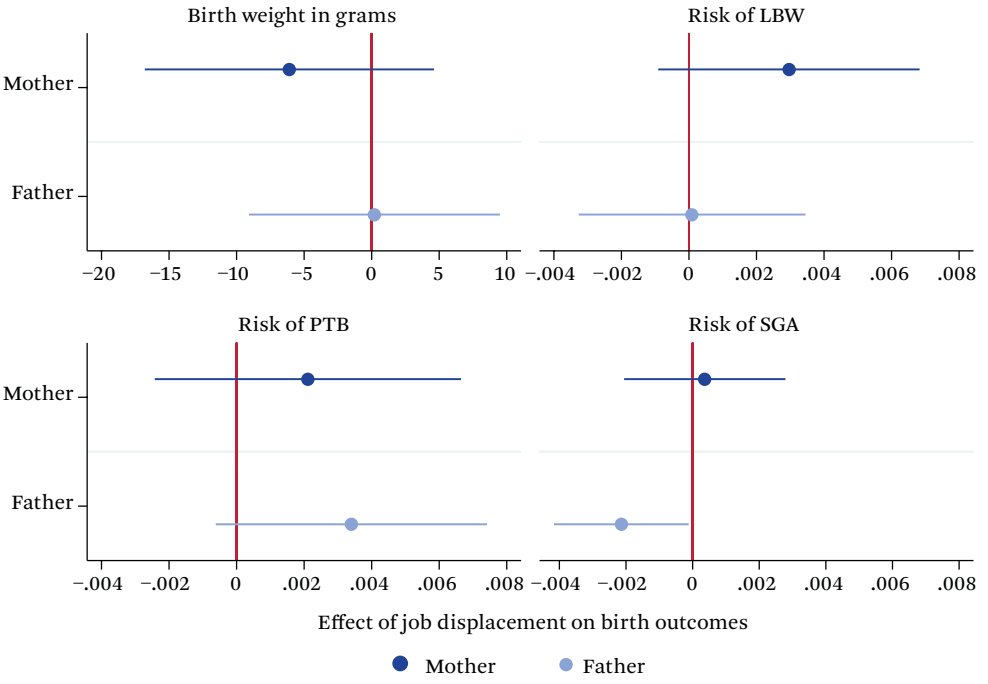
Note: Swedish register data; t = year of birth. Treatment status always measured in t-1. SEK = Swedish krona, adjusted to 2008 prices.

fects on birth outcomes. For mothers, the effects on birth weight, risk of low birth weight and risk of preterm birth point in the expected direction but are very small and not statistically significant, while the effect on SGA is close to zero. For fathers, we find virtually no effects on birth weight and low birth weight, a small but statistically insignificant increase in the risk of preterm birth, and a small but statistically significant reduction in the risk of being small for gestational age. Thus, we reject hypothesis H1, which states that maternal and paternal job displacement due to workplace closure has, on average, negative effects on birth outcomes.

To test hypothesis H2, we examined the regional differences in the effects of parental job displacement. The effects in figure 2 are grouped according to quintiles of the functional regions' unemployment rate (with the first quintile having unemployment rates at the level of 1 to 3 percent and the fifth quintile at the level of 5 to 13 percent). Contrary to hypothesis H2, which states that higher unemployment rates in functional regions should aggravate the negative effects of parental job displacement, we do not observe substantially stronger negative impacts of job displacement in the higher quintiles. If we only look at the size of the estimated risks of low birth weight and preterm births, we see a nonlinear pattern, in which the risks of adverse birth outcomes increase with higher unemployment rates, and then decrease again in the top unemployment rate quintile.

Hypothesis H2 predicts that the effects would be stronger in regions with higher unemployment rates. Hypothesis H3 claims the opposite based on the literature on the social norm of unemployment. The results presented in figure 2 do not provide support for that hy-

Figure 1. Effects of Maternal and Paternal Job Displacement due to Workplace Closure on Birth Outcomes



Source: Authors' tabulation.

Note: Swedish register data. LBW = low birth weight, PTB = preterm birth, SGA = small for gestational age. Horizontal bars indicate 95 percent confidence intervals. The point estimates and standard errors are reported in table A.2.

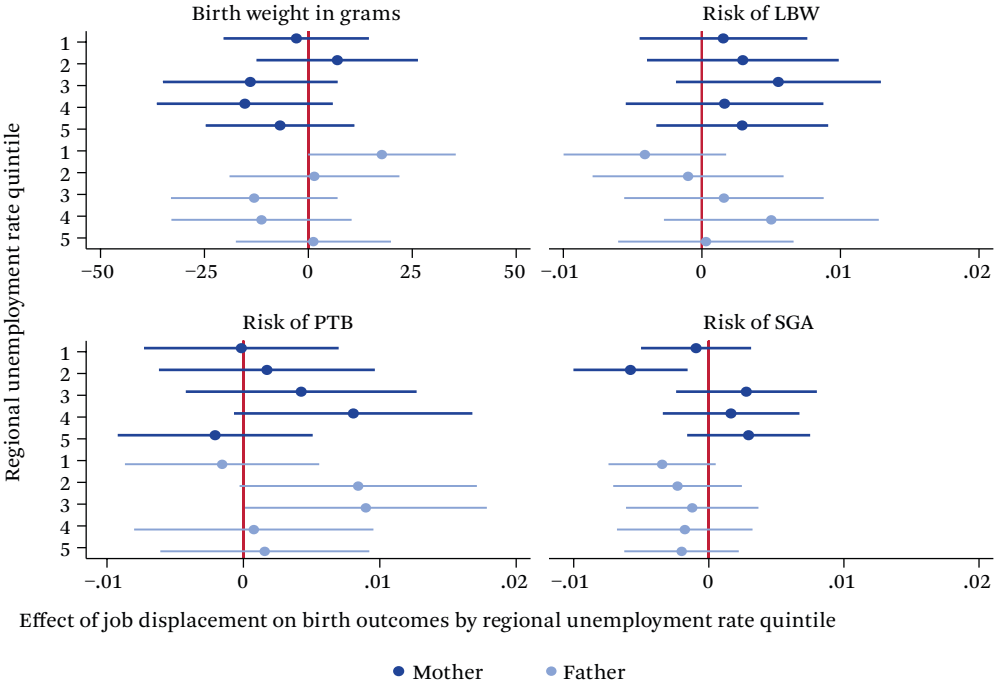
pothesis either. Overall, based on our evidence, both H2 and H3 are rejected, because any patterns that may be discernable are nonlinear and not consistent across birth outcomes. Hence, none of the results are consistent with higher unemployment decreasing or increasing the overall effects. Moreover, most estimates are small and the uncertainty of these estimates is quite large compared to the small differences between them in terms of point estimates.

We carried out sensitivity analyses to test whether job displacements lead to decisions *not to* have children, a mechanism that could potentially lead to a sample selection bias. Our results show that job displacement is not strongly related to a probability of not having a child after a job loss (see table S11 online). The relative risk amount to about 0.004, and even though they are statistically significant, with our sample of close to one hundred million observations, the conventional 5 percent statistical significance threshold is not a very meaningful indicator of whether the estimates are substantively important. The estimates are modest in absolute terms, indicating that job displacement is associated with an approximate 0.37 percentage point reduction in the probability of childbearing. Hence we do not find strong evidence suggesting that workers who experience job displacements decide to postpone childbearing or refrain from family formation altogether in anticipation of adverse birth outcomes. We also carried out additional analyses comparing birth outcomes of siblings before and after a job loss. The results from these robustness checks confirm our conclusions (see tables S13 and S14 online).

DISCUSSION

A large body of literature shows that job displacement is harmful for the health of individ-

Figure 2. Effects of Paternal and Maternal Job Displacement due to Workplace Closure on Birth Outcomes by Unemployment Rates in Functional Regions



Source: Authors' tabulation.

Note: Swedish register data. LBW = low birth weight, PTB = preterm birth, SGA = small for gestational age. Horizontal bars indicate 95 percent confidence intervals. Point estimates and standard errors are reported in table A.3.

uals. This raises the question of the conditions under which the effects of job displacement go beyond individuals who experience it and affect new generations (Brand 2015). This article examines the effects of parental job displacement on birth outcomes using Swedish register data. By focusing on parental job displacement due to workplace closure, we address potential concerns regarding reverse causality and bias due to confounding. The article also examines contextual heterogeneity, thereby looking beyond population-level average effects that could otherwise mask dissimilar effects across socioeconomic contexts (Aquino, Brand, and Torche 2022; Torche, Fletcher, and Brand 2022). It conceptualizes context on two levels. First, it provides evidence of regional heterogeneity within Sweden, shedding light on the moderating role of reemployment opportunities or the social norm of unemployment. Second, it offers suggestions of whether an appropriate social policy mix might restrict the health-related consequences of job displacement for future generations in the United States by comparing findings from this study for Sweden with research on the effects of job losses and unemployment on infant health in the United States.

Our findings show that the differences in birth outcomes between children of parents who experienced job displacements and children of parents who were not displaced turn out to be quite modest. For instance, the risk of low birth weight was 0.3 percentage points larger among children whose mothers experienced job displacement than those in the control group, and the corresponding difference concerning paternal job loss was close to zero. To place these differences in comparison with the United States, Jason Lindo (2011) shows that in the United States, the differences in the risk of low birth weight between infants whose fathers experienced job displacement and those

who did not amounted to 1.8 percentage points. That study did not examine the effects of maternal job loss. The estimates from Helen Scharber (2014) based on administrative records for Texas suggest that a difference between the risks of low birth weight among employed and unemployed mothers of 3 percentage points. Regarding the results from analyses that treated birth weight as a continuous outcome, David Dooley and Joann Prause (2005) find an effect of maternal unemployment on birth weight of -185 grams, which compares with -6 grams in our study, which is close to an effect of paternal job displacement of 23 grams that Samantha Gailey and her colleagues (2021) in Denmark report. Hence, the effects observed in Sweden are at least an order of magnitude lower compared to the U.S. Since studies focused on the U.S. quoted here adopt a research design similar to ours, in that the focus is on involuntary job losses and methods for causal inference, it is unlikely that the disparities in the findings are driven by methodological differences. What does the comparison of the results for Sweden and the United States tell us about the role of the policy context in shaping the effects of job displacement on infant health or the intergenerational transmission of social inequalities more generally?

These results could be related to how job loss affects the economic situation of individuals and their families in Sweden, a country with a relatively generous safety net, universal health care, and policies that shorten the duration of unemployment. Reflecting on these findings might be particularly useful for improving the social and living conditions in the United States, where support for families, including those families with unemployed parents, is far more limited than in the Nordic countries. Combined with research that highlights the importance of supporting unemployed parents (Kessler and Hevenstone 2022; Noghanibehambari and Salari 2020), our findings suggest the importance of a social policy mix that improves the situation of the unemployed and their families, thus restricting the health-related consequences of job displacement for future generations.

Exploring regional differences of the effects of parental job displacement, we tested theoretical hypotheses related to, first, expected chances of parental reemployment and, second, the social norm of unemployment. We found no monotonic increase or decrease in the magnitude of the effects of parental job displacement across unemployment rates measured at the level of functional regions. Hence we could not accept any of these two theoretical hypotheses as a complete explanation of the observed empirical patterns. Our findings may be related to the policy in Sweden, where the government offsets most of the municipal and regional revenues that are lost (André et al. 2021). Again, this is different from Anglo-Saxon contexts (Glasmeier 2000), raising questions on how policies that reduce regional inequalities in the United States could potentially help individual workers and their children. Recent research in the United States shows substantial geographic variation in social and living conditions (Chetty et al. 2014; Galster and Sharkey 2017) and highlights how exposure to differential geographic contexts matters for children's life chances (Chetty, Hendren, and Katz 2016). Our findings demonstrate that it is possible to create welfare state settings that provide limited health penalty for job displacements not only on average, but also for most of the population, including those who happened to be born in more disadvantaged geographic areas.

Although this study has a number of strengths, it is not without weaknesses. Most important, our analyses assume that job displacements do not have spillover effects on parents who are themselves not displaced but who share the same residential location as the displaced parents. Recent research raises doubts as to whether such an assumption is valid, particularly when job losses are concentrated in time and space (Gassman-Pines, Gibson-Davis, and Ananat 2015). Thus our estimates may be biased because birth outcomes might also be affected by the job losses of parental peers, coworkers, or neighbors. In addition, our analyses focus on parents but do not consider couples who may have decided to postpone parenthood or who separated as a consequence of job displacement. Research shows that such responses in families are not uncommon (Di Nallo et al. 2022), also in the Swedish context

(Eliason 2012). Couples who decided not to stay together due to a job displacement (and therefore decided not to have children) may represent a particularly vulnerable group, less well equipped with the economic or psychological resources to handle a family crisis. Thus, the effects of job displacement on birth outcomes may have been stronger for this group, had they decided to have children, than for the group that did have children and for whom we observe birth outcomes.

Despite these limitations, this study offers a number of important insights, particularly from the perspective of countries such as the United States that have room for improving use of economic resources for the sake of the future generations. This study finds that parental job displacement has zero or small average effects on health at birth in Sweden, and that these effects do not vary systematically depending on contextual unemployment rates. The nonexistent or small average effects are in line with other studies from Sweden and Denmark (Gailey et al. 2021; Högberg, Baranowska-Rataj, and Voßemer 2023; Mörk, Sjögren, and Svaleryd 2020), but diverge strongly from the large effects found in comparable studies from the United States (Dooley and Prause 2005; Lindo 2011; Scharber 2014). We argue that this partially reflects differences in labor-market policy and welfare state characteristics. Relative to the United States, Swedish (and Danish) labor market policies facilitate better reemployment opportunities and buffer negative income shocks following job loss or unemployment (Brady, Finnigan, and Hübgen 2017; DiPrete 2002; Gangl 2006), and more generous and universal welfare states make access to essential goods and services less dependent on employment and earnings (Brady and Bostic 2015; Marical et al. 2006). This in turn suggests that the negative effects of parental job loss or unemployment on infant health found in the United States could potentially be reduced by social policies, a conclusion further supported by research showing the strong positive effects of social policies on infant health among disadvantaged groups in the country (Strully, Rehkopf, and Xuan 2010). This raises the question whether adopting appropriate policies could provide institutional conditions under which children born in families exposed to job displacement are not negatively affected by economic adversity. Our results also show that these patterns are universal and are also present in the most disadvantaged regions with high unemployment rates. Thus, social policies may be beneficial in terms of reducing inequalities, not only across socioeconomic groups but also across spatial contexts.

Table A.1. Information on Variables Used in the Analyses

Variable	Description
Child Outcomes	
Birth weight, in grams	Birth weight, in grams
Low birth weight (LBW)	Dummy coded. Birth weight < 2500 grams
Preterm birth (PTB)	Dummy coded. Born before week 37
Small for gestational age (SGA)	Small for gestational age
Treatment	
Parental job displacement	1 = Job displacement due to workplace closure
Conditions	Only workers with paid employment as their main source of income are included. Self-employed and non-employed are excluded. Only children with complete data on all three birth outcomes are included. For analyses of father's job displacement, only children born to mothers who are not single are included.
Child data	
Birth year	Child birth year, categorical, range 1997–2017
Birth order of child	Birth order of child, 4 categories. 1,2,3 = 1,2,3. >4 = 4
Parent data – Socio-demographics	
Age category	Parent age, recoded into six categories <21, 21–25, 26–30, 31–35, 36–40, >40
Country of birth	Three categories: Sweden, Europe, outside Europe
NUTS region	8 categories, one for each NUTS3 region.
Household status	Dummy coded. 1 = Does not live with anyone aged 18 years or more.
Civil status	Three categories: Married, divorced/widowed, never married
Education level	Three categories: <ISCED 3, ISCED 3-4, >ISCED4
Parent data – Employment	
Registered unemployed	Dummy coded: 1 = Registered at unemployment office.
Days registered unemployed	Number of days registered at unemployment office
Job displacement	Job displacement due to workplace closure in t-2
Employment status	Three categories: Not employed, employed, self-employed
Sickness days	Number of days on paid sickness leave
Parental leave days	Number of days on paid parental leave
Parent data – Income	
Total employment-related income, in SEK	Total employment-related income, including social transfers, in SEK. Adjusted to consumer price index based on 1996 prices.
Wage income, in SEK	Income from paid employment, in SEK. Deflated with consumer price index to 1996 prices
Business income, in SEK	Income from own business, in SEK. Deflated with consumer price index to 1996 prices
Unemployment benefits, in SEK	Income from unemployment insurance, in SEK. Deflated with consumer price index to 1996 prices
Social assistance, in SEK	Income from social assistance, in SEK. Deflated with consumer price index to 1996 prices
Disposable income, in SEK	Total disposable income, in SEK (net of transfers and taxes). Individualized from household disposable income. Deflated with consumer price index to 1996 prices

Table A.1. (*continued*)

Variable	Description
Parent data – Workplace and firm level	
Industry sector (NACE code)	Industry sector of workplace, 10 NACE categories: A: Agriculture, forestry and fishing; B, C, D, and E: Manufacturing, mining and quarrying and other industries; F: Construction G, H, and I: Wholesale and retail trade, transportation and storage, accommodation and food service activities; J: Information and communication; K: Financial and insurance activities; L: Real estate activities; M and N: Professional, scientific, technical, administration and support service activities O, P, and Q: Public administration, defense, education, human health and social work activities; R, S, T, and U: Other services
Age of workplace, in years	Age of workplace (current year – year of establishment)
Age of firm, in years	Age of firm (current year – year of establishment)
No. of workers at workplace	Number of workers at workplace
Regional data	
Regional unemployment rate	Functional labor market regions unemployment rate in t-1
Moderating variables	
Regional unemployment rate quintile	Functional labor market regions' unemployment rate in t-1, grouped into 5 quantiles. Unemployment rate defined as total number of unemployed individuals as a proportion of the total population of the region.

Source: Authors' elaboration.

Table A.2. Effects of Parental Job Displacement on Birth Outcomes (Estimates for Figure 1)

		Birth Weight	LBW	PTB	SGA
Sample mean of outcome		3,542.85	0.0399	0.0580	0.0191
Mother's job displacement	ATT	–6.087	0.0030	0.0021	0.0004
	SE	5.463	0.0020	0.0023	0.0012
N (treated)		13,595	13,595	13,595	13,595
N (controls)		1,506,670	1,506,670	1,506,670	1,506,670
Father's job displacement	ATT	0.208	0.0001	0.0034	–0.0021*
	SE	4.737	0.0017	0.0020	0.0010
Sample mean of outcome		3,549.31	0.0387	0.0569	0.0185
N (treated)		17,305	17,305	17,305	17,305
N (controls)		1,474,287	1,474,287	1,474,287	1,474,287

Source: Authors' tabulation.

Note: SE = cluster robust standard error, clustered on mothers. LBW = low birth weight; PTB = preterm birth; SGA = small for gestational age. Birth weight is measured in grams, LBW, PTB, and SGA are binary variables, coded 1 when the outcome is observed.

* $p < .05$; ** $p < .01$; *** $p < .001$

Table A.3. Effects of Parental Job Displacement on Birth Outcomes by Regional Unemployment Rate Quintile (Estimates for Figure 2)

		Birth Weight	LBW	PTB	SGA
Mother's job displacement					
Quintile 1	CATT	−2.918	0.0016	−0.0002	−0.0009
	SE	10.498	0.0036	0.0043	0.0024
Quintile 2	CATT	6.941	0.0030	0.0017	−0.0058*
	SE	11.658	0.0042	0.0048	0.0025
Quintile 3	CATT	−13.963	0.0055	0.0042	0.0028
	SE	12.614	0.0044	0.0051	0.0031
Quintile 4	CATT	−15.282	0.0016	0.0080	0.0017
	SE	12.705	0.0043	0.0052	0.0030
Quintile 5	CATT	−6.808	0.0029	−0.0021	0.0030
	SE	10.737	0.0037	0.0043	0.0027
N (treated)		13,595	13,595	13,595	13,595
N (controls)		1,506,670	1,506,670	1,506,670	1,506,670
Father's job displacement					
Quintile 1	CATT	17.699	−0.0041	−0.0016	−0.0035
	SE	9.065	0.0030	0.0036	0.0020
Quintile 2	CATT	1.474	−0.0010	0.0084	−0.0023
	SE	10.427	0.0035	0.0044	0.0024
Quintile 3	CATT	−13.008	0.0016	0.0090*	−0.0012
	SE	10.224	0.0037	0.0045	0.0025
Quintile 4	CATT	−11.272	0.0050	0.0008	−0.0018
	SE	11.059	0.0040	0.0045	0.0026
Quintile 5	CATT	1.219	0.0003	0.0016	−0.0020
	SE	9.520	0.0032	0.0039	0.0022
N (treated)		17,305	17,305	17,305	17,305
N (controls)		1,474,287	1,474,287	1,474,287	1,474,287

Source: Authors' tabulation.
Note: See table A.2.

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PART II

Household Disruptions

Heterogeneous Household Change Among Children

KRISTIN L. PERKINS

Family instability has negative consequences, on average, for child and adolescent behavior, cognitive scores, and educational attainment. Beyond changes involving parents, many children experience household changes involving extended family and nonrelatives. These children are less likely to graduate from high school and complete some college than those who experience no such changes. Research finds small or insignificant negative consequences of these changes among Black children. I estimate heterogeneous effects of household changes involving parents, extended family, and nonrelatives on educational attainment among Black children based on the likelihood of such changes. Black children least likely to experience changes experience stronger negative effects on educational attainment than those moderately and most likely to do so. Black children who are least and moderately likely may be more negatively affected in terms of some college completion relative to Black children who are most likely to experience this type of household change.

Keywords: children, household change, educational attainment

Changes in household composition are disruptive events in the lives of children. Social scientists have long been interested in how father absence and changes in parents' romantic relationships affect children's well-being and outcomes (Cavanagh and Fomby 2019; McLanahan, Tach, and Schneider 2013). A growing, but still relatively small, literature explores how children's residence in shared households and exposure to changes in household composition are associated with longer-term outcomes (Harvey 2020; Perkins 2019). Looking beyond parents to examine whether the arrival and departure of nonparent members of children's households is related to their longer-term outcomes is a step forward in research on children's developmental environments. Despite increasing attention to heterogeneity in the effect of parental divorce and other types of disruptive events (Aquino, Brand, and Torche 2022; Torche, Fletcher, and Brand 2024, this issue), sociologists and social scientists more broadly have not yet explored heterogeneous effects resulting from the disruption of changes

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in household composition involving both parents and nonparents.

I build on two strands of recent research in this article, combining a focus on changes in household composition beyond parents and their romantic partners with the approach of other recent research considering heterogeneous effects of parental divorce on children's educational attainment. I accomplish this with data from the Panel Study of Income Dynamics (PSID), a longitudinal, nationally representative survey of families and households collecting data since 1968. I estimate propensity scores and use matching-smoothing estimates and linear probability models to assess whether the effect of changes in household composition involving parents, nonparents, or parents and nonparents differs across the population. Specifically, are children with a low propensity to experience household change more or less negatively affected by the change than children with a high propensity to experience household change in terms of high school graduation and some college completion? I estimate heterogeneity for Black children, both because research on family instability finds small or null effects among Black children (Brand et al. 2019b; Cavanagh and Fomby 2019) and because recent evidence demonstrates that family structures and family processes differ by racialized group (Cross 2020; Williams and Baker 2021).

My findings suggest that the effects of changes in household composition involving parents, nonparents, and both parents and nonparents may differ by the propensity to experience household change. The negative consequences of changes involving only parents, only nonparents, and changes involving both parents and nonparents, on educational attainment may be larger among Black children who are less likely to experience such changes whereas the negative consequences may be smaller in magnitude for Black children who are more likely to experience such changes. These findings suggest that a group of Black children may in fact be disadvantaged by changes in household composition, nuancing research concluding that all Black children are relatively unaffected by family instability. The findings thus add to a growing literature on heterogeneous effects of disruptive events. Further, the results finding significant negative effects among a subgroup of Black children support recent arguments (Cross 2021) calling for more research on how family processes differ and have different effects within racialized groups.

MOTIVATION AND OBJECTIVE

This article builds on two strands of recent research: one exploring the consequences of changes in household composition for children's educational attainment and a second estimating heterogeneous effects of family disruption on educational attainment. Demographers and family sociologists have established that family instability, defined as parental relationship dissolution and repartnering, has negative consequences, on average, for child and adolescent behavior, cognitive scores, and educational attainment (Cavanagh and Fomby 2019). Approximately 35 percent of children live with an extended family member at some point during childhood (Cross 2018); shared households that include adults other than the head of household and their romantic partner experience frequent changes in composition (Pilkauskas 2012). Thus, beyond changes in parental relationships, a substantial share of children experiences changes in household composition involving extended family members and nonrelatives (Perkins 2017; Raley et al. 2019). Our limited understanding of how these changes affect children and adolescents makes this a very active area of research. Among young children, those who experience changes in household composition involving nonparents have worse cognitive outcomes than children with stable households (Mollborn, Fomby, and Dennis 2012). Children who experience three types of changes in household composition, those involving parents only, nonparent extended family members and nonrelatives only, and both parents and nonparents, are less likely to graduate from high school and enroll in postsecondary education and more likely to have a child as a teenager compared with children who experience no changes in household composition during childhood (Perkins 2019, 2023). A negative effect, on average, could mask positive effects for some children and negative effects among

others, especially where the estimates are imprecise.

Household changes are motivated by a range of different characteristics and trigger events, and children and families may be more or less likely to anticipate such changes. Experiencing the divorce of one's parents has negative effects on children's cognitive and socioemotional skills and prompts young adults to leave home because of conflict and have nonmarital births (Cherlin, Kiernan, and Chase-Lansdale 1995; Kim 2011). These negative consequences, among others (Amato 2010), however, are not uniformly experienced across the population. Disruptive events including divorce, job loss, home loss and eviction, health shocks and deaths, and violence and incarceration are not equally harmful across groups (Aquino et al. 2022; Torche, Fletcher, and Brand 2024, this issue). Most relevant to this article, recent research has uncovered substantial heterogeneity by race, education, and propensity to experience divorce in the effects of divorce and family instability involving parental romantic relationships on child outcomes. Family instability has stronger associations with delinquent behavior, age at first nonmarital sex, and age at first nonmarital birth among White than among Black adolescents (Fomby, Mollborn, and Sennott 2010). A similar pattern is evident for educational outcomes: parental divorce lowers the probability of high school completion, college attendance, and college completion among White children, but effects are close to zero and nonsignificant among non-White children (Brand et al. 2019b). Children of more educated parents experience larger negative effects on the probability of their college completion after parental divorce than children of less educated parents (Bernardi and Radl 2014). The effect of parental divorce on children's educational attainment varies by the likelihood of divorce occurring: children who are least likely to experience parental divorce, and therefore, perhaps, least likely to expect it, appear to be more disadvantaged by divorce than children who have a higher propensity to experience divorce in terms of probability of high school completion, college attendance, and college completion (Brand et al. 2019a).

Given these findings of heterogeneity in the effect of family instability on children and adolescent outcomes, it may follow that the effects of other types of household change also vary across children. I estimate how exposure to changes in household composition involving parents and extended family and nonrelatives differentially affects educational attainment according to the likelihood of experiencing such changes. Selection into family structure and household changes may differ by race and recent evidence supports the conclusion that family structure operates differently by race, with time spent living in a two-biological-parent family less beneficial for Black children compared with White children in terms of on-time high school graduation (Cross 2020). Marriage is also less protective against poverty for Black mothers compared with White and Latinx mothers (Williams and Baker 2021). Household composition beyond the nuclear family, selection into changes in household composition, and the effects of these changes may differ by race (Cross 2018; Mollborn et al. 2012; Perkins 2017, 2019) and our predictions of such changes and estimates of their effects should account for different selection mechanisms.

One finding motivating this analysis is that the effect of household change on educational attainment is consistently negative among White children but imprecisely estimated among Black children (Perkins 2019). This result suggests that there could be positive effects of household change for some Black children and negative effects for other Black children based on the types of household change they experience, other characteristics of these children and families, or their propensity to experience such changes. Rather than speculatively choosing a particular dimension across which the effects of household change may vary, such as gender, income, or education, which may or may not represent the most meaningful variation across the population (Aquino et al. 2022), I estimate heterogeneous effects of three types of household change by the propensity of children to experience each type of household change. There are at least two potential explanations for heterogeneous effects of disruptive events across the population (Aquino et al.

2022; Torche, Fletcher, and Brand 2024, this issue). The first is a cumulative disadvantage pathway whereby negative effects of disruptive events are stronger for individuals who are more likely to experience them because these individuals have fewer resources to buffer against a disruption. Alternatively, a floor effect is possible whereby individuals whose disadvantages predispose them to experiencing disruptive events may not be adversely affected by any one given disruption because of general instability in their lives. The second proposed pathway, whereby those least likely to experience a disruptive event are most negatively affected by it, is a path of non-normative and unexpected shocks. When individuals who are unlikely to experience a parental divorce, job loss, health shocks, or other disruptive event do in fact face disruption, they may be poorly equipped to adjust to the change or may feel stigma, worsening the negative effect of the disruption (Aquino et al. 2022).

I explore heterogeneous change in household composition and the effect of such changes on educational attainment. Unlike research finding small or no negative effects of family instability and parental divorce on Black children's outcomes, I find that Black children who are less likely to experience changes involving parents and changes involving parents and nonparents have significantly lower educational attainment. The stronger negative effects among low-propensity Black children are consistent with the unexpected events explanation of heterogeneous effects. Even low-propensity Black children may have fewer resources supporting educational attainment other than a stable family that is disrupted by household change.

DATA

I use data from the PSID to examine heterogeneous household change and educational attainment. The PSID collected data from a nationally representative sample of approximately 4,800 families in 1968 and the study has added children and grandchildren of original sample members as they form their own independent households. There are now more than eighty thousand individuals who are captured in at least one wave of the study (PSID 2019). I use data from the 1968 through the 2019 waves of the study. The PSID surveyed respondents annually from 1968 through 1997 and biennially since 1997. Children enter my sample in the first year that they appear in the PSID, soon after they are born, and I must observe them over time to track changes in household composition during childhood and their educational attainment by age twenty, measured as high school completion (completed at least twelve years of education) and some college (at least thirteen years). My sample includes Black individuals born between 1968 and 1999.[1]

I use household roster data collected at every survey wave to identify the relationship between each household member and the focal child and track, across waves, who enters and leaves the child's household. The first step is using parent pointers and the relationship to head variables to identify the relationship between each household member and the head of household. Then I use the relationships between head and all other household members and the parent pointers to infer the relationship between each child and every other person in the household. Most households in the PSID contain only one family unit, but for the approximately 10 percent of households that contain more than one family unit I must use the variable identifying the relationship between heads of different family units to infer relationships within households, but across family units. I use a four-category measure of exposure to household change involving parents, extended family, and nonrelatives based on observing children's households through age seventeen: first, experienced household changes involving only parents and stepparents; second, experienced household changes involving only nonparents (that is, adult siblings age twenty-five and older, and extended family and

1. My sample includes individuals whose families were originally part of the Survey of Economic Opportunity (SEO) sample, families within 200 percent of the federal poverty level in 1967. Including the SEO sample means that African Americans are adequately represented in the PSID and permits analysis of heterogeneity by propensity to experience household change.

nonrelatives, including children and adults); third, experienced household changes involving both parents and nonparents, and, fourth, experienced no household changes. It is difficult to know whether the changes children are experiencing are considered good or bad: I conceptualize changes in household composition as disruptions in children's environments that may be stressful and require a period of adaptation, regardless of whether they bring more resources to or subtract resources from children's households. These categories are admittedly coarse, but they capture different levels of volatility children experience.

Readers are naturally curious about the effects of parent (or grandparent) exit versus entrance, for example, but children rarely experience only one type of change during childhood. I measure change rather than exit and entrance because for most children I cannot isolate one type or direction of change in an analysis that uses household composition across childhood to predict an outcome in young adulthood. In my sample, among children who had a parent leave their household, 57 percent also had a parent join, and 32 percent had a parent leave more than once. Among children who had a parent join their household, 75 percent also had a parent leave. Of the children in my sample who had a nonparent join their household, 91 percent also experienced a nonparent leave, and 65 percent experienced nonparent exits more than once. Of those who had a nonparent leave the household, 87 percent had a nonparent join and 60 percent experienced two or more nonparent entrances. Even if I limited my sample to children who experienced a parent leave only once and no parents join to estimate a "cleaner" effect of parental relationship dissolution, I would still have to account for the 62 percent of these children who had a nonparent join and the 56 percent who had a nonparent leave their household.[2] Therefore, I choose to model these events as categories of changes rather than exits or entrances because so few children experience an exit, or entrance, in isolation. Modeling exits or entrances in isolation would require either that I restrict my sample to the few children who experience only one type of change or that I ignore the complexity that characterizes the majority of children's households and developmental environments (for more, see Perkins 2019, 2023; DeLuca, Papageorge, and Boselovic 2024, this issue).

METHOD

Assessing heterogeneity in household change and its effects on high school graduation and some college completion requires estimating each child's likelihood of experiencing changes involving parents, changes involving nonparents, and changes involving both parents and nonparents. I begin by using the matching-smoothing method to estimate heterogeneous treatment effects (Xie, Brand, and Jann 2012). This method involves four steps (Jann, Brand, and Xie 2007). First, I restrict my sample to children who experienced at least one change involving parents only (treatment) and children who experienced no household changes (control). I estimate propensity to experience parent change using a logit model with the set of baseline covariates. Because household change can occur anytime during childhood, I must restrict pretreatment covariates to those available at baseline. This is a trade-off: pretreatment covariates alone do not adjust for time-varying confounders associated with both household change and educational attainment, but by limiting covariates to those observed at baseline I also avoid conditioning on endogenous variables, which could bias my estimates of the effect of household change. These models include baseline characteristics of the child (sex, indicator for living with married parents, indicator for parent head of household, indicator for having an older sibling, year of entry into PSID, whether the child's family joined the PSID as part of the SEO sample), characteristics of the head of household at baseline (sex, age, educational attainment, employment status, indicator for residence in the south), and characteristics of the household at baseline (home-

2. Christina Cross (2018) finds that more than one-third of children lived with an extended relative at some point during childhood and that coresidence often occurs simultaneously with more than one type of extended family member, further justifying an approach that considers household members beyond parents.

ownership, household income, poverty status, household size, number of children in the household). Results from these logit models estimating propensity scores are shown in table A.1.

The second step, after predicting a propensity score, is matching treated to control units using kernel matching. Third, I plot the difference in high school graduation and some college completion between treated and control units against a continuous representation of the propensity score. Fourth, I apply a local polynomial regression to visualize a nonparametric smoothed curve for the difference in educational attainment between those who experience at least one parent change and those who experience no household changes as a function of the propensity score. I repeat these four steps for two other treatment categories: household changes involving nonparents and household changes involving parents and nonparents. Following these four steps produces figures showing the observed differences in high school graduation and some college completion between children who experienced one of three types of changes in household composition and those who experienced no changes. Patterns evident in these figures inform the second part of my strategy for estimating heterogeneous effects: using linear probability models to regress indicators for high school graduation and some college completion on household change within propensity score strata.

Based on the matching-smoothing figures and the propensity score prediction models, I group individuals into three propensity score strata and estimate stratum-specific treatment effects. I specify eighteen linear probability models regressing an indicator for high school graduation or some college completion on an indicator for one of three types of household change (parent change, nonparent change, both parent and nonparent change; reference group experienced no household changes), separately by likelihood to experience the given type of change (least likely, moderately likely, most likely). These models include only one covariate: the propensity score estimate of the probability that the individual experiences the given type of household change (following Brand et al. 2019a). To check the robustness of these eighteen models, all of which have relatively small sample sizes, I specify a second set of six regression models (three types of household change, two education outcomes), interacting the type of household change with indicator variables for moderate and high propensity to experience the given type of change (low propensity is the reference group). These models pool the sample for each type of change, increasing precision while still allowing the treatment effect to differ by propensity to experience household change.

RESULTS

Table 1 shows, descriptively, how baseline child, head of household, and household characteristics differ among Black children in each of the four categories of household change.[3] Only 13 percent of Black children experience no changes in household composition involving parents or nonparents during childhood. Experiencing changes involving only parents is even less common, at 12 percent. A much larger share, 30 and 45 percent, experience changes involving nonparents or changes involving both parents and nonparents. Thus the modal category among Black children is experiencing household changes involving both parents and nonparents during childhood.

Most children in the no-change category live with married parents, at least one of whom is employed. The no-change category is more privileged, on average, than the change categories, but even within this relatively privileged category, the homeownership rate is rather low and poverty rate high. Most children in the parent change category experience one or two changes involving parents during childhood. Eighty-five percent of the children in the parent change group experience at least one parent exit, 20 percent experience parent exits twice, and 50 percent experience at least one parent entrance. Compared with children in the no-change category, a smaller share of children in

3. Descriptive statistics by the three propensity score strata within each treatment condition are shown in table A.2.

Table 1. Descriptive Statistics

	Overall Mean (SD)	No Change Mean (SD)	Parent Change Mean (SD)	Nonparent Change Mean (SD)	Both Change Mean (SD)
Household change category					
Change in parents	0.12	0.00	1.00	0.00	0.00
Change in nonparents	0.30	0.00	0.00	1.00	0.00
Change in both parents and nonparents	0.45	0.00	0.00	0.00	1.00
No change	0.13	1.00	0.00	0.00	0.00
Educational attainment					
High school graduation	0.76	0.80	0.87	0.75	0.72
Some college	0.29	0.48	0.40	0.26	0.23
Baseline characteristics					
Child sex (female=1)	0.47	0.48	0.45	0.49	0.46
Child lives with married parents	0.41	0.71	0.67	0.30	0.32
Child's parent is head of household	0.74	0.99	1.00	0.65	0.66
Child has an older sibling	0.59	0.64	0.63	0.66	0.52
Characteristics of head of household					
Sex (female=1)	0.47	0.27	0.31	0.59	0.50
Age	33.70 (12.47)	29.24 (5.89)	27.91 (6.07)	36.13 (12.97)	34.93 (13.92)
Education					
Less than high school	0.44	0.26	0.17	0.49	0.53
High school diploma	0.36	0.38	0.44	0.38	0.32
Some college	0.13	0.17	0.32	0.10	0.10
Bachelor's or more	0.06	0.19	0.07	0.04	0.04
Employment					
Employed	0.82	0.96	0.88	0.80	0.78
Unemployed	0.10	0.03	0.10	0.11	0.11
Retired or disabled	0.08	0.01	0.02	0.09	0.11
Marital status					
Married	0.51	0.71	0.67	0.38	0.48
Single	0.26	0.22	0.24	0.30	0.25
Widowed, divorced, separated	0.23	0.07	0.08	0.32	0.27
Region of Residence					
South	0.59	0.61	0.54	0.56	0.61
Characteristics of household					
Housing tenure: owned	0.29	0.34	0.23	0.31	0.29
Household income quintile					
First	0.38	0.26	0.25	0.43	0.43
Second	0.32	0.27	0.44	0.30	0.32
Third	0.16	0.24	0.17	0.15	0.14
Fourth	0.11	0.18	0.10	0.11	0.08
Fifth	0.03	0.05	0.04	0.01	0.03
Income below poverty line	0.39	0.24	0.22	0.45	0.43
Household size	5.08 (2.38)	3.74 (1.01)	3.95 (1.43)	5.63 (2.67)	5.42 (2.42)
Number of children in household	2.79 (1.82)	2 (0.97)	2.22 (1.34)	3.17 (2.01)	2.92 (1.89)

Table 1. (*continued*)

	Overall Mean (SD)	No Change Mean (SD)	Parent Change Mean (SD)	Nonparent Change Mean (SD)	Both Change Mean (SD)
First year child observed in PSID	1983	1983	1985	1983	1983
SEO sample	0.58	0.65	0.54	0.59	0.57
Observations	2,712	428	304	804	1,176

Source: Author's tabulation.
Note: Table based on author analysis of PSID data from 1968 to 2019. Statistics limited to Black children and are weighted to account for sampling design and attrition.

the parent change category live with married parents and in owned homes at baseline, and a larger share have household incomes in the lowest categories.

Overall, children in the parent change group live in households at baseline characterized by higher socioeconomic status than children in the nonparent and both change groups. Children in the nonparent change category experience between three and four changes involving nonparents, on average. In this group, 47 percent experience a grandparent exit, 22 percent experience a grandparent join, 47 percent experience an aunt or uncle leave, and 32 percent experience an aunt or uncle join. A larger share live in a grandparent's home at baseline and have household incomes below the poverty line relative to both the no-change and parent change categories.

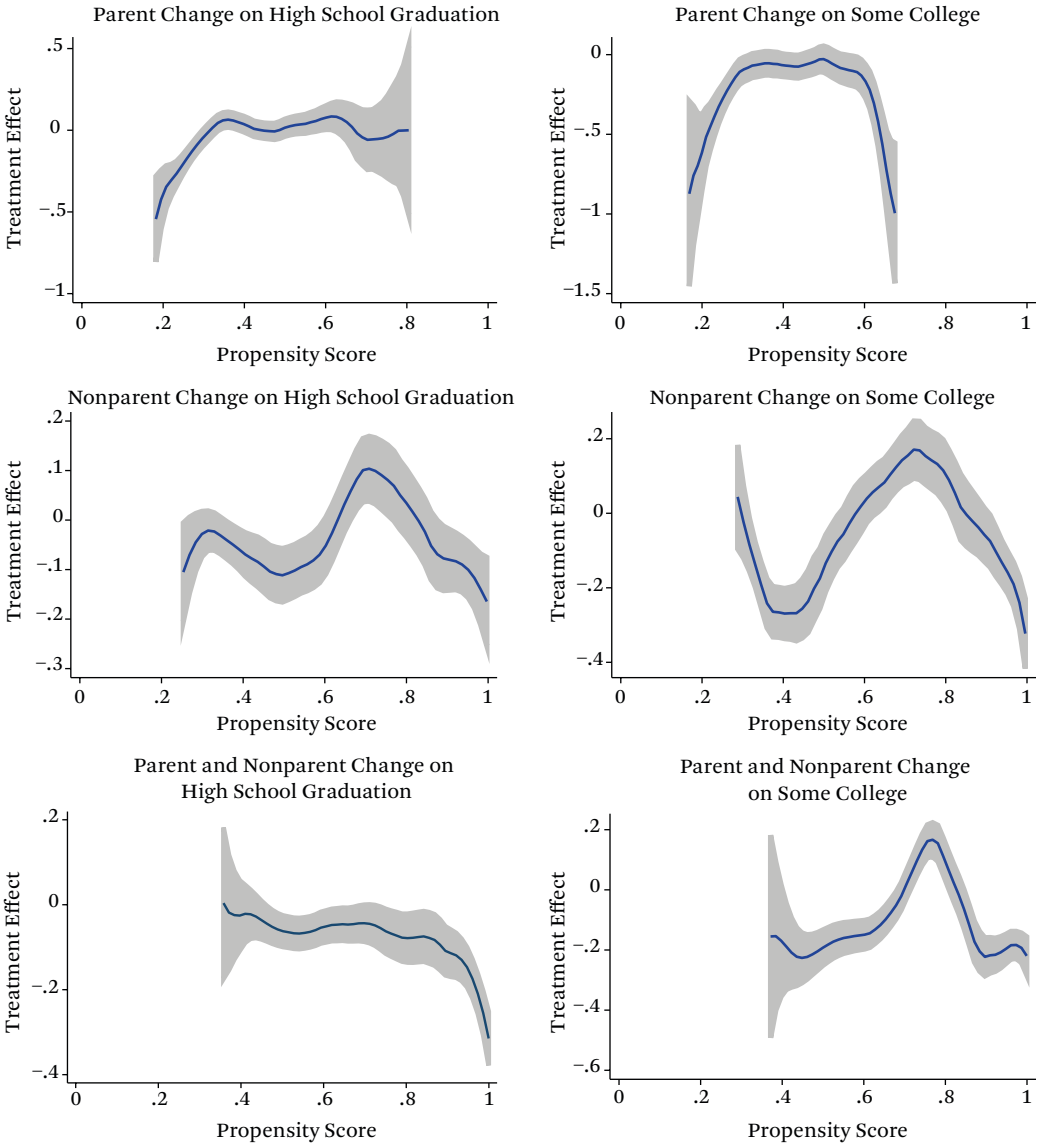
Finally, children who experience changes involving both parents and nonparents have, on average, the lowest socioeconomic status at baseline. This group experiences the most volatility in household composition: 29 percent more than one parent exit, 68 percent a parent entrance, 50 percent a grandparent exit, and 34 percent a grandparent entrance. Changes involving cousins and nonrelatives also occur, though less frequently than those involving parents, grandparents, and aunts and uncles. The relatively large proportion of Black children in the nonparent change and parent and nonparent change groups, combined with the volume of changes experienced by children in these groups, underscores substantial exposure to household change among Black children.

Matching-Smoothing Estimates

Figure 1 presents matching-smoothing heterogeneous effects for three types of household change, the x-axis being a continuous propensity score predicting the likelihood that an individual in the sample experienced a given change in household composition, and the y-axis representing observed differences in high school graduation or some college completion. All figures include 95 percent confidence intervals and represent the middle 90 percent of the propensity score distribution. The top two panels show the differences in high school graduation and some college completion for Black children who experience parent change during childhood. For high school graduation, children with a low propensity to experience household changes involving parents appear to be more negatively affected by these changes relative to those with a higher propensity. The pattern differs for some college completion, where children who are least and most likely to experience parent change are most negatively affected. Children in the middle of the propensity score distribution are predicted to experience small negative effects.

The middle panels in figure 1 show treatment effects of experiencing a household change involving nonparents compared with no changes in household composition. The matching-smoothing estimates for Black children who experience changes involving nonparents do not show monotonic patterns. The negative effect of experiencing a nonparent change on both high school graduation and some college completion is bigger around propensities of between 0.4 and 0.5 and 0.9 and

Figure 1. Matching-Smoothing Heterogeneous Effects of Changes in Household Composition



Source: Author's tabulation.

Note: Propensity scores estimated by logit regressions of household change involving parents, nonparents, and both parents and nonparents on a set of baseline covariates (see table A.1). No household change is the reference group in all models. Shading indicates 95 percent confidence intervals. Figures show middle 90 percent of the propensity score distribution (trimmed below 5th and above 95th percentiles).

smaller (or even positive) in the middle of the propensity distribution.

The bottom panel in figure 1 shows matching-smoothing estimates for the effect of changes involving parents and nonparents on high school graduation and some college completion. The negative consequences of parent and nonparent change for high school graduation among Black children appear to increase as propensity to experience this type of house-

hold change increases, driven by bigger negative effects at the upper end of the propensity score distribution. The pattern of effects of parent and nonparent change on some college completion among Black children is similar to the nonmonotonic pattern observed for nonparent change: more negative effects at smaller and larger propensity scores and less negative, or positive effects, at propensity scores around 0.8.

Linear Probability Models

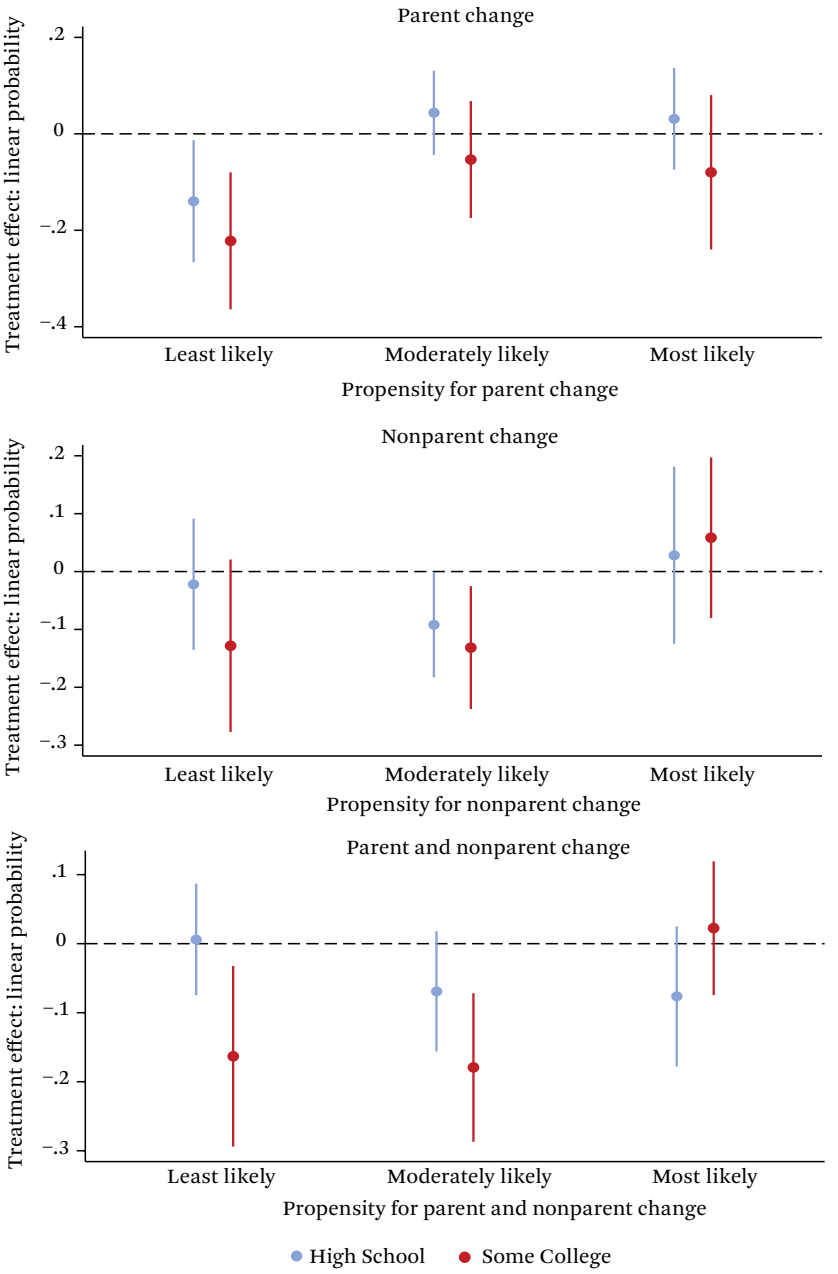
Altogether, the matching-smoothing figures suggest that the likelihood of experiencing different types of household change may help explain the severity of the effect on educational attainment. The next step in the analysis is to estimate treatment effects within each propensity score stratum and compare the effect of a given type of change in household composition on educational attainment for children who are least likely, moderately likely, and most likely to experience the change. Figure 2 plots coefficients from linear probability models regressing indicators for high school graduation or some college completion on parent change, nonparent change, or parent and nonparent change and the individual's propensity to experience the change (coefficients, standard errors, *p*-values, 95 percent confidence intervals, and number of observations per model are presented in table A.3).

The top left plot in figure 2 presents coefficients from models estimating the effect of parent change on educational attainment. The models suggest that the negative effect of parent change may be largest among Black children least likely to experience parent change. The coefficients among Black children moderately and most likely to experience parent change are not significant, much closer to zero, and for high school graduation, are positive. The sample sizes are small within propensity score strata, therefore, these estimates are imprecise, yet the pattern of the point estimates is consistent with the matching-smoothing results. Table A.4 presents a supplemental approach to assessing effect heterogeneity, predicting high school graduation and some college completion with an interaction between household change and indicator variables for propensity score stratum. The main effect of parent change (that is, parent change for the lowest propensity score stratum) is negative and significant, at -0.140 for high school graduation and -0.234 for some college completion. The next two rows of the table present linear combinations of the parent change coefficient and indicators for the moderately and most likely strata, all of which are closer to zero and none of which are significant. This suggests that the negative effects of parent change may be less negative at higher propensities to experience change.

In models estimating the effect of nonparent change on educational attainment (top right plot), the coefficients in the model predicting high school graduation in the least likely stratum and both educational outcomes in the most likely stratum are relatively close to zero and imprecisely estimated. The coefficient predicting some college completion in the least likely stratum and both coefficients within the moderately likely to experience nonparent change stratum are negative and (at least marginally) significant. Recall the matching-smoothing estimates were nonmonotonic, with large negative effects at propensities around 0.4 to 0.5 and positive effects at propensities around 0.8. The regression results reflect this nonmonotonic pattern. Results from table A.4 follow the same pattern, where the effects for least and most likely to experience nonparent change are close to zero with wide confidence intervals and the linear combination of nonparent change and the moderately likely interaction terms are negative and significant for both high school graduation and some college completion.

Finally, the bottom plot presents coefficients from models predicting high school graduation and some college completion for children who experience changes involving parents and nonparents compared with children who experience no such changes. Suggestive evidence indicates a negative gradient for high school graduation as propensity to experience changes involving parents and nonparents increases among Black children, but the estimates are imprecise may not differ from each other. The pooled specification (table A.4) returns negative and marginally significant linear

Figure 2. Coefficients from Strata-Specific Linear Probability Models Predicting Educational Attainment with Household Change



Source: Author's tabulation.

Note: Plots show coefficients and 95 percent confidence intervals for stratum-specific linear probability models predicting high school graduation and some college completion with household change (reference group in all models is no household change), controlling for the individual's propensity score. Propensity scores estimated by a logit regression model of household change on a set of baseline covariates (see table A.2). Coefficients, standard errors, *p*-values, 95 percent confidence intervals, and number of observations for each of the 18 models represented in this figure are shown in table A.3.

combinations of coefficients for the moderately and most likely strata for high school graduation. The pattern of effects for some college completion is similar to the pattern for parent change: significant negative effects of changes involving both parents and nonparents on some college completion among those in the least and moderately likely strata and a nonsignificant coefficient in the most likely stratum, notwithstanding overlap in the confidence intervals across strata.

Supplementary Analyses

My results suggest that different groups of children may experience more or less negative effects of changes in household composition on educational attainment. In supplemental analyses, I focus on characteristics of two groups negatively affected by household change: children who have a low propensity to experience parent change and children who have a moderate propensity to experience both parent and nonparent change. In general, children with a low propensity to experience parent change are relatively advantaged relative to all Black children. A reasonably high proportion live with married parents at baseline with relatively educated heads of household, high employment and homeownership rates, and a more even distribution across income categories (compared with the low-skewed Black income distribution overall). In sum, this group appears to be more advantaged socioeconomically, on average, than children with moderate and high propensities to experience parent change, for whom evidence of negative effects of parent change on educational attainment is much more limited.

One explanation for heterogeneous effects of household change is that the treatment of household change is itself heterogeneous. Perhaps the volume or type of change experienced is different for low-propensity children and high-propensity children. The volume of changes does not appear to explain why low-propensity Black children are the most negatively affected by parent change, given that the number of times children experienced parent change ranges from 1.4 to 1.6 across propensity levels. If we expect a higher volume to lead to more negative effects, this pattern is inconsistent with the regression results. Type of change, however, may provide an explanation. Among low-propensity children, 32 percent have a parent leave their household and 9 percent have a parent join. This group has the biggest gap between the proportion of children who experience a parent leave their household and the proportion who experience a parent join (23 percentage points). If having a parent join is particularly beneficial, or offsets other challenges, then it may not be surprising that I find that children for whom household change rarely includes a parent joining have lower educational attainment.

Whereas Black children who are least likely to experience a change involving parents have characteristics that put them at an advantage, Black children who are moderately likely to experience changes involving both parents and nonparents have on average many fewer resources. Fewer of these children live with married parents at baseline, nearly 30 percent of their heads of household have less than a high school degree, only 13 percent live in an owned home, and nearly one-third have household incomes below the poverty line. These children also experience a high volume of changes in household composition over the course of childhood. Together, fewer socioeconomic resources and more instability in household composition appear to make these children particularly vulnerable to low educational attainment.

DISCUSSION

Changes in household composition can be disruptive to children in the household because of relationships shifted or interrupted when household members join or leave the household, or as a result of changes in physical space, childcare arrangements, or other resources in children's lives. Not all changes in household composition are the same, however, and not all are experienced the same way. Elsewhere in this issue we learn that 150 low-income African American youth in a seemingly homogenous sample experience a wide range of adverse events and conditions and have heterogeneous responses to them: some youth perceive adverse events as negative and destabilizing while others perceive similar events as turning points

or sources of later strength (DeLuca, Papageorge, and Boselovic 2024, this issue). In this article, I explore one facet of heterogeneity in the effects of changes in household composition on Black children's educational attainment: is propensity to experience changes in household composition involving parents, nonparents, or both parents and nonparents related to whether household changes affect high school graduation or some college completion?

My results suggest that there may be heterogeneous effects of changes in household composition on educational attainment among Black children. Black children who are least likely to experience changes involving parents experience the strongest negative effects on educational attainment. This differs from research finding small or no effects of family instability and parental divorce on Black children (Brand et al. 2019b; Cavanagh and Fomby 2019). Instead, I find important, large effects of household change on educational attainment by exploring heterogeneity among Black children. Moving up the propensity score distribution for changes involving parents, the negative coefficients are closer to zero (or even positive) and most are not significantly different from zero. Finding strong negative effects among the least likely to experience change is consistent with an unexpected events explanation for heterogeneous effects (Aquino et al. 2022). Children least likely to experience household change are generally more advantaged than higher propensity children. And yet a stable family may be what is enabling this group to complete more education. When that resource is compromised, these children may have a much tougher time persisting in education. Children who are moderately and most likely to experience changes in household composition may have other disadvantage or instability in their lives, such that the independent effect of household change involving parents may be less consequential for their longer-term educational outcomes. Black children experiencing changes only involving parents are also a select group, only 12 percent of the sample, whereas most of the children in my sample experience changes involving extended family and nonrelatives instead of, or in addition to, changes involving parents.

In the biggest group, the 45 percent of Black children who experience changes involving parents and nonparents, my results suggest that the effects on some college completion are more consistently negative for children who are least and moderately likely to experience changes involving parents and nonparents than for those who are most likely: children who are more compared with less likely to experience these changes may be more negatively affected by them in terms of high school graduation, but confidence intervals for these estimates overlap. The sheer volume of changes in household composition among these children in combination with fewer socioeconomic resources may compromise this group's educational trajectory. Finding negative effects of changes in household composition for educational attainment among Black children runs counter to research concluding family instability is less consequential for Black children's outcomes. My results may differ because I allow for heterogeneity within a group that some prior research treats as homogenous, concurring with recent calls to examine within-group variation in the effects of family processes (Cross 2021; Cross, Fomby, and Letiecq 2022; see also DeLuca, Papageorge, and Boselovic 2024, this issue). Further, research estimating the effects of divorce on children's outcomes assumes an equal treatment for all children whose parents divorce, even if some children who experience divorce also experience parent repartnering and higher order dissolution. Research on family instability assumes household changes involving parents operate similarly regardless of whether changes involving parents are accompanied by changes involving nonparents. My results, suggesting that the pattern of effects may differ for children who have different propensities to experience parent changes and parent and nonparent changes, should justify future research and theory development exploring the full range of household composition and change to which children are exposed.

Attempts to explain or interpret differences by propensity to experience change raise some

limitations of the analysis. First, I use a categorical measure that accounts for all changes in household composition from a child's first year of life through age seventeen. This is a relatively parsimonious measure of change, but it admittedly masks quantity of changes experienced. Children in the no-change category by definition experience no changes in household composition involving parents or nonparents. Children in the parent change category experience, on average, between one and two such changes during childhood. Children in the nonparent change category experience more changes compared with children in the parent change category. And children in the parent and nonparent change category experience the highest quantity of changes overall. Supplementary analyses on type of change suggest that the groups most disadvantaged by changes involving parents—low-propensity—have relatively low rates of parent joining their households relative to parent leaving their households.

As true of all research based on observational data, drawing causal inferences relies on the assumption that I have included all confounding variables in the prediction model estimating the propensity scores. I discussed my decision to include only baseline covariates in the prediction models estimating the probability of experiencing household change. Characteristics that vary over time during childhood may indeed be associated with changes in household composition and educational attainment. By including only baseline covariates, I am not conditioning on potentially endogenous variables, those that could be pathways between household changes and educational attainment, but I am potentially missing some time-varying confounding variables. Additionally, my stratum-specific linear probability models require that I divide the distribution of propensity scores into discrete strata, assuming there is no pretreatment or treatment effect heterogeneity within each stratum (Xie et al. 2012). For ease of interpretation and comparability, I divided propensity scores for each type of change into three strata; some of these distributions may be better represented by a different number of strata.

Table A.3 shows household change coefficients, standard errors, *p*-values, 95 percent confidence intervals, and number of observations for each of the stratum-specific linear probability models predicting high school graduation and some college completion. Some of these estimates are based on only a couple hundred observations, which leads to imprecision in the results and limits my ability to claim that the effects of household change are significantly different across strata. I decided to model each type of household change separately: parent change (only) versus no change, nonparent change (only) versus no change, and parent and nonparent change versus no change. This reduces the sample sizes in each model but also produces "cleaner" estimates that may be easier to interpret, given that the comparison group in all cases contains children who did not experience changes involving parents or nonparents.

Consensus among family sociologists and demographers is established on the importance of family instability for child well-being and outcomes. One strand of recent research finds heterogeneous effects of divorce on educational attainment; a second strand shows that changes in household composition involving extended family and nonrelatives also negatively affect children. In this article, I combine the approaches of these two strands to estimate heterogeneous effects of household change on educational attainment among Black children. I find that the negative effects of changes in household composition may vary based on a child's likelihood of experiencing household change. These findings contribute to a burgeoning literature on heterogeneous effects of disruptive events and my results finding significant negative effects among a subgroup of Black children underscore recent research calling for more attention to how family processes differ and have different effects within racialized groups.

Table A.1. Logit Models Predicting Propensity Score

	Parent Change		Nonparent Change		Parent and Nonparent Change	
	Coefficient	95 percent CI	Coefficient	95 percent CI	Coefficient	95 percent CI
Year	0.03***	(0.01,0.05)	−0.01	(−0.03,0.01)	0.01	(−0.01,0.02)
Child female	0.01	(−0.29,0.30)	0.01	(−0.28,0.30)	−0.02	(−0.27,0.24)
Married parents	−0.49	(−1.61,0.63)	−0.74	(−2.04,0.55)	−1.29*	(−2.28,−0.30)
Has older sibling	0.03	(−0.41,0.47)	−0.14	(−0.58,0.29)	−0.48**	(−0.85,−0.12)
Parent is head	1.93	(−0.78,4.65)	−1.65*	(−3.03,−0.26)	−1.55*	(−2.75,−0.34)
Head characteristics						
Female	−0.14	(−1.57,1.29)	2.73***	(1.32,4.15)	0.94	(−0.15,2.03)
Age	0.01	(−0.02,0.03)	0.02	(−0.01,0.05)	−0.02	(−0.04,0.01)
Education (ref = high school diploma)						
Less than high school	0.09	(−0.29,0.48)	0.07	(−0.29,0.44)	0.29	(−0.02,0.60)
Some college	0.27	(−0.13,0.67)	−0.01	(−0.44,0.41)	0.26	(−0.10,0.61)
Bachelor's or more	−0.57	(−1.20,0.06)	−0.45	(−1.08,0.18)	−0.70*	(−1.26,−0.14)
Employed	−0.68**	(−1.19,−0.17)	0.05	(−0.49,0.59)	−0.44	(−0.89,0.02)
Lives in South	−0.19	(−0.53,0.15)	0.03	(−0.30,0.36)	−0.30*	(−0.59,−0.01)
Household characteristics						
Home is owned	−0.61***	(−0.96,−0.25)	−0.20	(−0.55,0.15)	−0.45**	(−0.75,−0.14)
Household income quintile (ref = first)						
Second	0.09	(−0.57,0.75)	−0.04	(−0.68,0.60)	−0.43	(−0.96,0.09)
Third	−0.45	(−1.18,0.28)	−0.17	(−0.89,0.54)	−0.94**	(−1.54,−0.35)
Fourth	−0.21	(−1.00,0.59)	0.10	(−0.69,0.88)	−0.53	(−1.18,0.12)
Fifth	−0.47	(−1.61,0.66)	−0.40	(−1.58,0.79)	−1.05*	(−2.05,−0.05)
Poverty income	−0.35	(−1.02,0.31)	−0.30	(−0.91,0.31)	−0.39	(−0.90,0.13)
Household size	0.55	(−0.46,1.56)	2.01***	(1.30,2.73)	2.03***	(1.38,2.68)
Number of children	−0.49	(−1.51,0.54)	−1.50***	(−2.24,−0.76)	−1.51***	(−2.17,−0.86)
SEO sample	−0.00	(−0.45,0.44)	−0.03	(−0.45,0.40)	−0.09	(−0.47,0.29)
Constant	−61.08***	(−96.18,−25.97)	10.37	(−25.84,46.59)	−17.56	(−48.51,13.39)
Observations	794		1,342		1,760	

Source: Author's tabulation.

Note: Table shows coefficients and 95 percent confidence intervals (CI) for three logit models predicting type of household change with child, head of household, and household characteristics. No household change is the reference group in all three models.

* $p < .05$; ** $p < .01$; *** $p < .001$

Table A.2. Descriptive Statistics by Propensity Strata

	Parent Change			Nonparent Change			Parent and Nonparent Change		
	Least Mean (SD)	Moderately Mean (SD)	Most Mean (SD)	Least Mean (SD)	Moderately Mean (SD)	Most Mean (SD)	Least Mean (SD)	Moderately Mean (SD)	Most Mean (SD)
Household change category									
Change in parents	0.33	0.38	0.72	0.00	0.00	0.00	0.00	0.00	0.00
Change in nonparents	0.00	0.00	0.00	0.22	0.59	0.90	0.00	0.00	0.00
Change in both parents and nonparents	0.00	0.00	0.00	0.00	0.00	0.00	0.35	0.63	0.92
Educational attainment									
High school graduation	0.87	0.78	0.85	0.91	0.74	0.72	0.85	0.76	0.71
Some college	0.48	0.43	0.42	0.55	0.30	0.27	0.55	0.29	0.22
Baseline characteristics									
Child sex (female=1)	0.50	0.42	0.47	0.45	0.38	0.56	0.46	0.46	0.46
Child lives with married parents	0.86	0.67	0.54	1.00	0.57	0.15	0.92	0.70	0.20
Child's parent is head of household	0.99	1.00	1.00	1.00	1.00	0.55	1.00	1.00	0.60
Child has an older sibling	0.60	0.65	0.65	0.49	0.76	0.66	0.56	0.59	0.54
Characteristics of head of household									
Sex (female=1)	0.14	0.32	0.41	0.00	0.41	0.71	0.08	0.29	0.59
Age	28.65 (5.70)	29.04 (6.25)	28.10 (6.04)	28.38 (5.18)	29.52 (7.47)	38.22 (13.33)	31.09 (6.49)	27.64 (5.72)	36.03 (14.64)
Education									
Less than high school	0.20	0.28	0.17	0.15	0.25	0.59	0.12	0.29	0.62
High school diploma	0.38	0.46	0.38	0.40	0.50	0.32	0.45	0.53	0.25
Some college	0.13	0.16	0.46	0.15	0.20	0.06	0.12	0.14	0.11
Bachelors or more	0.29	0.10	0.00	0.30	0.05	0.02	0.32	0.04	0.02
Employment									
Employed	1.00	0.96	0.80	0.98	0.92	0.77	0.98	0.98	0.73
Unemployed	0.00	0.04	0.15	0.02	0.08	0.12	0.01	0.01	0.14
Retired or disabled	0.00	0.00	0.04	0.00	0.01	0.11	0.01	0.00	0.13

(*continued*)

Table A.2. (*continued*)

	Parent Change			Nonparent Change			Parent and Nonparent Change		
	Least Mean (SD)	Moderately Mean (SD)	Most Mean (SD)	Least Mean (SD)	Moderately Mean (SD)	Most Mean (SD)	Least Mean (SD)	Moderately Mean (SD)	Most Mean (SD)
Marital status									
Married	0.86	0.67	0.54	1.00	0.57	0.26	0.92	0.70	0.39
Single	0.08	0.24	0.38	0.00	0.32	0.35	0.04	0.22	0.30
Widowed, divorced, separated	0.06	0.08	0.08	0.00	0.11	0.40	0.05	0.07	0.31
Region of residence									
South	0.71	0.58	0.43	0.62	0.53	0.58	0.65	0.63	0.59
Housing tenure									
Owned	0.59	0.20	0.04	0.50	0.23	0.30	0.62	0.13	0.27
Household income quintile									
First	0.18	0.34	0.24	0.08	0.35	0.50	0.05	0.33	0.49
Second	0.13	0.33	0.61	0.24	0.31	0.29	0.23	0.39	0.31
Third	0.40	0.16	0.06	0.39	0.13	0.13	0.40	0.15	0.11
Fourth	0.17	0.16	0.09	0.19	0.21	0.07	0.23	0.13	0.06
Fifth	0.12	0.01	0.00	0.09	0.00	0.01	0.10	0.00	0.03
Income below poverty line	0.18	0.32	0.19	0.07	0.32	0.53	0.04	0.31	0.50
Household size	3.71 (0.83)	3.83 (1.18)	3.99 (1.59)	3.54 (0.56)	3.84 (1.33)	6.18 (2.70)	3.63 (0.73)	3.62 (1.09)	5.80 (2.44)
Number of children in household	1.85 (0.83)	2.15 (1.13)	2.34 (1.44)	1.54 (0.56)	2.25 (0.94)	3.53 (2.11)	1.71 (0.69)	1.92 (0.89)	3.19 (1.95)
First year child observed in PSID	1979	1984	1990	1982	1983	1983	1983	1983	1983
SEO sample	0.51	0.71	0.55	0.65	0.58	0.61	0.53	0.59	0.60
Observations	235	312	185	290	337	605	302	371	931

Source: Author's tabulation.

Note: Table shows descriptive statistics presented in table 1 by the three propensity score strata (least likely to experience change, moderately likely, most likely) across each of the three treatment conditions. Each column contains individuals who experienced one of three types of household change and individuals in the reference group of no household change but who have a similar propensity to experience household change. Statistics limited to Black children and are weighted to account for sampling design and attrition.

Table A.3. Household Change Coefficients from Linear Probability Models

	High School					Some College				
	Coefficient	SE	*p*	95 percent CI	*N*	Coefficient	SE	*p*	95 percent CI	*N*
Parent change										
Least likely	−0.140	0.064	0.031	(−0.266, −0.013)	236	−0.222	0.072	0.002	(−0.364, −0.080)	211
Moderately likely	0.044	0.044	0.326	(−0.044, 0.131)	315	−0.053	0.062	0.387	(−0.174, 0.068)	288
Most likely	0.031	0.053	0.560	(−0.074, 0.136)	190	−0.080	0.081	0.326	(−0.240, 0.080)	178
Nonparent change										
Least likely	−0.022	0.058	0.703	(−0.135, 0.091)	295	−0.128	0.076	0.091	(−0.277, 0.021)	269
Moderately likely	−0.092	0.046	0.046	(−0.183, −0.001)	339	−0.131	0.054	0.015	(−0.238, −0.025)	312
Most likely	0.028	0.078	0.718	(−0.125, 0.181)	613	0.058	0.071	0.409	(−0.080, 0.197)	592
Both change										
Least likely	0.006	0.041	0.884	(−0.075, 0.087)	303	−0.163	0.066	0.015	(−0.294,− 0.032)	267
Moderately likely	−0.069	0.044	0.119	(−0.156, 0.018)	374	−0.179	0.055	0.001	(−0.287, −0.072)	350
Most likely	−0.076	0.052	0.140	(−0.178, 0.025)	945	0.022	0.049	0.650	(−0.074, 0.119)	903

Source: Author's tabulation.

Note: Table shows output from eighteen stratum-specific linear probability models predicting high school graduation or some college completion. Each row shows the treatment coefficient (no household change is the reference group in all models), standard error, *p*-value, 95 percent confidence interval, and number of observations. The only covariate in these models is the individual's propensity score estimating propensity to experience the treatment household change.

Table A.4. Household Change Coefficients from Pooled with Dummy Regression Models

	High School					Some College				
	Coefficient	SE	*p*	95 percent CI	*N*	Coefficient	SE	*p*	95 percent CI	*N*
Parent change					741					677
Least likely	−0.140	0.063	0.027	(−0.263, −0.016)		−0.234	0.072	0.001	(−0.375, −0.094)	
Moderately likely	0.047	0.044	0.284	(−0.039, 0.134)		−0.055	0.064	0.364	(−0.174, 0.064)	
Most likely	0.023	0.053	0.661	(−0.080, 0.127)		−0.081	0.080	0.315	(−0.239, 0.077)	
Nonparent change					1,247					1,173
Least likely	−0.024	0.057	0.675	(−0.135, 0.087)		−0.139	0.078	0.075	(−0.293, 0.014)	
Moderately likely	−0.106	0.046	0.020	(−0.196, −0.016)		−0.150	0.055	0.007	(−0.258, −0.042)	
Most likely	0.017	0.075	0.821	(−0.130, 0.164)		0.049	0.061	0.421	(−0.071, 0.170)	
Both change					1,622					1,520
Least likely	−0.014	0.041	0.723	(−0.095, 0.066)		−0.183	0.063	0.004	(−0.307, −0.060)	
Moderately likely	−0.076	0.043	0.081	(−0.161, 0.009)		−0.192	0.055	0.000	(−0.299, −0.084)	
Most likely	−0.079	0.048	0.097	(−0.173, 0.041)		0.028	0.044	0.528	(−0.059, 0.114)	

Source: Author's tabulation.

Note: SE = standard error. CI = confidence interval. Table shows output from three models predicting high school graduation and three models predicting some college completion with a given type of household change, two indicator variables for membership in the moderate or most likely strata to experience the change (least likely is the reference group), and an interaction between the type of change and the indicator variables. The coefficients shown are the main effect for the type of change (in the least likely row since that is the omitted category for the strata variable) and linear combinations of the main effect of the change plus the interaction term between change and strata (in the moderately likely and most likely rows). These rows should be compared with the equivalent rows in table A.3.

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Exploring the Trade-Off Between Surviving and Thriving: Heterogeneous Responses to Adversity and Disruptive Events Among Disadvantaged Black Youth

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This article examines heterogeneity in adverse events and conditions and how low-income African American young adults respond. Although nearly all individuals in the sample report at least one instance of adversity, the nature and frequency of adversity varies, as do the responses. Some individuals see their lives and plans derailed; others engage in more protective strategies. For still others, adversity presents a difficult trade-off between surviving and thriving. We formalize this trade-off as an extension of a basic model of costly human capital investments. The model shows that a rational, fully informed individual facing this brutal trade-off, in an effort to survive the fallout of adversity, may optimally choose not to make high-return investments that promote thriving in the future. Improved policy design would recognize this type of trade-off.

Keywords: poverty, adversity, violence, human capital, qualitative methods, mixed methods

Volumes of social science research show that different forms of adversity predict diminished social, educational, and economic outcomes among children and young adults. Adversity, moreover, includes a wide range of circumstances, patterns, and events, from long-standing disadvantageous conditions, such as living in a violent neighborhood or growing up

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with an addicted family member, to shorter disruptive episodes or events that could last merely seconds, such as witnessing or being a victim of a shooting. The impacts of exposure to adversity can occur immediately and also reverberate over the life course (see Felitti et al. 1998; Schafer, Ferraro, and Mustillo 2011). According to the U.S. Department of Justice (2020), 60 percent of American children have been exposed to violence, crime, or abuse, which can occur at home, at school, or in their neighborhood, with higher rates among Black children. For example, Dean Kilpatrick, Benjamin Saunders, and Daniel Smith (2003) find that 57.2 percent of Black children, versus 34.3 percent of White children, have witnessed acts of violence in their lifetime.

The consequences of exposure to adversity and disruptive events are dire, including low performance at school, poor physical and mental health, violent behavior, and criminality, among many others. Moreover, these impacts can vary; a long-standing literature on resilience (Troy et al. 2022) finds that not all adverse events lead to significant disruption in functioning, and a growing body of research examining heterogeneous impacts of adversity suggests that individuals who face similar adverse events may exhibit different responses in ways that affect the long-run consequences of adversity (Aquino, Brand, and Torche 2022). For instance, evidence suggests that females face worse mental health consequences after exposure to violence than males do (Fitzpatrick and Boldizar 1993).

Despite an increasing focus on heterogeneity, few studies examine variation in decision-making in response to adversity and disruption. Yet the strategies people develop and the choices they make in the face of adversity, including efforts to manage and mitigate the short-run consequences of adversity, can likely help explain heterogeneous consequences. This includes variation in whether and how the consequences of adversity extend to long-run outcomes over the lifecycle and thus contribute to or perpetuate inequality.

In this article, we examine heterogeneity in adverse experiences as well as subsequent behavior and decision-making in response to these disruptions. We use data from a sample of 150 low-income African American youth born in high-poverty neighborhoods in Baltimore. Data were collected via in-depth semi-structured interviews, and cover significant ground, from life histories to future hopes, and thus offer rich narratives on adversity and responses to it. Although our focus on low-income Black youth suggests homogeneity along important dimensions of disadvantage—indeed, we find that nearly all respondents experienced some form of serious adversity—our sample exhibits important variation in how adverse events manifest and how young people respond to them. Research documents that young adults growing up in neighborhoods of concentrated disadvantage face serious adversity and economic barriers to educational and occupational attainment, but less commonly examines the range of reactive behaviors and decision-making in the wake of these difficult events (for exceptions, see Small 2004; Edin and Kefalas 2005; Hannerz 1969). Moreover, as we explain, reported adversity shows temporal heterogeneity, from short one-time instances (disruptive events) to long-standing circumstances (adverse conditions). Thus, when we use the term *adversity*, we refer to both, although shorter disruptive events are often more remarked upon in youths' accounts.

Our analysis begins with a categorization of young adults' descriptions of adversity. We create a typology that allows us to observe not only the frequency but also the nature of disruption and adversity along several dimensions of heterogeneity, including the time frame. For example, some youth live in violent and poor neighborhoods or homes, where victimization, addiction, or family instability are long-standing and woven into the fabric of their lives (for other longer-duration adverse circumstances, see in this issue Turney et al. 2024; Bailey et al. 2024; Rauscher and Cao 2024). Others also experience more acute shocks, such as the death or incarceration of a family member or bouts of homelessness (on more acute events, see in this issue Baranowska-Rataj, Högberg, and Voßemer 2024; Alcaíno and Argote 2024; Khalid et al. 2024). In general, most respondents who report a destabilizing disruptive event do so against a backdrop of ongoing adverse conditions; for example, being a victim of

a violent assault may be reported by someone who also describes living in a neighborhood where violent crime occurs regularly.

We also examine respondents' perceptions of adversity. The interviews were not designed to ask about adverse events per se but to understand how social context shapes the transition to adulthood. Thus that we learn so much about adversity is telling in its own right. Although it is not always possible to draw conclusions given that interviewers did not explicitly ask about adverse events or perceptions of adversity, the perceptions we do observe provide prima facie evidence that what we as researchers characterize as adversity is indeed perceived as such by respondents. In their narratives, many young adults also describe what happened and what they did in the wake of these adverse events and shocks, which in turn supports the idea that we can describe some of their reactive and intentional responses and decision-making processes. Thus, this article not only describes adverse events in great detail, but also examines how youth explain their own rationales for how they responded to these events—prioritizing their agency over our analysis.

This leads to a second and central part of our study, which is to describe how young adults respond to adversity in general and disruptive events in particular. We find significant heterogeneity in these responses, including both reactive coping strategies and intentional protective decisions, which have implications for longer-term trajectories and outcomes, and may be potential mechanisms that help generate or perpetuate social and economic inequality. In particular, we identify three basic categories of responses. Responses in the first category amount to different forms of derailment, including running away, living on the streets, turning to crime to make money, or coping with trauma by using addictive substances. This response is best understood less as an active or deliberate way to manage adversity and more as a reaction to the perception—perhaps correct in many cases—that there is little to be done to improve circumstances given the depth of adversity faced. The second category of responses includes protective actions and behaviors that may counteract or help respondents avoid the worst aspects of adversity and, moreover, are likely to be beneficial in the long term. For example, a focus on school or extracurricular activities can provide a safe haven from violence and is also an investment in human capital with potential long-term payoffs.

A third and intriguing category—one that requires additional focus—embodies a set of behaviors and choices respondents make that may be helpful in the short term but could be harmful in the long term, such as dropping out of school to care for relatives and social avoidance or withdrawal strategies. Avoidance strategies, for example, may protect youth from violence in the near term, but might also backfire in the long term by limiting youths' exploration of social networks and activities, which could then limit their eventual schooling and career options. In other words, some strategies that can help individuals survive (that is, avoid some of the worst outcomes, such as death, incarceration, persistent criminality, homelessness, or neglect of an ailing or vulnerable family member), may diminish their ability to thrive (that is, reach their potential or make sustained progress toward their stated goals, or find activities at school, home, or work that they find meaningful or engaging).[1]

In the final part of this analysis, we posit a simple model, motivated by our empirical findings, especially heterogeneous responses and the potential trade-off between surviving and thriving that some individuals seem to face. The model formally characterizes this type of trade-off, which can lead individuals to adopt strategies that make it difficult to thrive and thereby captures one way that adversity can generate and perpetuate inequality. The model

1. A natural extension of the analysis would be to relate adversity and strategies in the sample to long-term outcomes, but the data are not well suited to this exercise. Most of the youth were just entering adulthood when they were last interviewed, and follow-up fieldwork was conducted with only a subset of respondents up to two years later. It would therefore be premature to make strong claims about the long-term impacts of varied responses to adversity.

also incorporates the idea that the trade-off between surviving and thriving may be irrelevant to individuals for whom survival is nearly assured, but for many people who face violence, instability, and scarcity, it may be a recurring factor affecting their choices.

In general, the model captures the idea that individuals living in poverty can face a brutal trade-off: surviving, even if doing so blunts their ability to thrive. An implication is that policies to break cycles of poverty could focus on interventions designed around recognition of this trade-off. As a simple example, afterschool programs to help students prepare for postsecondary education may not be useful for students who must take care of an ailing relative or who fear for their personal safety or literal survival when they travel to or from school (Burdick-Will 2013); similarly, postsecondary educational pathways and the financial aid policies to support them may require too stringent a timetable for completion than some youth can manage given the need to stop out and work to support a vulnerable household (see Hart 2019).

Our approach to investigating adversity is unique and multidisciplinary. Approaches to studying adversity vary both within and across disciplines and include the collection and analysis of qualitative data (such as semi-structured interviews and ethnographic observations), experimental or causal inference methods applied to "big data," and nationally representative data sets, to estimate treatment effects of adverse and disruptive experiences. Still other methods focus on the development of theoretical models of dynamic decision-making that can be matched to data and employed to simulate responses to counterfactual policies that reduce adversity or mitigate some of its consequences. Each approach can help us understand how adversity weaves its way through individuals' decisions and experiences over the life course and thus how adversity generates and perpetuates inequality. However, the conceptual frameworks and methods are nearly always used in isolation when, presumably, bringing more tools to bear could lead to stronger evidence of the nature and consequences of adversity and, thus, better policy to address it (for another example, see also Bergman et al. 2023).[2] Given the set of methods we use, this study represents an attempt to help bridge disciplinary divides.

LITERATURE REVIEW

Hundreds if not thousands of studies in the empirical social sciences examine adversity and its consequences (see Torche, Fletcher, and Brand 2024, this issue). We do not try to cover this entire body of literature, but instead focus on studies that illustrate approaches to which we see this article as a direct contribution. We consider examples of research from economics and sociology (among other fields) on adversity, especially in high-poverty neighborhoods; the interaction between poverty and low human capital investments, which helps perpetuate poverty; and interactions between poverty and decision-making more generally.

Adversity in High-Poverty Contexts

A well-developed literature spanning thirty years looks at how urban poverty—especially neighborhood disadvantage—presents adversities that shape child and youth outcomes (Mayer and Jencks 1989; Wilson 1987; Chetty, Hendren, and Katz 2016). In particular, scholars find that young people growing up in high poverty, violent communities are more likely to drop out of high school, engage in delinquency, and become teenage parents, and less likely to go to college (Leventhal and Brooks-Gunn 2000; Sampson, Morenoff, and Gannon-Rowley 2002; Sampson, Sharkey, and Raudenbush 2008; Sharkey 2010; Wodtke et al. 2011; Harding 2003; Papachristos, Hureau, and Braga 2013). More recently, many economists have also turned their attention to neighborhood-level factors that capture different forms of adversity

2. Different methods are not always used in tandem for practical reasons as well. For example, structural econometric models are computationally burdensome, which limits how many variables or mechanisms can be incorporated if the model is to remain tractable. Relatedly, qualitative data that generate rich narratives and could help inform conceptual models are not always well suited for causal inference and are labor intensive and expensive to collect as well.

for low-income children and families and also explain disadvantaged outcomes, such as health disparities (Currie 2011), violence (Grogger 1997), incarceration of parents and siblings (Norris, Pecenco, and Weaver 2021; Bhuller et al. 2018), eviction or foreclosures (Diamond, Guren, and Tan 2020; Collinson et al. 2022), exposure to pollution (Currie et al. 2009), discrimination (Lang and Manove 2011), and juvenile incarceration (Aizer and Doyle 2015).

Yet the specific mechanisms through which these adverse events experienced by young adults like those in our sample (that is, those facing the same types of family, school, or neighborhood disadvantage) affect their development—though well theorized—remain relatively understudied (Sharkey and Faber 2014; Galster and Sharkey 2017). Variation in neighborhood and structural factors such as schools (Schwartz 2010; Johnson 2019), exposure to violence (Sharkey 2010; Sharkey and Torrats-Espinosa 2017), and policing regimes (Neil and Sampson 2021) predict unequal educational and economic outcomes, and additional work has suggested that violent, high-poverty neighborhoods diminish parents' mental health and their efficacy (Ludwig et al. 2013; Diez Roux and Mair 2010). Yet research focusing on how such factors—violence, policing, parental efficacy under duress, and inadequate school conditions—directly shape the decisions of young people that are most consequential for their future attainment is still scant. We know youth face these conditions in their daily lives in low-income neighborhoods or households, but exactly how do these adversities and constraints translate into diminished outcomes, and how do we explain heterogeneity in these outcomes for youth from similar backgrounds?

Beyond providing a detailed taxonomy of adversity and disruptive events from a sample of low-income Black youth, our contribution is to leverage interdisciplinary frameworks and qualitative data to formalize a specific mechanism through which adversity can have long-term consequences consequences. We argue that adversity can generate a trade-off between mitigating the immediate consequences of adversity and improving longer-term outcomes. We formalize this idea as a simple model of human capital in which long-term investments imply large—and largely unappreciated or invisible—costs that make them suboptimal.

Poverty and Human Capital Accumulation

The literature in economics on human capital accumulation, defined as the set of skills, traits, experiences, and other factors that predict lifecycle outcomes, is massive. Traditionally, models of human capital incorporate education and work experience (Mincer 1958; Becker 1962) or different kinds of productive abilities, such as manual versus academic skill (Willis and Rosen 1979). Economists have since incorporated new dimensions into our understanding of what constitutes human capital, such as health (Grossman 1972) and socioemotional skills (Heckman and Rubinstein 2001), among many others. A large literature continues to extend our understanding of human capital, focusing on how individuals make costly investments that increase their human capital, a canonical example being investments in education. An important question that continues to generate scholarship is why disadvantaged groups often invest less in their human capital; for example, why do people from poor families complete less education even after conditioning on measures of academic performance, such as test scores? Earlier work has offered many plausible explanations, including credit constraints (Lochner and Monge-Naranjo 2012; Hai and Heckman 2017), impatience (Levitt et al. 2016), and incorrect information about the returns to human capital investments (Cunha, Elo, and Culhane 2022), among others.

Sociological research, especially scholarship in urban and cultural sociology, comes closer to our article in recognizing that contending with poverty can itself create additional hardships, which thus reinforce disadvantage and inequality in human capital outcomes; this literature also argues that heterogeneity is significant in these processes (for reviews, see Newman and Massengill 2006; Small, Harding, and Lamont 2010). Low-income African American youth, whose neighborhoods have long been more socially isolated and economically disadvantaged than the neighborhoods of White youth (Sampson 2012; Sharkey 2008), must make difficult trade-offs as they cope with

adverse events and navigate their social networks, families, and communities. For example, experiences of school or neighborhood adversity or instability lead some youth to isolate or strategically cut their social ties (Chan Tack and Small 2017; Clampet-Lundquist et al. 2011; Koogler 2019; Rosenblatt, Edin, and Zhu 2015; Trinidad 2021; Warner, Warner, and Kuhl 2017) and take on or exit certain challenging family roles (Burton 2007; Haynie et al. 2009; Turney, Liu, and Marin 2024, this issue). Nikki Jones (2010) finds that some young African American women in Philadelphia survived violent and risky neighborhoods by fighting, and others by practicing "situational avoidance."

Scholars also find that youth in low-income neighborhoods pursue low-wage jobs and subbaccalaureate education after high school—instead of four-year degrees—because they perceive these to be viable options to avoid the street, meaningful ways to provide for one's family in the near term, and tethers to long-term aspirations that in the short term, seem impossible to realize (Cox 2017; Newman 1999; Deterding 2015; Holland and DeLuca 2016). Such research suggests that rather than a lack of interest in optimally investing in their futures, youth can be strategic and adaptive in the face of limited resources and environments that make their goals much harder to achieve (see Harding 2010).Indeed, significant work in urban sociology argues that we must account for the importance of poverty, neighborhoods, and adverse experiences when trying to understand the outcomes of low-income young adults, as these contexts shape how they make investments in their education and perceive trade-offs between different options (Anderson 1999; Elliott et al. 1996; Wilson 1987; Young 1999). Such insights also help explain why their efforts do not necessarily accumulate into conventional indicators of social mobility and success (Anderson 1999; Elliott et al. 1996; Wilson 1987; Young 1999). This perspective is consistent with and guides our work in this article.

Less explicitly developed in earlier research is the idea that there may be circumstances or contexts in which surviving and thriving are in direct conflict with one another in the sense that investments that make the former more probable make the latter less probable. Some precedent for this idea is found in models of long-run investments focused on individuals living at or near subsistence in developing economies (see, for example, Banerjee and Duflo 2007). Individuals living near subsistence may not save even despite high returns if doing so means they cannot meet their most basic needs, such as consuming sufficient calories. Similarly, if an investment in long-term human capital lowers the likelihood of avoiding disastrous outcomes, rational individuals may not make them.

Poverty and Decision-Making

More generally, we relate to earlier scholarship on decision-making among disadvantaged groups that goes beyond decisions about human capital investments. However, some distinctions are significant. Research in economics has often argued that people living through scarcity, disruption, or adversity may exhibit suboptimal decision-making, for example, due to lack of information or a failure to properly incorporate long-term ramifications of their behavior (Mullainathan and Shafir 2013; Bertrand, Mullainathan, and Shafir 2004). Often categorized under the umbrella term *behavioral economics*, multiple modeling approaches predict suboptimal investments in long-term outcomes, such as savings and human capital (education, for example). These include incorrect information, such as biased beliefs about the returns to long-term investments (see Cunha, Elo, and Culhane 2022) or a preference for short-run payoffs that thwart plans that have payoffs far into the future (see Levitt et al. 2016).[3]

Other lines of research, common in sociology, have focused less formally on decision-making and rationality per se (see discussion in Bruch and Feinberg 2017; DeLuca and Jang-Trettien 2020) but have long acknowledged some of the inherent trade-offs that low-income individuals may face when deciding how to achieve mainstream goals such as marriage and parenthood without well-resourced avenues to do so (Edin and Lein 1997; Bell et al.

3. For a summary of these models, see Rabin 1998.

2018). Similarly, some sociologists have explored the adaptative behaviors some low-income men enact to achieve alternative goals (such as drug dealing and pursuing working-class jobs) when opportunity for higher aspirations is blocked (MacLeod 1987; Willis 1977; Anderson 1999); many of these decisions essentially raise the costs of long-term investments in education or other forms of human capital. As Mario Small, David Harding, and Michèle Lamont (2010, 9) point out, acting on "the 'right' set of values or beliefs may actually undermine one's mobility when exercised in a difficult context."

Our article, especially the model we develop, suggests that a rational, fully informed, and dynamically optimizing individual seeking to survive may engage in behaviors that undermine their ability to thrive. For example, social isolation may be the optimal choice to survive adversity or danger even if doing so reduces labor-market opportunities because it makes success in school more elusive. Although suboptimal decision-making may certainly play a role in the lives of the youth in our study, as in many contexts, the model we propose does not require these features to explain seemingly counterproductive behavior. Instead, the model is based on the idea that choices may be fully rational. In our case, long-term investments in human capital may entail sizable costs for disadvantaged individuals (costs that are underappreciated or invisible to some researchers and policymakers even if they are well known to others) such that it appears that decisions affecting investments in human capital are suboptimal even though they are not.

DATA AND METHODS

This article uses qualitative data gathered from in-depth semi-structured narrative interviews to examine heterogeneity in the experience of adverse events, and how youth respond to adverse events, with attention to how such responses and decision-making might relate to outcomes in the transition to adulthood. We draw on a sample of 150 low-income African American youth and young adults living in high-poverty, racially isolated neighborhoods in the city of Baltimore, Maryland (table 1). The data originated from a mixed-methods follow-up study of families in Baltimore who were part of the Moving to Opportunity (MTO) program, an experimental housing and neighborhood intervention implemented in the 1990s.[4] A total of 636 families in Baltimore participated in this program, and a qualitative component was later added to examine the transition to adulthood among youth in the study (directed by Susan Clampet-Lundquist, Stefanie DeLuca, and Kathryn Edin).

A stratified random sample of two hundred youth from the MTO study (ages fifteen to twenty-four) were chosen (stratified by gender, age and treatment arm), and 75 percent agreed to participate in the qualitative portion of the study ($N = 150$). Most interviews were conducted in respondents' homes, and 96 percent of respondents still lived in the Baltimore area at the time of the interview. All names have been changed, many to pseudonyms chosen by the respondents themselves. Forty-nine percent of the sample was female, and the mean age of respondents was 19.6 years old.[5] The sample at baseline was significantly disadvantaged—youths and their families were public housing tenants, who were among the poorest residents in Baltimore at the time. Mean household income (in 2022 dollars) was $10,580.60, roughly 42.9 percent of the poverty line in 1994. Some 63.2 percent of the sample lived in households receiving Aid to Families

4. The MTO experiment is not a focal part of this article; rather, participants whose families were part of the initial MTO experiment make up a population of economically disadvantaged individuals from which we use the data to understand adverse events in the lives of youth. While the experiment, which reduced exposure to neighborhood poverty, also reduced exposure to adverse events for some youth (namely, victimization and safety issues in the neighborhood, see DeLuca, Clampet-Lundquist, and Edin 2016), the extent and frequency of adversity experienced by youth in the study is still significant.

5. The more detailed sample distribution is as follows: fifteen to sixteen years old (14 percent); seventeen to eighteen years old (17 percent); nineteen to twenty years old (27 percent); twenty-one to twenty-two years old (34 percent); and twenty-three to twenty-four years old (8 percent).

Table 1. Descriptive Characteristics of Youth Sample

	Percent	Mean
Age	—	19.6
Household income (in 2022 dollars)*	—	10,580.6
Black or African American	100.0	—
Female	49.3	—
Household received AFDC*	63.2	—
Head of household never married*	74.2	—
Head of household not working*	76.3	—
Missing**	1.3	—
Parent educational status		
Did not finish high school	67.6	—
Completed high school degree or GED	32.4	—
Never attended college	86.7	—
Ever attended college	13.3	—
Highest level of youth educational attainment		
Currently in high school	25.3	—
No high school diploma	9.3	—
High school diploma or GED	24.0	—
Attended trade school	16.7	—
Attended two-year college	12.7	—
Attended four-year college	10.7	—
N	150	—

Source: Authors' tabulation.
Note: Household income was adjusted for inflation from 2003 dollars to 2022 using the BLS CPI Inflation Calculator. AFDC is Aid to Families with Dependent Children.
*Data were collected when youth were ten years old and younger.
**Missing indicates the percentage of respondents who are missing key demographic data.

with Dependent Children. Most of the youth (74.2 percent) lived in households where the head of household had never married, and where the head of household was not working (76.3 percent). Only 32 percent of the sample had parents who completed a high school degree or the equivalent, and only 13.3 percent had parents who ever attended any kind of postsecondary institution (almost none were four-year). Among youth respondents, 25.3 percent were currently in high school at the time of the study, 9.3 percent had no high school diploma or GED (General Educational Development) certificate, and 24 percent had a GED or high school diploma as their highest level of education. Although 40 percent of the sample (69 percent of the high school graduates) ever attended any postsecondary educational institution, only 10.7 percent ever attended a four-year institution; 16.7 percent had ever attended trade school; and 12.7 percent ever attended a two-year institution.[6]

The interviews covered a wide scope of topics and experiences around respondents' transition into adulthood (for more on sample and interview design, see DeLuca, Clampet-Lundquist, and Edin 2016). The semi-structured, in-depth interviews included open-ended questions

6. By the end of our study, only one youth had completed a bachelor's degree.

about employment, education, neighborhoods, friends and family, risky behavior, and mental health. Youth were asked directly about their college and career preparation, postsecondary decision-making process, and, for youth who were interviewed after high school, their experiences in the labor market and postsecondary institutions. However, discussions of adverse experiences emerged inductively in these interviews—they were not asked about directly. The sample allows us to understand heterogeneity among a group of youth often studied as if their trajectories were the same. Their shared socioeconomic origins explain how they ended up in the sample, but we observe significant differences in their pathways into adulthood and responses to adversity.

Methods

These data were not collected with the intention to analyze heterogeneity in adversity and disruption. Despite the difficulty in simplifying the complex and layered landscapes of adversity in respondents' lives, we developed our coding scheme by first identifying several important aspects of adversity where heterogeneity could be observed, such as geographic and social proximity, and recency. Duration is a key dimension where we observe differences as respondents describe both long-standing adverse conditions along with individual events that could last a few seconds or something in between, such as relatively short periods of scarcity or crisis. Indeed, they often report several; for example, it is typical for disruptive events to occur during a longer period of adverse conditions.

Our typology thus extends beyond the well-known Adverse Childhood Experiences Study (ACES) (Felitti et al. 1998). Whereas the ACES includes self-reports of adverse experiences such as living in a household with domestic violence, substance abuse, or child abuse, our conception of adversity extends to include hardships such as neighborhood- and school-level violence, untimely death of family and friends, and absent parents. Further, rather than capturing only the presence of adversity, we also account for temporality, the proximity of the adversity to the respondent, and whether an adversity occurred multiple times. Even though our analysis tends to focus on responses to short disruptive events, our taxonomy includes longer periods of detrimental conditions. This means we can offer a fuller picture of what respondents report and also avoid imposing arbitrary temporal cutoffs in our decision of what to include as adversity. For example, the incarceration of a family member suggests a disruptive event (the arrest or conviction) but also leads to a potentially long period of disadvantageous conditions.

To generate a typology of adverse experiences, the research team documented each report of adversity and characterized each along the following dimensions: the social settings in which they took place (school, family, neighborhood, friend group, and other); recency (coded dichotomously for whether within the past two years); and duration (coded as continuous for uninterrupted periods, intermittent for multiple discrete events or periods, and one-time for discrete events). More detailed descriptions of our analysis process and these categories are presented in the online appendix (https://www.rsfjournal.org/content/10/1/103/tab-supplemental). Rather than simply trying to track each form of adversity as an isolated phenomenon, we also noted instances in which one source of adversity or disruption seemed to be rooted in a prior form of adversity to identify potential downstream effects. As we explain, some instances of diversity can be seen as negative shocks or events to which respondents actively respond. Others seem to reflect reverberations of some initial instance of diversity (such as eviction leading to homelessness, drug use, and school absences). We found a range of such experiences, including but not limited to assault, domestic violence, unplanned pregnancy, family members' struggles with addiction, financial instability, housing instability, school instability, and inadequate resources.

Rather than solely drawing on our characterizations as researchers or basing our understanding only on existing studies of poverty, we also include descriptions of how youth themselves characterize adverse events. Our research team reviewed cases seeking to under-

stand how respondents framed adversity, coding for negative, destabilizing, and neutral perceptions. We also found evidence of youth perceiving disruptive events as clarifying points, positive turning points, or as experiences that were not uncommon among their familial and social networks. The original qualitative interviews did not explicitly ask about perceptions. Consequently, although we may be able to identify certain perceptions when the respondent discusses them, we are careful not to consider the absence of an expressed perception as a lack thereof. We account for this by coding only explicit mentions of perceptions with an indicator variable. We code the lack of any specific mention as not applicable. The research team also provided justifying narrative data from the interviews for each perception coded. This was done to ground our coding decisions in each respondent's language as expressed and to justify analysis and coding decisions.

Next, the analysis considers the responses to disruptive events and adversity that youth describe within the contexts of their daily lives and their life course trajectories. The research team coded for responses and strategies by thoroughly reading field notes and transcripts and noting instances where the respondent reports some consequence or strategy in response to adversity or as a preventive measure to guard against potential adversity. Examples include isolating from friends, co-workers, family, or neighborhood spaces as strategies for physical protection; becoming a caretaker for a family member or partner, due to illness or loss of income; or youth changing their college and career plans to assist family members. Detailed descriptions of these response types are available in the appendix. A systematic review of the qualitative data yielded a broader taxonomy of responses: reactive coping mechanisms and derailed pathways, proactive and protective strategies, and tough trade-offs. We discuss these later and in the appendix.

Although we separate these aspects of adversity for analytic clarity and illustration, the dimensions, perceptions, and responses to adversity that youth shared are often interconnected or conditionally related in the interview narratives. As such, evidence of each of the three dimensions will appear across each of the subsequent findings sections. This is especially evident when we present within- and between-case examples from the qualitative data to illustrate the range of responses to adverse events. The cases presented here were chosen to not only include diversity by gender, age, and response, but also because these cases are typical of the accounts that fit into these three emergent categories of responses. Different types of responses to adversity can also be present within-case. In other words, in our main analysis, we describe responses to instances of disruptive events rather than characterize individuals' cumulative trajectories, the caveat being that we note when an instance of disruption appears to be a direct consequence of a previous instance.

FINDINGS

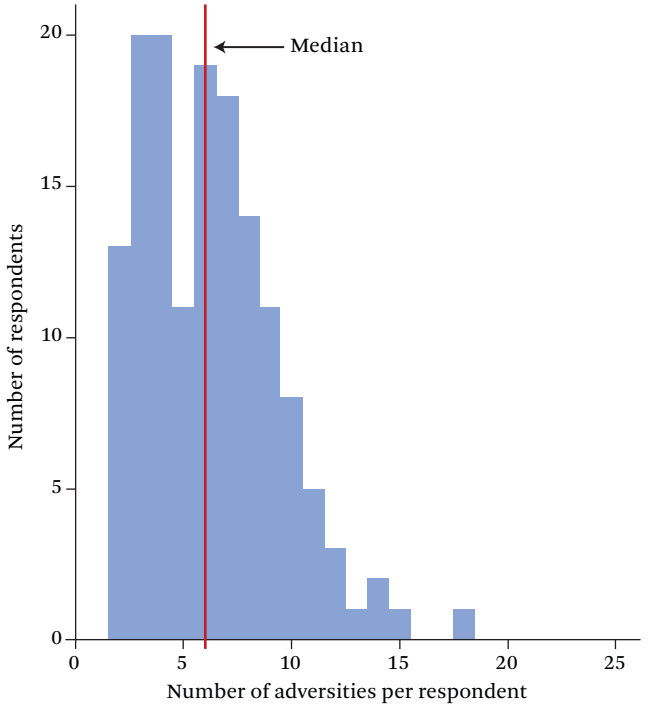
We present three main sets of findings: the range and prevalence of adversity in our sample, heterogeneous responses to adversity, and a mathematical formalization of the trade-off between surviving and thriving using an economic model of human capital investments.

Range and Prevalence of Adversity

We examined each case to identify instances of adverse events reported by respondents. Table 2 shows that 919 reports of adversity were reported by 150 individuals. Figure 1 provides a histogram for person-level counts to illustrate how the frequency of adversity is distributed across the sample. The average is 6.2 and the median is six. One individual reported no adversity and several individuals report fifteen or more distinct adverse events. More than half of the youth, 52 percent, reported between two and eight adversities.

To better demonstrate which kinds of adversity different individuals experience, we report the prevalence of various adverse circumstances and events in table 2. The first column describes the type of event—for example, neighborhood violence. The second and third columns show the frequency of the adversity as

Figure 1. Distribution of Adversities per Respondent



Source: Authors' tabulation.
Note: A histogram of the number of adversities for each respondent including all 919 adversities described in table 2.

individuals in the sample report it, as a count and a percentage, respectively; the fourth column shows the total instances reported across all sample members. For example, in the first row, ninety-one (of 150) respondents (60.7 percent of the sample) reported experiencing neighborhood violence. A total of 107 instances of neighborhood violence were reported in the sample (11.6 percent of all instances of adversity).

Table 2 shows the wide range of adversity in the lives of the youth in our study. For example, violence can occur at school, in the neighborhood, or at home. Other indicators of economic disadvantage include job loss, addiction problems of a family member, and housing instability. Some youth report encounters with police, some of which they characterize as harassment or misconduct. Other youth reported instances of family instability, such as estrangement or incarceration of a family member. Co-occurring with (or perhaps caused by) some of these adversities are physical and mental health problems, some diagnosed by clinical providers, others self-described. The vast temporal range includes disruptive events, long-standing disadvantageous conditions, and many others, such as bouts of homelessness or parents' divorce or separation, a process that can last many months. School can provide a safe haven in the face of adversity, but many youth also report problems there, including violence and inadequate resources.[7] Only one respondent in 150 does not report any adverse events during the interviews.

Table 3 provides additional characteristics

7. We also found a range of experiences, decisions, and outcomes that are harder to cleanly categorize as adversities per se, rather than as consequences of adversities or one's own decisions; we consider these "gray areas" and describe them in the appendix to be comprehensive.

Table 2. Categories of Adversity in Youth Sample

Adverse event	Frequency	Percent	Instances
Neighborhood violence, drug activity, gang presence (environmental)	91	60.7	107
Arrested or incarcerated (family or friend)	82	54.7	117
Death of (family or friend)	79	52.7	112
Substance abuse (family or friend)	55	36.7	66
Police interactions	52	34.7	57
Unplanned pregnancy	49	32.7	49
Absent parent	46	30.7	48
Housing instability (forced moves, reactive moves, evictions)	44	29.3	48
Arrested or incarcerated (self)	40	26.7	47
School violence (R not involved)	40	26.7	40
Physical and mental health challenges (family or friend)	35	23.3	35
Physical and mental health challenges (self)	34	22.7	49
Domestic violence or abuse	31	20.7	37
Experienced violence	16	10.7	16
Witnessed violence	13	8.7	14
Experienced nonviolent crime	11	7.3	11
Parental separation or divorce	11	7.3	11
Experiencing violence (friends or family)	10	6.7	12
Forced school transfer(s)	10	6.7	10
Bullying (self)	8	5.3	8
Substance abuse (self)	7	4.7	7
Family estrangement	5	3.3	6
School disorder	5	3.3	5
Lost job	4	2.7	4
Foster care	2	1.3	2
No adversity	1	0.7	—
Observations	150	100.00	919

Source: Authors' tabulation.

Note: Each row reports the frequency of different categories of adversity in three different ways. Column 1 presents each category. Column 2 shows the person-level frequency for each category, that is, the number of people who report experiencing it at least once over the course of the interview. Column 3 divides the number in Column 2 by 150 to obtain the proportion of the sample that reports experiencing the category of adversity at least once. Column 3 reports how many times specific instances of this category of adversity are mentioned over the entirety of the 150 interviews and differs from the number in Column 1 because some people report multiple instances. For example, 40 individuals report at least once that they have been arrested or incarcerated, which is 26.67 percent of the sample of 150 individuals. The sample contains reports of forty-seven instances of arrest or incarceration since some individuals report experiencing it more than once.

of adversity reported by respondents. The table is organized similarly to table 2, that is, first at the individual and then at the adversity-instance level. We first coded instances of adversity according to their social locus (school, family, friend, neighborhood, or other). We also consider temporal heterogeneity, such as a single recent disruptive event, an intermittent source of adversity, or a longer-standing disadvantageous condition. What emerges is considerable range in the proximity, duration, and perceptions of adversity that youth face. For

Table 3. Dimensions of Adversity in Youth Sample

	Count Individuals	Percent Individuals	Count Instances	Percent Instances
Social proximity				
School	62	41.3	75	8.2
Family	144	96.0	528	57.5
Neighborhood	125	83.3	258	28.2
Friends	65	43.3	94	10.2
Other	63	42.0	103	11.2
Temporality				
Continuous	136	90.7	413	45.0
Intermittent	58	65.3	165	18.0
One-time	130	86.7	340	37.0
Within the past two years	140	93.3	437	52.0
More than two years ago	143	95.3	615	74.1
Perceptions of adversity				
Viewed as negative	105	70.0	284	82.8
Viewed as destabilizing	50	33.3	88	57.1
Viewed as positive turning point	20	13.3	20	10.2
Viewed as clarifying turning point	63	42.0	85	57.1
Viewed as neutral	40	26.7	53	17.6
Viewed as ordinary	30	20.0	33	28.5
Viewed as other	54	36.0	86	34.5
No adversity	1	0.67	—	—
Observations	150	—	919	—

Source: Authors' tabulation.

Note: The person-level counts and percentages are calculated based on the total sample, including the respondents that were not coded as having experienced adversity. The remaining columns are conditional on the presence of adversity. Each adversity could be coded with multiple perceptions, that is, the perceptions categories are not mutually exclusive.

most categories, both social proximity and temporality, a majority of individuals report at least one corresponding adverse event or circumstance. For example, 140 individuals (93.3 percent of the sample) report an adverse event within the past two years; 125 (83 percent) report a neighborhood-level adversity.

We also examined how individuals framed adversity. Specifically, 105 individuals (70 percent) expressed a negative perception for one or more adversities, and fifty (33.3 percent) viewed one or more adversities as destabilizing. Notably, sixty-three respondents (42 percent) viewed at least one adversity as clarifying, and twenty (13 percent) perceived at least one adversity as positive (such as a helpful turning point). Approximately thirty (20 percent) viewed one or more adversities as ordinary, or not uncommon in their familial or social networks (see Aquino, Brand, and Torche 2022). A caveat to reports of perceptions is that in many cases where we have coded an adverse event or circumstance, no perception was reported. This occurred for 430 instances of adversity (roughly 46.8 percent of all reported adversities); for another twenty-seven (3 percent), the coder was unsure whether any text corresponded to a perception. However, respondents were never asked how they framed adversity, leaving the absence of a reported perception as difficult to interpret. In general, the counts and prevalences of perceptions must be

interpreted with care. Most important, they provide some evidence that what we code as adversity is indeed perceived as such by youth, at least in some cases.

Heterogeneous Responses to Adversity

In the wake of these adverse events, youth described a range of consequences, decisions, reactions, coping mechanisms, and strategies.[8] We observed at least three types of responses in the interviews, all varying in the extent to which they appeared to be reactions or derailments in the face of shocks versus deliberate or strategic decisions.[9] The first set may be described as reactive coping mechanisms and derailed pathways, which include more impulsive and emotional responses that might have provided immediate relief or respite, but also ended up being quite costly in terms of school completion and employment. These included responses such as dropping out of school, running away to live on the streets, or substance use. A second set of responses are described as proactive and protective strategies that youth enacted to shield themselves from exposure to risks in their neighborhoods, schools, and families, and might also have eventually promoted long-term educational and professional goals, including cultivating deeper relationships with parents and mentors; investing in hobbies, personal interests, and extracurricular activities; and selective friendship and strategic avoidance of people and places they believed would jeopardize their plans. A third set of responses provided insight into some of the tough trade-offs youth were forced to make—these were decisions that seemed to provide short-term stability and survival, but could also backfire or have potentially negative long-term consequences, limiting educational and career pathways. These included leaving school to be a caregiver for sick relatives, leaving school to make money to support family, more severe social isolation, and avoiding school to stay safe.

Reactive Coping Mechanisms and Derailed Pathways (Neither Survive nor Thrive)

In the aftermath of adverse events described earlier, it is perhaps not surprising that a number of youth described feeling frightened, angry, or desperate, and made decisions they later came to regret. These consequences and reactions are those that might typically come to mind when thinking about how adverse events predict disadvantage. Some describe being thrown into a spiral, sharing accounts with less evidence of deliberation and choice in the wake of adverse events. When Daphne, twenty-one, reflected on how she dealt with the difficult events she experienced in her life, including her brother's murder, her father's incarceration, repeated episodes of school instability and fighting, an unexpected pregnancy with an abusive partner, and abuse from an uncle, she said with flat affect, "Can't feel happy because it's nothing to be happy about. Can't feel sad because you can't do nothing about it. It's already done happened. You just got to go with it, just for real, deal with it." Viewing their cur-

8. For about one-third of the sample, we could not identify a response to adversity in the interview data, or the response was hard to categorize.

9. For the full sample, of those for whom a response could be identified in the interviews, 10 percent reported derailed or reactive coping responses, 64 percent reported protective or promotive strategies, 17 percent reported tough trade-offs, and 9 percent reported other types of responses not easily categorized. Some gender differences appeared in the proportion of the sample who reported any response to adverse events during the interviews: 81 percent of the male respondents and 61 percent of the female respondents. These differences are likely due to the types of responses reported—more male young adults reported protective social avoidance strategies as well as more severe social isolation, for example, which combined were also the modal subcategories of responses. Conversely, reporting responses differed little by age; 70 percent of those nineteen to twenty-three years old reported responses and 74 percent of those fifteen to eighteen years old did. However, we caution against interpreting these rates of response and gender differences as reflective of all responses youth ever had to adversity; as noted in the methods section, we did not ask about these experiences directly, and therefore assume what we report here to be an undercount of the true prevalence of adversity as well as responses to adversity.

rent situations as so difficult, some youth resorted to actions that if anything made things worse.

Terry, twenty-three, grew up in a family of nine. He told the interviewer that his drug-addicted mother was so emotionally abusive that he repeatedly ran away from his home in suburban Columbia, Maryland, sleeping on the street by the time he was eight years old. Eventually, he became a ward of the state and cycled through group homes. He rejoined the family when he was fifteen, but found once more the emotional abuse he had tried to escape. He fell into a depression after this reunion and began binge drinking. To escape his mother's house again, he moved in with a brother, who then asked him to move out when the brother married; after this, he returned to his coping mechanism of sleeping in Leakin Park, hiding his belongings in the woods while he attended school. Reflecting on this period, he said, "I prayed and smoked a lot of weed," and started hanging out with a group of other homeless youth. As he described their connection to each other, he explained: "People—out of a desperation—they cling to each other, complete strangers. . . . But they were never really friends. Kids, they drink together, they smoke together, because they don't have anybody. . . It's like this depression thing in the air, man, pain in people's eyes and everything. . . . Nobody knows what to do, so they just party and [do] drugs." Out of sheer determination, Terry was able to graduate from high school and eventually worked at one of the homeless shelters where he lived, but shared that he is still "learning to be comfortable inside a house," something he still associates with his childhood abuse.

Anna, twenty-two, experienced repeated spells of housing instability growing up alongside repeated spells of paternal incarceration. When she was interviewed, Anna explained that she had had an unwanted pregnancy at age fourteen and that her parents helped push her to give the baby up for adoption. Looking back on what she called a "rough time" in her life, she deeply regretted giving her child away. She said that she felt unloved by her family and the turmoil of the unplanned pregnancy and subsequent adoption led her to run away from home and drop out of high school after ninth grade. She survived by engaging in sex work and living on the streets for two years before deciding to move back with her family. Anna explained that at the time, dropping out made sense to her: "I just didn't complete it [high school] because my life wasn't goin' right at that time. . . . I felt as though quitting was the right way to go. But now I feel as though it wasn't, like, I didn't get my high school diploma, I don't have my GED."

When Jamison, twenty-one, was growing up, both of his parents struggled with substance use—his father with drugs and his mother with alcohol. Near tears throughout the interview, Jamison shared that he suffered from depression and turned first to weed, and then to alcohol, drinking every day, first thing in the morning. He had dropped out of high school to make money, and then lost his first job at a restaurant because he was drinking at work. His grandparents took him in to live with them in a retirement community in Florida to get straight and try to attend college. He left after three weeks and returned to Baltimore because his mother said she missed him, and because he started to feel isolated. He also felt that if he went back home, he could get a job through one of his cousins or his uncle. On returning to Baltimore, unfortunately, he did not find the fresh start he had hoped for:

> But, I thought I had a master plan. . . . So, I was like, "I can get a job when I get back in Baltimore. I can save up money, work toward getting a car, and everything." So, I came back here and nothing went right. Nobody called, I was getting frustrated. I'm thinking, "I have no criminal record, I got my GED, I'm planning on going to school." They like, "But you don't have any college." . . . So, nothing went right. I look out for my mother and my family a lot so, they like, "You want anything?" and I'm like, "Yeah, can I get a drink?" and so, I came back drinking, drinking real heavy and stuff like that.

At the time of his interview, Jamison had found work at a restaurant, but struggled still with alcohol every day. He was hoping to return to Florida again to attend community college while living with his grandparents.

Shortly before Marco (twenty-two) was interviewed, his maternal uncle, who Marco said "was more like my dad for me," had recently died of heart failure, which he said was the result of years of drug abuse. Adverse events were not new to Marco: growing up, his mother was in and out of the house and on the street doing drugs, leaving him to care for his siblings. At the time of his interview, he had not seen his father in ten years—his father was in jail for stealing cars. In high school, Marco had trouble sleeping and missed school regularly. At sixteen, he was incarcerated for armed robbery, which meant that he missed the summer school session he had needed to attend to make up for failing grades, and then he subsequently dropped out. By the end of the study, he had moved in with his grandmother in a nearby suburb, was unemployed, and had not yet gotten his GED. Reflecting on the past he said, "And like if I could, I probably wouldn't of never missed all them days in school like I have, or been late like that. I don't know, just a lot of things that I think is different from when I was a kid."

Proactive and Protective Strategies (Survive and Thrive Aligned)

Although some of the youth who were interviewed turned to the streets, alcohol, and drugs, dropping out of school and sometimes work without much of a forward-looking trajectory, most did not. Many youth instead enacted deliberate strategies to prevent such unwanted outcomes. Some were identity projects—specific activities that provided youth with a sense of self and purpose in their daily lives (for details on identity projects, see DeLuca, Clampet-Lundquist, and Edin 2016). In particular, some of the youth said that they engaged more deeply in hobbies or sports, which provided a channel for positive connection with peers. Others invested more deeply in relationships with particular friends and family members or teachers, actively staying away from places and people who they felt might derail them or get in the way of their goals. By keeping busy, they explained, they could also avoid being in the wrong place at the wrong time, where violence might find them.

Hobbies and Positive Channels Despite struggling with a severe bipolar disorder and having been hospitalized, Tony, twenty-one, found his footing after becoming deeply involved in the church and eventually finding a passion to pursue a career in pharmacy. Both of Tony's brothers sold drugs and ended up in prison rather than following through on plans to go to college. Between his brothers' imprisonment and the violence he saw in his neighborhood, he tried to avoid getting involved with too many people. In high school and after, he stayed to himself most of the time: "I did what I had to do, then went home. . . . I don't want anyone to throw me off, so I'm like if you talkin' negativity about doin' something, I don't even wanna hang around you, like you can do that by yourself." Instead Tony invested in two close friends—Britney, with whom he took a biology class at a local community college and shared career aspirations in science, and Joshua, whom he knew from high school and who was in the Navy. He remained close with members of his family as well, such as his older sister, who was a school teacher. He also cultivated ties at his church, including Mr. Carter, who paid for him to go on a men's Bible study retreat.

Tony explained how church helped motivate him and give him optimism: "It was interesting. I had, it's a lot of people that went through a lot of things in their lives, and I thought I was the only one that went through something. . . . I'm still learning now, but they educating me and keep my, like I said, my spirit just, you gotta keep the Lord on your side because all things are possible doin." As was often the case for respondents who found a hobby or positive channel to ground themselves, such investments could also benefit their longer-term educational and career prospects. In addition to the church and his close friends, Tony sought out other mentors at a youth program, who gave him job interviewing skills, which also eventually led to the internship that sparked his dream to become a pharmacist. When he was interviewed, Tony was working through the community college courses he needed to complete to transfer to the University of Maryland and study pharmacy.

Ashley, eighteen, provides another perspective on how some youth found positive outlets to process adverse events. She was among the younger respondents in the study, but easily recounted many disruptive experiences. Across eight moves she made as a child, Ashley recalled navigating violent schools and neighborhoods and the death of a friend in gang violence. When her mother was diagnosed with leukemia, she switched to a homeschooling arrangement but did not graduate. Her father had recently died unexpectedly of heart disease, and she was still grieving when she was interviewed. To cope with these events, Ashley wrote in her journal: "If you go through something, they always say the best thing to get it out is to write it down or talk to somebody. . . . What I write in my journal is stuff that I go through, probably everyday life that you won't really compare with somebody, [because] they going through something." Ashley had come to see writing not just as a hobby and an outlet to process the loss of her father, but also as a possible vocation. Although she was struggling to earn her GED by the end of the study, she was still hopeful about going to college and saw journalism as the field of study she might want to pursue.

Selective Avoidance, Selective Investment The most common response to adverse events in one's family life (death, drug use, and incarceration) and more general adverse circumstances (neighborhood violence and drug dealing) was to be deliberate about who one spent time with or became friends with, echoing findings from Anjanette Chan Tack and Mario Small (2017) and Holly Koogler (2019). More than 63 percent of youth in the sample mentioned using socially selective or avoidance strategies to avert the trouble they saw around them. Marcus, age nineteen, for example, explained how he combined his passion for sports with selective friendships. He explained:

> I like to play basketball, I really like to play, I'm just a sports guy. I stay out of trouble a lot. I will be outside all year, I will be around a lot of people. I've got two good friends and one girlfriend. That's about it. . . . Stayin out of trouble, like don't hang around people out there sellin' drugs or nothing, or I know a lot of people out here sellin' drugs, I don't be around that. I'll be out or I'll be in the house all day, that's about it. And [with] my mother—that's about it. . . . we just play all day till the sun go down.

Jessica, twenty-three, described how a friend group focused around a common set of educational goals helped her stay on track. She spoke glowingly about friends she made in elementary school and kept through college, a group who referred to themselves as the Circle of Success. She spoke of these friends as "bright" and "intelligent," and described how they made it easy to both have fun and stay in school and on the path to college. Jessica delineated between this friend group and her peers in the neighborhood whom she referred to as "knuckle heads." She elaborated, "I don't talk to them, they are crazy. These people don't have no goals. I don't have nothing to do with that." Through these selective friendships, Jessica was able to develop an identity related to academic success that distinguished her and her friends from their other high school peers.

Much like Jessica and her Circle of Success, Megan, seventeen, avoided friends who did not have the same long-term plans as she did:

> Certain people I do avoid, just because they don't have the same goals as me. I'm worried about getting money for *school books* and they're worried about getting money for *a new outfit*. And some of the girls are really promiscuous and I prefer not to hang out with them, just because like—not because they're bad people, it's just because they do things that I'm not comfortable with and I don't wanna hang out with them and like pick up their bad habits.

Megan also bonded with a mentor—a middle school art teacher who took her to high school open houses and helped her fill out applications. They still stayed in touch through email. When she was interviewed, Megan was in her senior year of high school and focused on ap-

plying to out-of-state four-year colleges to study broadcasting or film.

Developing Relationships with Family and Other Adults Some youth also invested more time in their relationships with immediate or extended family as they sought to avoid negative peers. Delmont, nineteen, had endured one friend's death and another's being incarcerated, as well as housing instability that led to multiple school changes. These experiences left him very reluctant to meet and engage with new people. As Delmont explained, "I do not wanna know that many people" so that no one has "no reason to have an altercation." Asked what he did to avoid trouble and stay safe, Delmont explained that he spent much of his time each week with his father and uncle, cultivating his passion for rapping and exercising to stay in shape for his football team. When it came to rap, he shared, "First, it was jokin' around, but then we got serious with it and people actually like it. . . . I try to do it, I would do it every day if I could, 'cause I got a passion for it." By the time Delmont was in high school, he and his father and uncle regularly performed at paid shows in Baltimore. When the research team last spoke with him, Delmont had been admitted to a four-year college in Baltimore, where he planned to start school the following fall.

For Bella, nineteen, playing sports and getting involved with clubs at her high school brought her closer to her teachers and a small group of friends, while keeping her away from peers she saw as being on the wrong path. "I wasn't a very friendly person in high school just because the people that were there were not people I would want to have involved in my life. [My high school] was not full of a lot of positive people." She credits one of her teachers, who was also her basketball coach, for seeing something in her and guiding her plans. She explained how her teacher/coach didn't want Bella "to fall down that path of others and get distracted from school, so in order to keep myself occupied that's when I really became in touch with the groups and sports and all that stuff." Bella ended up playing multiple sports and joined the school's entrepreneurship program, in addition to participating in the volunteer club. She developed a small set of friends she remained close with. Staying this busy had a benefit: "I didn't get home 'til late, but it kept me out of trouble."

After high school, Bella was able to draw on the support of her coach, who was "a really big help," to successfully navigate the process of applying for academic scholarships. When Bella was interviewed, she was heading into her second year at a four-year college in Maryland, pursuing business and finance, interests she developed while participating in her high school's entrepreneurship program. She was already thinking about pursuing graduate education.

Tough Trade-offs (Survive But Maybe Not Thrive?)

Another set of responses to adverse events was a sort of triage approach, where the loss of family income, sick relatives, or fear of personal safety at school required decisions and strategies in the immediate term. Some youth dropped out of school or changed their educational plans to take care of relatives.[10] Others withdrew from social life more severely, "hunkering down" and rarely leaving the house, avoiding school and avoiding friendships. Although the rare exception, a few youth in the sample turned to selling drugs to make money. Unfortunately, these decisions, understandable in the context of family and other needs, risked diminishing longer-term educational or professional trajectories.

Leaving or Delaying School to Care for Family One tough decision that youth faced was whether to stay in high school or college or to take care of family in times of need. For example, Sherika, seventeen, described how she had generally earned mostly As in her ninth grade year but struggled to maintain those grades when she started skipping school to keep her sister safe from an abusive partner. Sherika explained, "I have a sister who was being abused and she lived right around the corner from me. And she

10. The literature in gerontology and economics on the negative labor-supply consequences of caregiving, especially among women, is huge (see Burton 2007).

would call me and she was scared to stay in the house. And I knew if I was there, he wouldn't touch her. And she wanted me to stay with her, so I stayed with her." She said that this situation made it hard to be at school on time or at all some days and that skipping was not something she enjoyed: "It wasn't like I was just hooking to have fun. It was like, I felt like I was here to protect my sister." Although she felt she kept her sister safe, she still feels as if it was a "mistake," because she received very poor grades for many of her tenth and eleventh grade classes, something that weighed heavily on her as she looked to the future.

Isaac, twenty-three, made it to a two-year college despite significant difficulties growing up, including the death when he was young of his father and getting arrested shortly after graduating high school, serving a six-month sentence for agreeing to give his friends a ride after they had committed a robbery. When Isaac was in his second year of college and on track to graduate with an associate's degree, his twin sister died unexpectedly of a rare disease, leaving behind a son. With no other siblings and a mother who has health issues related to a disability, Isaac felt as if he had no choice but to leave school and take care of his nephew. When his sister died, he told the interviewer, "I just dropped everything and I just came home." Isaac expressed how he wanted to finish college but it simply was not possible in the near term given his new life situation: "It's not that I *don't* want to go back to school, it's just like trying to find time with school and then my nephew and then work. . . . My concern right now is money." Isaac had not returned to school by the end of our study.

Just after Sierra, twenty-one, graduated high school, her mother lost her job at a hospital, leaving them both worried about how they would make ends meet. Sierra described how this destabilizing "downfall" meant her own college dreams had to be put on hold: "We had like this little downfall in our family, whereas I had to wait a while [to go to school], I had to wait. . . . I was thinking about Baltimore City Community College . . . take some classes, get a little education. But I was like, 'I'm gonna wait, I'm gonna try to help my mother. I don't wanna be crying cause we're homeless or we don't have this or that, I didn't want that. So I waited." Sierra described the unfortunate trade-off: "[right now] I'd rather have a home than my education." Looking ahead, she still wants to go to community college, but explains that she "wants to be sure" that her family is on solid ground before she feels that she can pursue her original goal.

Similarly, Martin, twenty-two, recounted the difficulties he endured in high school, shuffling between schools and hanging out with a girlfriend who got in fights and was eventually expelled. In the eleventh grade, Martin was put in the difficult position of having to either continue in high school or help out when his mother was hospitalized: "I actually quit school when I was like seventeen. I basically stopped because my mother, she was in the hospital. . . . So, I basically did what I had to do as far as going and getting a job and, you know, even though I wasn't making much of nothing, but I buy food, buy toilet paper, buy milk, or whatever else I needed to do for the house." Shortly after, a subsequent girlfriend got pregnant, and Martin also took on the caretaking responsibilities of a new baby with her. By the end of the study, Martin had made a few attempts but had yet to earn his GED.

Withdrawal from Social Ties and School Whereas Delmont, Bella, and Jessica protected themselves by avoiding certain people and places, instead turning selectively toward some of their family members and friends, other youth turned away from social ties more severely, deliberately isolating themselves in an effort to focus on their goals, and stay safe, themes also discussed by Peter Rosenblatt, Kathryn Edin, and Queenie Zhu (2015) and Holly Koogler (2019). Previous adversity had led to a generalized sense of mistrust so pervasive that some youth thought it was better to go at it alone, echoing Sandra Smith's (2007) account of defensive individualism. For example, when asked, "And so can you tell me about your two closest friends?" Nathan, nineteen, responded, "I don't have friends." He avoided even clubs and activities in high school, "so I don't lose track."

Ralph, twenty-one, experienced a range of adverse events growing up—including his

mother's drug abuse and a high school where violence and disruption were common. In the front of his mind, though, was his experience of having been recently attacked by a man who was part of a group that Ralph considered close friends. As he told one interviewer, "It was . . . very unexpected. I didn't even suspect nothing like that. I just . . . man, I told myself: that will never happen again." In light of the pain and shock of this event, Ralph felt he was better off not making friends and that he didn't need them: "I don't do too much hanging no more. This world, man. I don't like hanging out no more. . . . I cut all these friends; I don't have no friends. I don't want no friends, I am finished with friends. I am a grown man, so I don't need no friends. I am better off by myself."

Tyler, twenty-one, said that he rarely left the house at all: "I feel like that's the best way to protect yourself. Rather than shootin' or stabbin' or killin' somebody I'd rather just stay in the house because that's all, that's the only other outcomes that's outside."

When Michael, eighteen, was interviewed, he said, "I really have no close friends, to tell you the truth. . . and really my friends down here I don't even hang around cause all them is just doin' all the wrong things, which I'm not tryin' to do, so I just stay away." He described how his decision to socially isolate was motivated by a desire not to end up in prison again, and by a lack of trust in people after one of his friends was killed by another friend. Michael did time for selling weed, although he reflects that things could have been worse. "I could of got locked up for serious stuff that I didn't get locked up for. And that must be, I just thought like that must be my wakeup call." He says that another reason for turning himself around was to be a good role model for his little brother.

Another tough trade-off was the decision to not attend school in order to stay safe (Burdick-Will 2013). A recurring theme in an interview with Kelly, twenty-two, was that her high school could not keep students safe, let alone provide an environment conducive to learning. On one occasion, she related, "There was a riot after school. Everybody was throwing food. It was people that didn't go to the school up there sitting at the lunch table and people didn't even [know] that they was in there at first until the fight had started. And I remember a couple people getting stabbed, people getting maced, it was terrible." As Kelly reflected, "It just be crazy. Like, we were not here for this. We was supposed to be learning." Kelly explained that with all of the fighting and violence, "I was like, I would rather hook school then to be in here with all this other stuff. So, I would hook school and smoke with my friends and stuff like that." Although this strategy took her out of the chaos she perceived in her high school, it also meant that graduating from high school became a more distant possibility. Kelly was subsequently expelled in tenth grade for chronic absenteeism. Kelly reflected on this period, saying, "Now, I look back on it—it wasn't good."

Selling Drugs to Earn Money for Family Turning to the street, selling drugs, or committing crimes was the exception rather than the norm in the study, with only twenty-six of 150 youth ever reporting such activities. In fact, it was the least desirable way to end up, according to the youth in our study. While rare, Jayden's case provides an example of why one might do it to survive. Jayden, twenty-two, began selling drugs when he was in his mid-teens, after his stepfather recruited him, and "sat me down and told me everything, as far as the prices and what was, how much you can make off certain drugs and everything." He was tired of never having any money and was influenced by a friend who always had money from selling. When asked the best job he ever had, he responded, "selling weed," because, he explained, "More money. I don't never had to worry about nothing, like a bill had to be paid, it wasn't nothin'. Just touch what you saved and—yeah. All that, I saved up a lot of money, selling marijuana."

Jayden mostly stopped dealing when his daughter was born, saying that he'd "rather work for a paycheck" than getting locked up or killed. Two years before he was first interviewed, his grandmother passed away, and his mother was committed to the psychiatric unit for eight months for depression, hallucinations, and detoxing from alcoholism. He drained his savings during this time because he was solely in charge of the household, and

he paid the hospital bills for his mother's stay. He said that once he was caring for his daughter and mother, that was the point at which he felt like an adult. Yet he was struggling to get the kind of job with which he could adequately support them like one. He hated his job at Kentucky Fried Chicken, saying it made him "feel like a loser" and that he longed for an office job. He applied for other jobs but said that mostly he was not called back. When asked why, he said he assumed it was how he looked, "Probably my hair. But I go to a job, I make sure I get my hair done, get it re-twisted."

As Jayden explained, most of the better jobs want "college." He said, "I think about going back to school a lot. I keep telling myself, by the time I'm a certain age, I want a certain amount of money saved up. But when I told you I went to ITT [for-profit school], I never paid them, so they're threatening me with garnishing my taxes and stuff, so a bank account right now is out of the question. But if I put my little $500 paycheck in there and they take it from me, I'm going to be sick." He was frustrated with his current work options and considered getting involved in drugs more seriously again. He explained, "I don't want to hustle, but if, if I have enough money to invest in a friend that I know that's getting money, I will invest. I'm not gonna say I'm not. If I give him five hundred and he can turn it into a thousand, I'm gonna do it." When the research team last spoke to him, he was selling weed on a small scale to people he knew well.

A Model of "Surviving Versus Thriving"

The first response category, whereby adversity can derail individuals' lives, suggests a possible lack of agency. The second and third categories suggest agency in the form of active decision-making or strategizing in the face of adversity. We cast such responses to adversity as potential investments in human capital. We emphasize the third category, characterized by a trade-off between surviving now and thriving in the future, because it constitutes a novel addition to traditional views of human capital accumulation—and yet is a straightforward extension of basic frameworks. As we show, the model easily accommodates the second category of responses and, moreover, can provide an interpretation of the first category. We also discuss possible extensions to the theory along with ways we could use data to calibrate or to estimate model parameters, though we caution that the qualitative data used in this project may include too few observations to accomplish this effectively. We therefore discuss how larger-*N* data sets, such as the National Education Longitudinal Study or the National Longitudinal Survey of Youth 1997, could be explored for this purpose.

The Basic Setup

To begin and to fix ideas, we focus on "surviving" and envision a two-period model and a single decision. In the first period, an agent decides whether to make an investment or to engage in a strategy $G \in \{0,1\}$ that is potentially costly (where the cost is denoted c) but raises the probability of survival from $\pi(0) \in (0,1)$ to $\pi(1) \in (0,1)$. If the agent does not survive until the next period, he receives utility $U(N)$, which is normalized to zero. If he survives until the second period, he receives the utility of surviving, denoted $U(S)$, which is distinguished from that of thriving, denoted $U(T)$, where we assume that $U(T) > U(S) > 0$. The second period is discounted by factor $\beta \in (0,1)$.

The model could easily accommodate different kinds of strategies distinguished by different costs c and different probabilities of survival $\pi(G)$. These factors could also be a function of the kinds of adversity an individual faces. Moreover, the model could be extended to incorporate a menu of potential strategies rather than a binary choice, each option distinguished by different costs and probabilities. Finally, an individual's perceptions of the strategy could influence their choice to engage in a strategy; for example, an individual may not have a correct belief of $\pi(G)$. However, rather than extending the model in these directions, we offer a highly stylized version that allows the individual with correct perceptions of $\pi(G)$ to engage in a strategy G or not.

The lifetime values (the sum of utility over two periods) for choosing G or not, denoted $V(G = 1)$ and $V(G = 0)$, respectively, are given by the following two equations:

$$V(G = 1) = -c + \beta\pi(1)U(S) \quad (1)$$

$$V(G = 0) = 0 + \beta\pi(0)U(S) \quad (2)$$

The individual will choose $G = 1$ if $V(G = 0) < V(G = 1)$, which is equivalent to the following inequality:

$$c > \beta[\pi(1) - \pi(0)]U(S) \quad (3)$$

This expression means that the agent will engage in strategy ($G = 1$) when the future benefits of doing so exceed the upfront cost. The benefits are the discounted marginal increase in the likelihood of obtaining the utility from surviving by engaging in the action. To fix ideas, a person would not engage in a costly strategy if they heavily discounted the future (β close to zero), if doing so increased the likelihood of survival only slightly ($[\pi(1) - \pi(0)]$ close to zero), or if the utility of surviving were sufficiently low relative to not surviving ($U(S)$ close to zero). Notice, the individuals in the first category (Anna and Marco) may not see the point of making investments because the degree or complexity of the adversity they face means that they see few options that could have an appreciable impact on their likelihood of avoiding a continued downward trajectory toward some of the worst outcomes, which would mean investing has little payoff.

The model allows for the possibility that engaging in G is enjoyable as some strategies may be, for example, joining a sports team or engaging in extracurricular or other personally fulfilling activities that generate utility. An important example is an identity project. If this is the case, the cost c is negative, which means that inequality (3) always holds given that the right side consists of the product of three positive expressions and is thus always positive.

Extending the Model to Capture When Surviving and Thriving Are at Odds

Having exposited a version of the model where survival is the only concern, we now incorporate a distinction between surviving and thriving as we discussed earlier. The key addition to the model is allowing engagement in strategy G to have different effects on the likelihood of surviving versus of thriving in a potentially countervailing manner. The earlier notation remains unchanged. However, we add the probability of thriving $\theta(G)$. In this case, both the probability of surviving and of thriving are endogenous to the choice of G, which distinguished this model from those that allow investments in human capital to be a function of exogenous shifts to survival. The lifetime value of $G = 1$ versus $G = 0$ is now as follows:

$$V(G = 1) = -c + \beta\pi(1)[\theta(1)U(T) + (1 - \theta(1))U(S)] \quad (4)$$

$$V(G = 0) = 0 + \beta\pi(0)[\theta(0)U(T) + (1 - \theta(0))U(S)] \quad (5)$$

The individual will choose $G = 1$ if $V(G = 0) < V(G = 1)$, which is equivalent to the following inequality:

$$c > \beta[\pi(1) - \pi(0)]U(S) + \beta[\pi(1)\theta(1) - \pi(0)\theta(0)](U(T) - U(S))] \quad (6)$$

This somewhat more complicated expression is interpreted similarly to inequality (3): the individual will choose $G = 1$ if the benefits exceed the upfront costs. As before, the benefits include the discounted increase in the likelihood of enjoying the utility of surviving, which is the first expression on the right side of the inequality. However, there is now a second expression, which is the additional increase in utility from thriving (which is of course contingent on surviving, which is why this expression also includes survival probability). Notice, if the likelihood of thriving is zero ($\theta(1) = \theta(0) = 0$), inequality (6) collapses to inequality (3). Likewise, if there is no utility difference between surviving and thriving ($U(T) - U(S) = 0$), there is no additional benefit to choosing $G = 1$ and, again, the agent faces the same cost-benefit analysis as captured by inequality (3). Hence, the key addition to the model is the second expression on the right side, which is the impact of choosing G=1 on thriving versus surviving.

The crucial expression in inequality (6) is $\pi(1)\theta(1) - \pi(0)\theta(0)$, which captures the interplay between the likelihood of surviving and, conditional on survival, on thriving. To fix ideas, suppose the agent faces little serious adversity and so survival is assured whether he engages

in G. If so, the probabilistic expression is simply $\theta(1) - \theta(0)$, which means that choice to engage in G is driven by the additional probability of thriving. This appears to be the case for no individual in our sample. Alternatively, suppose that by choosing G the agent can affect survival but has little influence on thriving. In that case, $\theta(1) = \theta(0) \equiv \theta$ in which case we can write the probabilistic expression as $\theta[\pi(1) - \pi(0)]$. This means that the agent faces increased incentives to engage in strategy $G = 1$ because it not only raises survival but also means that the agent, if he survives, may also enjoy the higher utility generated by thriving even though the choice of G has no direct impact on the likelihood of thriving. This situation seems consistent with the individuals who responded to adversity by engaging in activities that will keep them safe in the short term and also help them succeed in the long term; consider Tony and his church or internship or Jessica and her tightknit Circle of Success.

An interesting case arises when $\pi(1)\theta(1) - \pi(0)\theta(0) > 0$. This occurs if the same strategy G raises the likelihood of survival, but decreases the likelihood of thriving so much so that it lowers the total benefit in inequality (6). For example, consider strategies that raise the likelihood of survival, such as withdrawal from activities, self-isolation, and caring for family in a way that crowds out other opportunities. These strategies might help ensure a basic level of utility and avoidance of some of the worst circumstances, that is, survival but might also essentially preclude thriving. In this situation, the agent faces a terrible trade-off between surviving and thriving. If he chooses $G = 1$, he survives, but has little chance of thriving once he survives. Alternatively, if he chooses $G = 0$, he is more likely to thrive if he survives (which would generate $U(T) > U(S)$), but is also less likely to survive, which means he may receive zero. More simply, whereas some strategies mean that agents raise the likelihood of receiving $U(S)$ and perhaps $U(T)$, other strategies mean that the agent chooses between a high likelihood of simply surviving $U(S)$ versus a high likelihood of thriving, but also of not surviving at all, that is, a higher probability of either zero or $U(T)$.

The model as outlined assumes that the agent is fully aware of the potential trade-offs between surviving and thriving when choosing G. It is also possible (likely) that agents are not fully aware of this trade-off, in which case survival strategies can backfire. For example, when facing inequality (3), the agent may assume that the strategy increases survival probability and has no impact on the likelihood of thriving, which increases their incentives to choose $G = 1$ since $\theta > 0$ and $U(T) > U(S)$. However, in reality, the second expression on the right side of equation (3) could be negative. If the costs are high enough, an agent may choose $G = 1$ even though they would optimally choose not to if they were fully aware that doing so might diminish the likelihood of thriving.

The albeit very simple and stylized model nonetheless highlights how in formally distinguishing between surviving and thriving, we are able to capture several potentially important reactions to adversity. For many people, survival (broadly construed to include avoidance of some of the worst outcomes) is all but guaranteed and the relevant trade-off is between the cost of investments or strategies and their positive impact on thriving. This possibility aligns with typical economic models of human capital accumulation via costly investments among youth who are not severely disadvantaged or facing substantial adversity. The model also allows for situations where actions have little bearing on survival or on thriving, which means that the payoff to investments is small. This would be observationally equivalent to assuming the agent has little to no agency. The model also captures the possibility that both survival and thriving are a concern, but where a disadvantaged agent can do little to influence the likelihood of thriving and only faces options that raise the likelihood of survival. It also allows for options whereby surviving and thriving go hand in hand. Finally, the model accommodates a possibility articulated by several of the respondents earlier: strategies, investments and actions that increase survival probabilities can reduce the likelihood of thriving, so much so that agents face a trade-off between the two. Understanding the relevant trade-offs can also offer lessons for policy. For example, school-based enrichment programs can be a helpful lifeline for dis-

advantaged students, but will be of limited value if students do not feel safe at school and thus avoid them. Notice, once again, that the model does not require individual irrationality or specific pressure from a peer group or a community to invest little in one's human capital. Instead, the central focus of the model is a tension between surviving and thriving such that lower investments in human capital are an optimal response to a brutal trade-off.

CONCLUSION

In this article, we examine heterogeneity in disruptive events and adverse conditions among a sample of disadvantaged youth growing up in high-poverty and racially isolated communities in Baltimore. Although many studies might group these respondents together based on their similarity along dimensions used to explain variation in human capital outcomes (they are all Black and from low-income families), we provide evidence of rich heterogeneity along several important dimensions, including what specific kinds of adversity respondents reported and in how they perceived their adversity. Importantly, we provide evidence of differences in how individuals responded to adverse events. Some were essentially derailed by traumatic events such as homelessness, deaths in the family, or parental incarceration. In the face of stark adversity, deliberate and thoughtful choices might not be expected to influence outcomes and so individuals made sometimes dangerous and harmful reactive choices. Others appeared to make more deliberate decisions in the face of adversity with both short-term and long-term implications. Some choices not only kept them safe in the short-term, but also seemed likely to serve them in the long run, akin to making deeper investments in human capital. We also find evidence that some youth, when developing strategies in response to adversity, appeared to face a trade-off between surviving (interpreted broadly to incorporate avoiding some of the most costly outcomes) and thriving.

We formalize this trade-off in a model, which extends basic human capital theory to allow for the possibility that some actions that might be thought of as good decisions in the sense that they increase the likelihood of future success (thriving) do so at the cost of also increasing the likelihood of never getting to the future (not surviving). For example, leaving school to make money to support a family is not a recipe for success, but it is also a way to avoid a disastrous short-term outcome, such as not being able to pay the hospital bills for your mother and further burdening her. The model not only provides some guidance for further empirical research; it also illustrates that a straightforward addition to a basic dynamic model of human capital accumulation allows it to capture a type of dynamic trade-off that may be largely irrelevant for middle- or high-income youth, but may nonetheless be pervasive in the lives of the disadvantaged youth in this study.

These ideas can lead to two changes in how we approach adversity in the social sciences: improvements to data and improvements to models. The former point is simply that larger-*N* data collection of factors we examine (such as coping strategies) would allow us to draw more conclusions about their role in predicting variation in trajectories. The latter point is that models of decision-making that omit trade-offs relevant to respondents who face adversity should be modified to capture how adversity can perpetuate inequality in part through the adoption of strategies that allow people to survive but dampen their ability to thrive. Indeed, an implication of the model is that we need not focus on suboptimal decision-making or cultural factors or social norms to understand why individuals make choices that undercut future thriving.

The model provides a starting point for more elaborate models that could be used to develop hypotheses that could be tested using larger-*N* data sets or, if matched to data (such as using structural econometric estimation techniques), to simulate how policy interacts with decisions surrounding adversity to drive inequality. Indeed, better data coupled with models that incorporate such channels could be used to explore policies that specifically target individuals forced to contend with adversity. The ultimate goal is to explore, devise, and design policy interventions that relax this particular trade-off so that individuals who are born into disadvantage and face various forms

of adversity need not be put into the unfortunate and untenable position of choosing between surviving and thriving. Certainly, some of these policies must confront larger upstream structural sources of racial and economic inequality. But even many of these policies lack an understanding of how youth make decisions within unequal contexts, which we believe is crucial to better policies and better outcomes.

A natural extension of the current study would be to consider how different categories of strategies map to different outcomes. Unfortunately, data collection ended just as the individuals in the sample were beginning adulthood and thus it would be premature to draw strong conclusions. Moreover, we must be mindful of additional limitations to the current study. We focus on a small sample of Black youth in one city. Data from another context (such as non-Black or rural youth) could provide different lessons, as we know literature points to challenges faced by families in rural areas (Edin, Shaefer, and Nelson 2023) and among youth from indigenous communities, for example. Another useful exercise, which we leave to future research, would be to use larger-*N* data sets to more carefully examine investments in human capital that could put individuals at immediate risk of losing something critical (such as attending school despite violence at school). In general, larger data sets could be used to corroborate and further explore the degree to which the types of strategies and trade-offs we observe and analyze here are more general feature of adversity among disadvantaged youth that helps to explain heterogeneous responses to it.

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Stepping In and Stepping Away: Variation in How Children Navigate Responsibilities Stemming from Paternal Incarceration

KRISTIN TURNEY, AMY GONG LIU, AND ESTÉFANI MARÍN

Despite reasons to believe that paternal incarceration has heterogeneous consequences for children, little research explores the processes underlying variation in children's responses to this adverse event. We use data from the Jail and Family Life Study, an in-depth interview study of incarcerated fathers and their family members (including their children), to understand the heterogeneous processes linking paternal incarceration to children's well-being. Children commonly reported that their father's incarceration restructured their lives by altering their emotional and instrumental responsibilities. Within each of these domains, though, children expressed considerable variation in their responses, with some children seamlessly stepping into new responsibilities stemming from paternal incarceration and other children, especially older children who had witnessed their fathers' frequent entanglements with the criminal legal system, consciously stepping away from these responsibilities. These findings illustrate the range of responses that children have to paternal incarceration, shedding light on processes that have not been observed in survey research.

Keywords: children's well-being, criminal legal system, heterogeneous effects, incarceration, inequality

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The expeditious growth of incarceration over the past half century in the United States means that a historically unprecedented number of children experience parental incarceration over the course of their lives. More than 2.6 million children have a parent, most commonly a father, currently incarcerated, and millions more children have fathers recently released from jail or prison (Sykes and Pettit 2014). More than 16 percent of U.S. adults—some forty million individuals—report their father has been confined in jail or prison (Enns et al. 2019). Among urban children, about one-third experience paternal incarceration by age nine (Turney and Haskins 2019). The concentration of paternal incarceration among children of color and economically vulnerable children, combined with the negative intergenerational repercussions of paternal incarceration, can exacerbate existing inequalities in children's well-being (Wakefield and Wildeman 2013).

Paternal incarceration is an overwhelmingly stressful life event—and a unique form of household disruption—that is often accompanied by trauma, can create internalized stigma, and can facilitate strain within the household and beyond (Hagan and Dinovitzer 1999). Paternal incarceration strains family economic resources (Schwartz-Soicher, Geller, and Garfinkel 2011), creates challenges for children's caregivers as they navigate parenting demands (Turney and Wildeman 2013), and fractures relationships between parents (Turney and Halpern-Meekin 2021), all of which can contribute to deleterious intergenerational outcomes from childhood through adulthood. Indeed, research consistently finds that paternal incarceration impairs mental and physical health, reduces educational achievement and attainment, and increases hardship and deprivation, net of characteristics associated with selection into experiencing paternal incarceration (for reviews, see Foster and Hagan 2015; Haskins, Amorim, and Mingo 2018; Johnson and Easterling 2012; Murray, Loeber, and Pardini 2012; Poehlmann-Tynan and Turney 2021; Turney and Goodsell 2018). This research also highlights children's heterogeneous responses to paternal incarceration (Burgess-Proctor, Huebner, and Durso 2016; Foster and Hagan 2013; Haskins 2014; Turney 2017, 2022; Wildeman 2010).

Despite accumulating evidence of the deleterious intergenerational consequences of paternal incarceration, our understanding of these consequences is limited. Perhaps most important, existing research nearly exclusively relies on survey data to estimate differences in outcomes between children who do and do not experience paternal incarceration (for research using qualitative methods, see Johnson and Easterling 2015; Nesmith and Ruhland 2008; Wakefield and Wildeman 2013). This focus on group differences—and the corresponding focus on causal inference despite the challenges of isolating paternal incarceration from other adversities—means that little research systematically considers the processes underlying children's responses to paternal incarceration. A more complete understanding of children's responses could help reconcile inconsistent or heterogeneous findings across data sources, identify places of intervention to reduce inequalities, and inform future survey development.

In this article, we use qualitative data from the Jail and Family Life Study, an in-depth interview study of incarcerated fathers and their family members (including their children), to document the processes through which children respond to their father's jail incarceration. Understanding the repercussions of jail incarceration, where most people incarcerated are awaiting adjudication of their case and have not been convicted of any crime, and are therefore experiencing considerable uncertainty about their release date, is especially important (Turney and Conner 2019). Jail incarceration is six times more common than prison incarceration, meaning that having a father incarcerated in jail is far more common than having a father incarcerated in prison (Sawyer and Wagner 2023). Jail incarceration is also relatively short in duration, with people commonly churning between institutions and communities, a form of instability that can create considerable challenges for children (Cavanagh and Fomby 2019).

Our analysis of longitudinal interviews with thirty-eight children (ages eight to seventeen), two-thirds of whom identify as Latino/a, show

that the carceral system imposes symbiotic harms on children of incarcerated fathers (Condry and Minson 2021). First, we find that exposure to an incarcerated father restructures the lives of children, with children describing how the criminal legal system socializes them to take on emotional and instrumental responsibilities in response to their father's incarceration. Second, we find that within the domains of altered emotional and instrumental responsibilities, children expressed considerable variation in their responses to their fathers' incarceration. Some children reported seamlessly stepping into these new responsibilities and others reported consciously stepping away from these responsibilities (sometimes stepping into new responsibilities as well), and both stepping in and stepping away took considerable energy. Third, these heterogeneous responses stem partially from variation in children's age, particularly differences between those in middle childhood (ages eight to twelve) and those in adolescence (ages thirteen to seventeen), which intersects with variation in their father's incarceration history (for example, duration and frequency of incarceration). These findings, which bring Latino/a children to the forefront of scholarship on the harms imposed by the criminal legal system, illustrate the range of responses children have to paternal incarceration.

BACKGROUND

The stress process perspective provides a lens for understanding how paternal incarceration can affect children's well-being. We first review the stress process perspective, focusing on the stressor of paternal incarceration, and then describe prior research on the repercussions of paternal incarceration for children's well-being.

Paternal Incarceration in the Stress Process Perspective

The stress process perspective posits that stressors, events, and disruptions concentrated among vulnerable groups that challenge adaptive functioning can be meaningful for well-being (Carr 2014; Pearlin 1989; Pearlin et al. 1981). Stressors can be quite consequential for children (Avison 2010). Three aspects of the stress process perspective are especially relevant to understanding the relationship between paternal incarceration and children's well-being: first, inequality in exposure and responses to stressors; second, stress proliferation across people (that is, how stressors proliferate from the person initially exposed to the stressor to those connected to that person); and, third, stress proliferation across stressors (that is, how initial stressors lead to stressors in other domains).

Inequality in Exposure and Responses to Stressors

First, the stress process perspective highlights inequality in exposure to stressors, with exposure to stressors concentrated among historically and contemporarily disadvantaged social groups (Pearlin 1989). Paternal incarceration, rooted in structural inequalities stemming from racism and slavery, is a relatively common adverse childhood experience (Alexander 2020; Gjelsvik et al. 2014; Turney 2018) and form of household disruption. A nationally representative sample of children shows that 8 percent of children (ages zero to seventeen) have experienced the incarceration of a residential parent (Turney 2018). A nationally representative sample of adults finds that more than one-third (34 percent) of those ages eighteen to twenty-nine have experienced parental incarceration (Enns et al. 2019). Given the disproportionate share of men in the carceral system, paternal incarceration is more common than maternal incarceration (Carson 2021).

The commonality of paternal incarceration masks considerable inequality in exposure to paternal incarceration. Paternal incarceration is concentrated among children who endure additional vulnerabilities such as structural racism, residence in disadvantaged neighborhoods, and extreme poverty (Johnson and Easterling 2012). Among those born between 1989 and 1993, paternal incarceration is six and three times more common among Black and Hispanic children, respectively, than among White children (Sykes and Pettit 2014). Paternal incarceration is four times more common among Hispanic children of fathers with less than a high school diploma than among their counterparts of fathers with some college education (Sykes and Pettit 2014). Therefore, though

much scholarship on parental incarceration focuses on Black children (or disparities between Black and White children), Latino/a children are commonly exposed to this stressor.

Stress Proliferation Across People

Second, the stress process perspective postulates that stressors can proliferate across people, that is, from the individual initially exposed to the stressor to those connected to that individual, and that this type of stress proliferation can operate to impair the well-being of both parties. Stressors can proliferate across generations, from parents to children or from children to parents, for example; within generations, from individuals to their siblings; or within nonfamilial connections, from individuals to their caregivers (Pearlin, Aneshensel, and LeBlanc 1997).

Indeed, most currently and formerly incarcerated individuals are embedded within families. Paternal incarceration can have far-reaching symbiotic harms for families (Condry and Minson 2021), with the consequences of incarceration extending beyond the consequences for the incarcerated and extending to the children (Foster and Hagan 2013), parents (Goldman 2019), romantic partners (Turney and Halpern-Meekin 2021), and siblings (Tadros, Fye, and Ray 2020) of the incarcerated. Given the strong bonds between parents and children, as well as the interdependence between parents and children over the life course (Elder 1998), research increasingly explores the deleterious repercussions of paternal incarceration.

Stress Proliferation Across Stressors

Third, the stress process perspective posits that stressors can proliferate to create additional stressors (in addition to proliferating from one person to another, as described). Primary stressors give rise to additional, or secondary, stressors, with both primary and secondary stressors collectively impairing well-being (Pearlin 1989; Pearlin et al. 1981). The primary stressor of paternal incarceration can lead to secondary stressors such as economic hardship, fractured romantic and co-parenting relationships, and impaired caregiver health, all of which can undermine children's well-being.

Paternal incarceration, as a primary stressor, can facilitate economic strain for families, and this secondary stressor may be one pathway through which paternal incarceration impairs children's well-being. Most incarcerated fathers contribute economically to their households (or their children's households) prior to their incarceration (Geller, Garfinkel, and Western 2011). Incarcerated individuals are mechanically removed from employment and, after release, the stigma of a criminal record makes finding and sustaining employment difficult (Pager 2003). Economic hardship can facilitate unstable living situations, lead to fewer resources for children, and increase the labor-force participation of children's caregivers while decreasing their time for parental monitoring and supervision (Bruns 2019; Geller and Franklin 2014). In turn, economic strain undermines children's well-being (Hill et al. 2013).

The stressor of paternal incarceration also fractures family relationships, including romantic and co-parenting ties, and this secondary stressor may be another mechanism linking paternal incarceration and children's well-being. Most incarcerated individuals are in romantic relationships prior to their confinement, but the liminality associated with the carceral period makes it difficult to sustain romantic relationships while one partner is incarcerated (Comfort 2008). Incarceration creates challenges surrounding intimacy and communication and simultaneously gives partners an opportunity to reevaluate the role of the relationship in their lives (Comfort 2008). Incarceration increases the likelihood of union dissolution, reduces relationship quality, and creates difficulties in co-parenting (Turney and Halpern-Meekin 2021; Turney and Wildeman 2013; Western, Bloome, and Percheski 2008; Widdowson et al. 2020), all of which can damage children's well-being (McLanahan, Tach, and Schneider 2013; Palkovitz, Fagan, and Hull 2013).

The stressor of paternal incarceration can put tremendous strain on children's caregivers (most frequently their mothers), and this secondary stressor—impaired caregiver mental health—may explain the relationship between paternal incarceration and children's well-being. Romantic partners of incarcerated men

may experience considerable distress and worry while their partner is incarcerated (Fishman 1990). They may also be forced to take on additional household and childcare responsibilities in their partner's absence (Braman 2007), which can be distressing or worrisome. Romantic partners may also experience considerable anticipatory stress about if and when their partner will be released and, if so, the role he will play in their lives after release (Fishman 1990; Miller 2021). Research shows that women who share children with recently incarcerated men, relative to their counterparts, have a greater likelihood of depression and life dissatisfaction (Wildeman, Schnittker, and Turney 2012). Caregiver mental health, in turn, is a key predictor of children's well-being (Meadows, McLanahan, and Brooks-Gunn 2008).

Existing Evidence of Intergenerational Consequences of Paternal Incarceration

The stress process perspective, with its focus on the unequal distribution of stressors and the proliferation of stressors across both people and stressors, is a useful framework for understanding the intergenerational consequences of paternal incarceration. Research highlights the role of paternal incarceration in structuring inequalities—above and beyond inequalities prior to paternal incarceration—between children who do and do not experience this adverse childhood event. Children with incarcerated fathers, relative to their counterparts, have more behavioral problems, including internalizing behaviors, externalizing behaviors, and attention problems (Geller et al. 2012; Haskins 2014, 2015; Wildeman 2010). Children with incarcerated fathers also have poor educational outcomes—lower attainment, lower achievement, and higher rates of exclusionary school discipline (Jacobsen 2019; but see Norris, Pecenco, and Weaver 2021). They are also more likely to engage in delinquent behavior or have contact with the criminal legal system themselves (Wildeman and Andersen 2017). The magnitude of the differences between children with and without incarcerated fathers differ across both data sources and outcomes.

Research also demonstrates considerable heterogeneity in children's responses to paternal incarceration. First, boys experience more deleterious consequences than girls, particularly in regard to behavioral and educational outcomes (Haskins 2014; Wildeman 2010). Second, the consequences are concentrated among children who were living with their fathers prior to his incarceration (Geller et al. 2012). Third, the age of exposure to paternal incarceration can also structure children's behavioral and educational outcomes, with paternal incarceration in early childhood being more consequential than paternal incarceration later in the life course (Foster and Hagan 2013; Turney 2022). This survey research provides some understanding of heterogeneous responses to paternal incarceration, but is limited because the data are often underpowered to detect statistically significant differences (which may suggest null results that would not be null if powered appropriately), is only focused on specific outcomes such as behavior or educational attainment, or comes to inconsistent findings across studies.

Expanding Our Understanding of Incarceration's Intergenerational Consequences

Despite increased research attention to how the stressor of paternal incarceration shapes children's lives, opportunities to advance our understanding of how children respond to this stressor are available. Most important, little research examines the processes through which paternal incarceration transforms children, in part because the survey data commonly used to understand these intergenerational consequences (including the Future of Families and Child Wellbeing Study and the National Longitudinal Study of Adolescent to Adult Health) are not well positioned to investigate processes. This survey research focuses on differences in outcomes between children who do and do not experience paternal incarceration and, given the stark differences between these two groups prior to the incarceration, often endeavors to strengthen causal inference around this association (Haskins 2014; Norris, Pecenco, and Weaver 2021).

The survey research that does investigate the mechanisms linking paternal incarceration to children's well-being cannot fully explain this

association and is limited by the cyclical nature of incarceration, which makes it especially difficult to identify causal mechanisms. One study finds that familial characteristics—including maternal depression, maternal parenting stress, paternal involvement, and spanking—explain some, but not all, of the relationship between paternal incarceration and children's behaviors, suggesting other mechanisms are at play (Antle, Gibson, and Krohn 2020; also see Dwyer Emory 2018). Qualitative research is ideal for understanding these processes (Johnson and Easterling 2015; Nesmith and Ruhland 2008; Wakefield and Wildeman 2013). Qualitative data, and its associated complexity, is also ideal for providing greater context for the heterogeneous consequences of paternal incarceration that have been identified in survey research (Sampson 2011; Torche, Fletcher, and Brand 2024, this issue).

DATA AND METHODS

This article advances our understanding of the intergenerational consequences of incarceration by exploring the range of processes through which children respond to paternal incarceration. We use data from the Jail and Family Life Study, a longitudinal in-depth interview study of fathers incarcerated in southern California and their family members. Fathers were recruited and interviewed in jail and, during their interview, were asked to provide names and contact information for their family members (including their children, children's caregivers, and mothers). The sample includes 123 fathers and their family members, all of whom we attempted to interview twice, between July 2015 and December 2017. Fathers were eligible for participation if they had contact with at least one child in the month prior to their incarceration, although living with children was not a requirement for participation. We conducted baseline interviews with fathers while they were in jail. We conducted most baseline interviews with family members while the father was in jail, though occasionally fathers were released from jail before we were able to conduct these interviews. We conducted follow-up interviews with fathers and family members about two months after the father had been released from jail or, when fathers had not been released or sentenced to prison, about one year after the baseline interview. We asked children's caregivers to provide written consent for both their interview and, if applicable, the interview of their child. Children provided oral consent. We draw on sixty-eight interviews, including thirty-eight baseline and thirty follow-up interviews with children—from ages eight to seventeen—of incarcerated fathers.[1] These thirty-eight respondents come from twenty-six families because we interviewed siblings when possible. It is especially important to incorporate children's voices into the stress process perspective and research on the consequences of paternal incarceration more generally, as children may provide the most direct accounts of their familial experiences (Avison 2010).[2]

After working to establish rapport, we asked children questions about their families, their schools, and their peers, focusing especially on how their lives had changed since their father's incarceration (Turney et al. 2017). We paid attention to children's developmental age when conducting the interviews. We asked similar questions of all children, but varied the question wording and order as necessary to ensure that the interview flowed as much as possible like a conversation. Baseline and follow-up in-

1. Many fathers in the study had children younger than eight, consistent with expectations given the age distribution of incarcerated people. These fathers were eligible for study participation, but we did not interview their children; this is the primary reason we do not have corresponding child interviews for all father interviews.

2. Children may have different perspectives than their caregivers (Siegel and Luther 2019). We triangulated children's responses with those of their caregivers. These analyses revealed that children and caregiver accounts of instrumental responsibilities (described later) were consistent across reporters. They also revealed subtle differences in emotional responsibilities (described later). Children's accounts showed how children took on emotional responsibilities stemming from the incarceration, whereas caregiver accounts focused on the emotional consequences of the incarceration on the child. This suggests that a reliance on caregiver reports alone would miss the considerable emotional responsibilities described by children.

terviews with children lasted an average of forty-eight and forty-nine minutes (in a range of fourteen to 105 minutes), respectively. The relatively short length of the interviews with children is consistent with expectations from other research (Siegel and Luther 2019). Participants received $10 cash for each interview. We transcribed interviews verbatim.

Analytic Approach

The analytic approach occurred in three primary stages. First, a team of trained graduate students conducted deductive coding of all child interviews. We primarily derived the deductive codes from the interview questions, and they covered broad topics such as the father's incarceration, contact with the father, and mental health (Deterding and Waters 2021). Second, a team of trained graduate students conducted inductive coding of all child interviews. This involved coding the portions of the child interviews identified in the deductive coding as Incarceration Effects. We engaged in an iterative coding process, with the research team continually refining the codebook and recoding as necessary (Deterding and Waters 2021). We paid careful attention to intercoder reliability in both the deductive and inductive coding, with the research team coding multiple transcripts together until we reached consistency in coding and each transcript being coded by two team members, the larger team working closely together to resolve discrepancies. Third, we wrote analytic memos based on key themes that emerged during this inductive coding. We first wrote analytic memos for each of the key themes and then wrote separate analytic memos across emergent areas of heterogeneity including gender, father-child relationship prior to incarceration, and age.

Sample Description

Table 1 presents demographic characteristics of the analytic sample. The analytic sample comprises roughly similar numbers of children in middle childhood (ages eight to twelve) and adolescence (ages thirteen to seventeen). Nearly two-thirds (66 percent) of the analytic sample identified as Latino/a. Girls made up about two-thirds (66 percent) of the sample. Most children (71 percent) were living with their biological mother at the baseline interview, and nearly all children (95 percent) were not living with their father immediately before his incarceration.

FINDINGS

Analysis of interview transcripts reveal three key findings. First, children experienced changes in their emotional and instrumental responsibilities resulting from their father's incarceration. Second, children's responses to their father's incarceration were heterogeneous, with many children reporting increased emotional and instrumental responsibilities and others reporting conscious decisions to step away from these responsibilities, sometimes while describing increased responsibilities. Third, these heterogeneous responses stem partially from variation in children's age, particularly differences between those in middle childhood and those in adolescence, which intersects with variation in their father's incarceration history, such as duration and frequency of incarceration.

Emotional and Instrumental Responsibilities Stemming from Paternal Incarceration

Paternal incarceration, and the related removal of fathers from households, leaves children and their caregivers to manage in their father's absence. Most children responded to these changes by describing a range of emotional and instrumental responsibilities that they took on in response to their father's incarceration. Other children with incarcerated fathers, though, stepped away from these emotional and instrumental responsibilities. Therefore, children have heterogeneous responses to paternal incarceration.

Stepping into New Responsibilities

First, as expected, most children with incarcerated fathers commonly reported increased emotional and instrumental responsibilities that arose directly from their father's incarceration. These children incurred emotional responsibilities that included concealing their own emotions from their family members (mothers, siblings, and fathers) and providing consolation to these family members. Children

Table 1. Descriptive Characteristics of Analytic Sample

	Mean or *N*	Frequency (%)
Race-ethnicity		
Latino/a	25	66
Black	0	0
White	5	13
Asian–Pacific Islander	3	8
Multiracial–multiethnic	4	11
Missing	1	3
Gender		
Boy	13	34
Girl	25	66
Age		
Eight to twelve	20	53
Thirteen to seventeen	18	47
Caregiver[a]		
Biological mother	27	71
Grandparent	7	18
Someone other than biological mother	4	11
Household social class[b]		
Poor or working poor	33	87
Middle class	5	13
Living with father prior to incarceration		
Yes	2	5
No	36	95
Father previously incarcerated		
Yes	36	95
No	2	5
N	38	

Source: Authors' tabulation.

[a] Percentages do not add to 100 percent because some children live with more than one caregiver.

[b] Poor or working poor children had unemployed caregivers; caregivers who were employed but reported erratic hours, low pay, and few benefits; or caregivers who were employed full time in low-paying positions with some benefits. Middle-class children had caregivers who worked full time in professional or white-collar careers.

engaged in these two types of emotional responsibilities—concealing their emotions and consoling their family members—to protect both themselves and their family members. These children also incurred instrumental responsibilities that included maintaining relationships with the father through visitation and other forms of contact, managing aspects of their father's incarceration, and taking on caregiving responsibilities for their father and other family members.

Many children reported increased emotional responsibilities in response to their father's incarceration. Consider sixteen-year-old Sean, who described how he conceals his emotions about his father's incarceration to protect

his family members. Sean told us that his father's incarceration—and the accompanying behaviors that led to his father's engagement with the criminal legal system—has taken a toll on his family, especially his three siblings, who are ages twenty-seven, twenty-nine, and thirty-one. Sean describes sadness about his father's year-long absence and worry about the uncertainty of his father's release because his father's release date was still unknown despite more than thirty court appearances. Sean told us that he works hard to keep these emotions from his siblings. "I don't really say much, and I try not to say anything. Because I know that will not affect them on the outside, but I know inside it's gonna hurt them." Sean also described an acute awareness of the struggles that his father's first-time incarceration has created for his mother, and he says that the four of them look out for each other's emotions to lessen the burdens on their mother. "My mom went through so much," he told us.

Similarly, many children reported an increase in instrumental responsibilities in response to their father's incarceration. Children commonly reported the labor they engaged in to maintain contact with their father, which was often coordinated through their caregivers. All but three children sustained some form of contact with their incarcerated father during his most proximate incarceration, through visits, phone calls, and letter writing. Nearly two-thirds reported visiting their father in jail during his most proximate incarceration stay. For example, sixteen-year-old Renee told us about the instrumental responsibilities she and her three sisters took on to maintain contact with their father during his time in jail. Renee and her siblings, like many children we spoke with, visited their father, accepted his frequent collect calls, and wrote him letters. Renee told us that she worked hard to maintain contact with her father and also frequently put money on his books. "I was always there for him," she said. "[I thought] if we were there for him and giving him support, it would help him through it. . . . If he needed any money or food, if he needed money on his books, I put money on it. And, I'd write him whenever I could. Like, I was just always there for him, you know, to make sure—so, he knew that we were there for him and supported him." Renee's discussion of maintaining contact with her father was typical among children.

Another type of instrumental responsibilities that children commonly report is managing aspects of their father's incarceration. Children did so by attending court dates, passing messages along to those on the outside, and relaying or disclosing information about their father's whereabouts and well-being to his friends and family. Renee described the many ways she and her siblings managed their father's incarceration. They attended about ten of his court dates in the past year, each time sitting in court from 8 a.m. to 4 p.m. only to learn that their father's case had been postponed. Renee and her siblings also communicated with her father's public defender, questioning why their father had been incarcerated so long on a probation violation, which contrasted with their online research suggesting he should spend no more than forty-five days in jail for this violation. When their father's case was finally adjudicated, after multiple postponements, and he was scheduled for immediate release given the length of time he had served, the sisters took responsibility for meeting him upon release. Renee and her sisters arrived at the jail at their father's scheduled release time of 10:30 p.m. and took him to a hotel when he was eventually released at 3 a.m.

Stepping Away from New Responsibilities

Although many children described taking on increased emotional and instrumental responsibilities during their father's incarceration, notably by concealing their emotions and consoling distressed family members, adopting them was not universal, perhaps expected given research demonstrating children's heterogenous responses to paternal incarceration. Instead, some children described consciously stepping away from these emotional and instrumental responsibilities to protect themselves, even as a number simultaneously engaged in some emotional and instrumental responsibilities. Many of these children described making decisions to minimize contact with their father—thereby partially lessening their potential for emotional and instrumental responsibilities—or minimize the support they

provide to their mothers, siblings, or other family members. They describe scaling back their duties over time or being selective about the responsibilities they incur. Violet, twelve years old, is an exemplar of a child who reports stepping away from emotional and instrumental responsibilities during her father's most recent incarceration. Her father had been in and out of jail most of her life and, when he requested that she visit him, by writing this in a Christmas card, she decided that she did not want to see him. She told us, "He doesn't exist. I try to forget about him. I try to not focus on the past and focus on the present. I don't want to know about my dad anymore cuz it's too much information." Therefore, Violet, like many children we interviewed, described not wanting to incur additional responsibilities related to her father's incarceration.

Explaining Variation in Heterogeneous Responses to Paternal Incarceration

Our analyses show that many children step into emotional and instrumental responsibilities stemming from their father's incarceration and that others step away from these responsibilities sometimes while also stepping into some responsibilities. Why do some children step into these responsibilities and others step away? We systematically examined variation in children's responses to their father's incarceration, focusing on similarities and differences across child gender, the father-child relationship prior to the father's incarceration, and child age, particularly differences across middle childhood and adolescence, given some evidence from survey research that familial processes underlying paternal incarceration may vary across these dimensions.

Child's Gender

Our analyses show little evidence that the processes through which children respond to paternal incarceration—at least with respect to their emotional and instrumental responsibilities—vary by child's gender. Contrary to expectations, both boys and girls similarly described both incurring and stepping away from emotional and instrumental responsibilities. For example, both boys and girls commonly worked to conceal their emotions and spend time consoling family members. Both boys and girls also similarly described stepping away from such responsibilities. Therefore, although some children described stepping into these responsibilities, others described stepping away, and still others described both stepping into some and stepping away from others, we found no evidence that these decisions are patterned by gender.

Luke, a nine-year-old boy, reported increased emotional and instrumental responsibilities in response to his father's incarceration. Luke took on the emotional responsibility of consoling his distressed family members. Like many of the children we interviewed, family members—including children's caregivers and siblings—commonly expressed distress, worry, and fear about the father's time in jail. Children were commonly aware that their family members were experiencing these emotions, and this knowledge often translated into increased emotional responsibilities. Luke told us that he and his siblings often witness his mother crying as a result of their father's incarceration. "We would cheer her up," he said. This type of emotional responsibility, consoling distressed family members, was common among both boys and girls in our sample.

In addition to children, like Luke, telling us they console their distressed family members, both boys and girls described an awareness that their siblings are protecting them. Nikki, a thirteen-year-old girl whose father experienced a series of short incarceration stays, provides an example. Nikki told us that her older sister, who experienced considerable distress related to her father's incarceration, does not bring up events related to the incarceration to avoid triggering Nicole. "My sister . . . tried to hide it so I wouldn't get sad," she said. Children, like Luke and Nikki, take on emotional responsibilities for protecting their family members or express an acute recognition of the emotional responsibilities that others are incurring, which is perhaps an emotional responsibility itself.

Father-Child Relationship

We also find little evidence of variation in children's emotional and instrumental responsibilities by their relationship with their father,

as measured by both father's residential status prior to his incarceration and the quality of the father-child relationship. All but two children we interviewed were not living with their father immediately beforehand. Given the energy that nearly all children spend on navigating new responsibilities in the wake of their father's incarceration, or stepping away from responsibilities, which also takes considerable energy, children are clearly not shielded from the repercussions of incarceration when their father lives in a separate household. We also examined variation in children's emotional and instrumental responsibilities based on their relationship with their father before his most proximate incarceration, comparing children with low-quality relationships with their fathers and those with high-quality relationships.[3] We found that children with both low- and high-quality relationships with their fathers engage in emotional and instrumental responsibilities in the wake of their father's incarceration. That is, even children with virtually no relationship with their fathers commonly describe having to manage the emotions of other family members, conceal their emotions from these family members, or reject their father's desire to connect with them. Likewise, we found that children step away from emotional and instrumental responsibilities regardless of their relationship with their father.

Children who report low-quality relationships describe emotional and instrumental responsibilities that stem from their fathers' incarceration. Ernesto, sixteen years old, provides an example. Ernesto reported having virtually no relationship with his father, both before and during his father's incarceration. Ernesto last visited his father in jail a year ago earlier, and although his father occasionally wrote him letters, he did not write back. Even so, Ernesto described the emotional responsibilities that come with consoling his mother and brother. Like Luke, Ernesto told us about the sadness his mother experiences because of his father's incarceration. He said that he consoled his mother, who was especially sad about the lack of father figure for Ernesto and his brother, by telling her that she was solely responsible for the fact that he "grew up good." He also reassures his mother that his younger brother will similarly persevere during his father's incarceration, and tells her that "I could be the father figure for my little brother." He went on to describe how he comforted his brother, saying, "Gotta keep my brother in a happy place. I'ma make him happy and keep him here by my side." This consolation of both his mother and brother is similar to how many children describe reassuring and encouraging family members experiencing incarceration-related distress.

Children who report high-quality relationships with their fathers describe emotional and instrumental responsibilities that stem from their fathers' incarceration. Alexis, sixteen years old, was similar to the many children who reported high-quality relationships with their fathers. Alexis's parents divorced when she was in eighth grade and, although she had not lived with her father immediately before his incarceration, she talked to him on the phone every day. Now that he was incarcerated, she visited him as often as possible, telling us that she scheduled her weekends around these visits. Alexis described tremendous sadness regarding her father's absence, a sadness exacerbated when she visits him in jail. Alexis told us that she has hidden this sadness while visiting her father over the past three years, going to great lengths to obscure her tears from him and encouraging her younger sister to do the same. She told us, "It messes him up more because he knows what he did. He knows that he has to fix some things. With [my sister] crying or whatever, it just makes it that much harder for him. Yeah, it's hard for us, but we can make it easier for us and make it easier for him, that way it's just not as stressful on everyone." Alexis

3. We create two relatively crude categories for this analysis. We consider children to have low-quality relationships with their fathers if they reported not seeing their father for an extended period before incarceration, if their father had minimal involvement in daily tasks (such as taking the child to school or playing with the child), or if they reported negative feelings toward their father (such as resentment or anger). We consider other children to have high-quality relationships.

and her sister are exemplars of children who endure the labor of concealing their emotions to protect their fathers.

Child's Age

Finally, despite little evidence of heterogeneity by child gender or father-child relationship, we find that age is a key factor in understanding how children respond to paternal incarceration via emotional and instrumental responsibilities, with the differences especially pronounced for instrumental responsibilities. We find that children's age matters for two reasons. First, children develop agency over time, to either take on more responsibilities or step away from these responsibilities. Second, children's age often dovetails with their father's incarceration history, with age being positively correlated with cyclical or lengthy incarceration. Children become better positioned to take on instrumental responsibilities as they age. We find that younger children often played a supportive role to other family members but, as they get older, they undertake instrumental responsibilities that are independent of their mother's or caregiver's involvement. They take a more active role in supporting their father and other family members and, similarly, are more forceful in stepping away from these responsibilities. The combination of age and father's incarceration history becomes especially pronounced when children choose to step away from these responsibilities, because older children have both agency to step away and often report being worn down from their father's cyclical incarceration. More broadly, this suggests an intersection between heterogeneous treatments (duration of incarceration) and heterogeneous responses (children's age).

Young children, ages eight to twelve, commonly describe taking on responsibilities during their father's incarceration. Chocolate, nine years old, described how her father's confinement—his second time experiencing incarceration—means that she now had the responsibility of walking the family dog. She said, "It was hard to take care of our dog. And just hard to do a lot of other things that [my dad] used to do." More commonly, children described how they incurred additional responsibilities for their siblings or caregivers (as Luke described, for example). Similarly, twelve-year-old Paula, whose dad had been incarcerated for just over four months when we interviewed her, described emotional responsibilities incurred during his incarceration. Perhaps most notably, she told us about how she had to conceal her knowledge of the reason for her father's incarceration, a detail she overheard via eavesdropping. Paula also told us, though, that she was frustrated with her father's frequent incarcerations; his most recent time in jail was his fourth. She told us that she had visited him but that, should he be incarcerated a fifth time, she would not. She also said that she was going to tell her mother to stop putting money on his books "cause you really don't deserve it if you're gonna be going in here in and out." Therefore, though Paula has incurred emotional and instrumental responsibilities during her father's incarceration, she planned to pull back at least some of this support in the future. Children alter—or, in Paula's case, plan to alter—their instrumental responsibilities because they become worn down by fathers who frequently cycle in and out of jail.

Considerably more evidence of heterogeneity is in response to paternal incarceration as children age, with some older children (thirteen to seventeen) stepping into emotional and instrumental responsibilities and other older children stepping away. Two siblings (fourteen-year-old Nellie and seventeen-year-old Madeleine, as well as their eleven-year-old brother Ruben) described how they stepped into new responsibilities during their father's incarceration. They explained how they worked to care for their mother emotionally—by letting her express her sadness, fear, and loneliness about the father's incarceration; by providing a sounding board for her emotions; and by comforting her that everything would be OK—to protect their mother's emotional health. These siblings all described how they worked to manage their mother's emotions to keep her from ending her own life, an act she had previously expressed as a possibility. Madeleine said, "It was really hard. She would say, 'I just wanna give up. I wanna give up at life.'" Madeleine and her siblings, like many children we spoke to, took on considerable emotional responsibilities following their father's incarceration.

Older children also reported stepping away from emotional and instrumental responsibilities (and this was more common among older children than younger children). Nikki, the thirteen-year-old who expressed an acute recognition of the emotional responsibilities incurred by others, told us that her primary emotional responsibilities—of worrying about her father—decreased when her father was incarcerated for the tenth time. She said, "I feel like I would rather him be in jail because I know he's safe there. And I know he's eating and I know he's getting medical attention if he needs it. And I don't have to worry." This sentiment of relief accompanying a father's jail stay, and corresponding decline in emotional responsibilities, was commonly reported, even by children who also reported incurring emotional responsibilities. Therefore, some children, especially older children who had experienced their fathers cycling in and out of jail and prison over many years, described consciously stepping away from these emotional and instrumental responsibilities (even as a number simultaneously engaged in some emotional responsibilities).

DISCUSSION

Research on the intergenerational consequences of paternal incarceration comes to two broad conclusions. First, on average, paternal incarceration is a disruption with deleterious repercussions for children's well-being (for reviews, see Foster and Hagan 2015; Haskins, Amorim, and Mingo 2018; Johnson and Easterling 2012; Murray, Loeber, and Pardini 2012; Poehlmann-Tynan and Turney 2021; Turney and Goodsell 2018). Second, there is considerable variation in how children respond to this stressor in terms of the magnitude of the differences between children with and without incarcerated fathers, differences across outcomes, and subgroup variation in associations (Foster and Hagan 2013; Geller et al. 2012; Haskins 2014; Norris, Pecenco, and Weaver 2021; Turney 2017). The processes underlying these average and heterogeneous repercussions are less understood, in part because of a reliance on survey data that lacks contextual information to understand these processes. In this article, we use qualitative data from the Jail and Family Life Study, which includes in-depth interviews with thirty-eight children enduring paternal incarceration, the majority of whom identify as Latino/a, to provide a systematic accounting of the processes linking paternal incarceration to children's well-being.

The first key finding is that children consistently identify sometimes overlapping emotional and instrumental responsibilities related to the stressor of paternal incarceration. Emotional responsibilities often include concealing their emotions and consoling their family members. These increased emotional responsibilities were in addition to the emotions such as distress, worry, and fear that children had regarding their father's incarceration (Geller et al. 2012). Instrumental responsibilities commonly entailed maintaining relationships with their father through visitation and other forms of contact, managing aspects of their father's incarceration, and taking on caregiving responsibilities for their father and other family members. These findings highlight how children of incarcerated fathers undertake adult responsibilities to help themselves and their families adapt to their father's incarceration (Burton 2007). This is consistent with other research showing how those experiencing paternal incarceration are more likely than their counterparts to experience subjective adulthood, that is, report feeling older than their biological age (Turney and Lanuza 2017). These increased responsibilities took a toll on these children, who were often navigating their father's incarceration alongside other responsibilities in their lives. Some of these increased responsibilities may be unique to the adverse event of paternal incarceration, given the shame sometimes stemming from family member criminal legal contact (Braman 2007) and the considerable uncertainty associated with jail incarceration (Walker 2022). Future research should systematically examine how children's responses to paternal incarceration mirrors or diverges from their responses to other adverse events such as parental job loss or relationship dissolution.

This finding—that children commonly step into new roles to manage the emotional and instrumental responsibilities demanded by their father's incarceration—sheds consider-

able light on the processes underlying the consequences of paternal incarceration. Indeed, these increased responsibilities may explain the deleterious consequences that paternal incarceration has for children's behavioral and educational outcomes. The incarceration may shift roles and responsibilities and, in turn, the stress associated with these increased demands could impair mental health (potentially increasing anxiety and depression), leave less time for educational achievement, or facilitate delinquency. Children's extensive discussions of their increased responsibilities occurred simultaneously with their relative silence on other mechanisms commonly posited in prior research, such as challenges for children's caregivers (Antle, Gibson, and Krohn 2020) and fractured relationships between parents (Dwyer Emory 2018).

The second key finding, consistent with the stress process perspective that people's reactions to stress unfolds within a broader social context (Pearlin 1989), is that children reported considerable variation in emotional and instrumental responsibilities. Most children report that their father's incarceration increases their emotional and instrumental responsibilities in at least one but sometimes both domains. Many, however, even those who report some increased responsibilities, report stepping away from responsibilities during their father's incarceration. That is, many both step into and step away or, less commonly, only step away.

The third key finding is that children's age, by both their increased agency to make decisions and its correlation with their father's incarceration history, structured their heterogeneous responses. Their gender and their relationship with their incarcerated father did not. These findings complement the relatively small body of research that considers how age of exposure to paternal incarceration conditions responses. Most of this research considers paternal incarceration occurring within a narrow time frame (Wildeman 2010) or at some point in childhood (Foster and Hagan 2007). Much of it comes to inconsistent conclusions depending on the data sources or outcome variables (Turney 2022). Children's greater agency as they age may facilitate making conscious choices to step away from increased responsibilities, and these responses may begin to explain other heterogeneity identified in survey research (Foster and Hagan 2013; Geller et al. 2012; Turney 2017, 2022). It may also explain null findings for certain groups of children (Turney 2017). Future research should consider the role of this heterogeneity in structuring responses in traditionally examined indicators of children's well-being, such as externalizing behaviors and test scores.

That children's emotional and instrumental responsibilities did not vary by their gender or relationship with their father prior to his incarceration is inconsistent with survey research that the repercussions are concentrated among boys (Wildeman 2010) or those living with their fathers prior to his incarceration (Geller et al. 2012). Two explanations for these seemingly diverging findings are possible. First, the qualitative nature of this study and the small number of participants make it difficult to identify differences in the way that is possible with a large sample quantitative study. Second, the process of taking on additional responsibilities or choosing to step away from them is quite different from the outcomes commonly considered in survey research; a lack of differences in the domains of emotional and instrumental responsibilities may not translate into differences in behavior problems or test scores between children who do and do not experience paternal incarceration.

Future research should continue to investigate variation in children's responses to paternal incarceration based on their position in the social structure. Stress unfolds within a social context and, accordingly, children respond to stressors based on their position in the broader social structure (Pearlin 1989). Children in relatively disadvantaged social positions—such as poor children or those whose fathers have experienced cyclical incarceration—may experience the most severe consequences of stressors, particularly if they lack resources to protect against such stress (Torche, Fletcher, and Brand 2024, this issue). Alternatively, children in relatively advantaged social positions may experience the most severe consequences of stressors, especially if the stressors are unanticipated or unexpected (Torche, Fletcher, and Brand 2024; also see Turney 2017). These data

do not provide an opportunity to consider such variation given the limited variation in children's socioeconomic status (thirty-three of the thirty-eight children were living in poor or working-class households) and father's incarceration history (thirty-six had fathers who had been previously incarcerated). That said, it is not clear that these structural conditions would condition children's emotional and instrumental responsibilities stemming from paternal incarceration. Children across the socioeconomic spectrum may engage in emotional responsibilities (such as concealing their own emotions and consoling their family members) and instrumental responsibilities (such as maintaining relationships with their father, managing aspects of their father's incarceration, and taking on caregiving responsibilities for their fathers or other family members).

This analysis provides one of the first qualitative examinations of the intergenerational consequences of paternal incarceration from the perspective of children, shedding light on processes that have not been observed in survey research in part, by asking semi-structured questions and allowing for open-ended responses. The findings have implications for survey research on families and children. First, because the qualitative nature of the study generated findings not previously documented in a systematic way, results suggest that future surveys should incorporate measures of emotional and instrumental responsibilities into questionnaires, both as outcomes themselves and as mediators in the relationship between paternal incarceration and other traditionally considered outcomes such as mental health, educational attainment, or delinquency. The primary stressor of paternal incarceration may lead to the secondary stressor of increased emotional and instrumental responsibilities, which together may impair children's outcomes (Pearlin 1989). Indeed, research documents that caregiving responsibilities among youth and adolescents can limit educational and occupational pathways (DeLuca, Papageorge, and Boselovic 2024, this issue; Wiggins, Harrington, and Gerstel, 2022; also see Burton 2007; McMahon and Luthar 2007). For example, a longitudinal study of fifty Latino/a high school seniors shows that caring for siblings and parents comes at the expense of educational success in postsecondary pathways (Ovink 2014). Second, the findings suggest the importance of understanding children's heterogeneous responses to paternal incarceration (and, likely, other stressors), highlighting the need for large-scale surveys that have enough power to detect statistically significant differences across groups (and allow researchers to, for example, tease out differences between children's age and father's incarceration history). These findings show that surveys should consider both heterogeneous treatments (such as duration of father's incarceration, distance between child's home and father's facility) and heterogeneous responses (such as child's age).

Limitations

Several considerations should be kept in mind when interpreting these results. First, like most all qualitative research, these findings are not generalizable. Future research should work to extend these findings across contexts. A sample that included Black children might yield different conclusions, for example, given that some research finds differences in Black and non-Black children's responses to paternal incarceration (Craigie 2011; but see Haskins 2014; Turney and Haskins 2014). Our predominantly Latino/a sample—coupled with the commonality of familism, and the associated privileging of family needs over individual needs, among Latinos (Desmond and Turley 2009)—may yield an overrepresentation of emotional and instrumental responsibilities incurred by children. Our analysis of responses between Latino/a children and non-Latino/a children did not suggest meaningful differences across groups, but race-ethnic variation in children's responses should be investigated with larger and more diverse samples. Similarly, a sample that included children experiencing prison incarceration—rather than jail incarceration—may yield different conclusions. Those incarcerated in jail are often closer to their children, which could potentially increase the responsibilities these children incur. The focus on jail incarceration is unique in that most research on the intergenerational consequences of incarceration fo-

cuses solely on prison incarceration or conflates jail and prison incarceration. Second, access to children depended on the consent of fathers, children's caregivers, and children. Those who participated may have better relationships with their fathers than those who did not, which may influence the incarceration-related responsibilities children incur and heterogeneity in these responsibilities.

Conclusion

By documenting the processes through which paternal incarceration affects children's well-being and how these processes vary across children, these findings provide new insights into how the unintended consequences of the expanding penal system transforms the life course of children. That is, paternal incarceration is both a stressor that is unequally distributed and one with consequences that are unequally experienced. Children have both differential vulnerability and differential responses to paternal incarceration. Understanding the processes linking paternal incarceration and children's well-being provides direction about how to intervene most successfully to improve well-being. Furthermore, understanding heterogeneity in processes provides both insight about which children most need and most benefit from interventions and guidance about how to allocate resources.

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PART III

Educational Disruptions

The Effects of the COVID-19 Pandemic on Educational Attainment

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We study the effects of the COVID pandemic on educational attainment. By 2022, entry into two-year colleges was 21 percent lower than before the pandemic, with larger declines in Black- and Hispanic-majority colleges. Four-year college entry declined by only 6 percent and then rebounded 4 percent. High school graduation reached an all-time high in 2022. To explain these patterns, we undertook an interrupted time series design. Lower numbers of COVID cases and higher levels of in-person instruction led to increased college entry and possibly increased graduation. Relaxation of graduation standards explain between-state variation in high school graduation and helps explain the continued high graduation rates. Changing labor-market opportunities do not explain cross-state variation in attainment. We suggest additional explanations for these trends. Barring other substantial changes, we predict that future college attainment will be lower for cohorts of school or college age during the pandemic, especially for some marginalized groups.

Keywords: COVID, pandemics, educational attainment, high school graduation, college-going

Education has been near the center of the COVID crisis in part due to a concern about what the pandemic would do to students academically, socially, and psychologically. A large and growing number of studies find that the pandemic lowered test scores and exacerbated score gaps associated with poverty and race-ethnicity, especially in districts that made more use of remote instruction (Bacher-Hicks, Goodman, and Mulhern 2021; Betthäuser, Bach-

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Mortensen, and Engzell 2022; Goldhaber, Kane, et al. 2022; Halloran et al. 2021; Lewis et al. 2021; Sass and Goldring 2022; Thorn and Vincent-Lancrin 2021; West and Lake 2021). These score gaps may foreshadow large and negative economic impacts in the future (Goldhaber, Kane, et al. 2022; Hanushek and Woessmann 2020). Others have found evidence of declining mental health and stunted emotional development (Blanchflower and Bryson 2022; Czeisler et al. 2020), which may also have long-term repercussions.

Some research has also examined educational attainment, especially overall K–12 enrollment and college enrollment. Thomas Dee and his colleagues, for example, reported a sharp drop in kindergarten enrollments and smaller effects on enrollment in higher grades (Dee and Murphy 2021; Dee et al. 2021). Also, the National Student Clearinghouse (NSC 2022) reported declining college enrollment, especially in two-year colleges.[1] Remote and hybrid schooling was likely a key factor, which is troubling given the limited evidence that COVID education policies had much benefit for public health (Harris, Ziedan, and Hassig 2021), especially when masking and vaccine policies were in place (Chernozhukov, Kasahara, and Schrimpf 2021; Goldhaber, Kane, et al. 2022).[2] However, we show that COVID triggered other changes, which were partly conflated with instruction, that may also have affected attainment.

We make four contributions to this discussion. First, we examine two forms of educational attainment that have received little attention in the COVID literature: high school graduation and the transition from high school to college. Others have reported trends in the total number of students attending college. We focus on initial college entry, as distinct from other influences such as dropout and persistence. High school graduation and college entry are both key stepping stones to further human capital investment that are critical to individual well-being and macroeconomic growth. It is therefore important to document pandemic-related trends in these outcomes.

What effect did COVID have on high school completion and college entry during the first year of the pandemic? Given the declines in achievement and enrollment observed in every other study, and the apparent decline in the ability of educators to engage students in a pandemic, we expected similar declines in high school graduation and the transition to college. For college entry, our results confirmed our expectation. The transitions from high school to college dropped significantly—by 16 percent in two-year colleges and 6 percent in four-year colleges in 2021 relative to the pre-pandemic period. In 2022, two-year entry dropped even further, by 21 percent, whereas four-year entry rebounded to just 2 percent below 2019 levels.

But we find a very different pattern for high school graduation, which actually increased slightly in 2020, dipped slightly in 2021, and then rebounded in 2022 to an all-time high. As far as we know, high school graduation was the only educational outcome to improve during the pandemic. Given the decline in the quality and engagement of schooling during this period, this is a somewhat surprising result.[3]

1. This finding aligns with research on the 1916 polio epidemic, which led to a decline in educational attainment (Meyers and Thomasson 2017), though a study of the 1918 flu pandemic found no such effect (Ager et al. 2022).

2. Research suggests that school-age children played little role in the early spread of the virus (Goldstein, Lipsitch, and Cevik 2021; Viner et al. 2020), and that reducing class sizes—a large part of the rationale for hybrid schooling—does little to slow the spread of viruses (Bazant and Bush 2021; von Hippel 2021). Also, the switch away from in-person schooling did little to slow the spread of COVID, except perhaps in the districts where the prior level of COVID was highest (Goldhaber, Imberman, et al. 2022; Harris, Ziedan, and Hassig 2021). Unfortunately, the decision to adopt remote or hybrid schooling was not concentrated in the districts with the highest COVID levels—the districts where remote schooling might have made a difference—but instead in districts with more people of color and low-income families, and in Democratic-leaning districts, whether those districts had high levels of COVID (Flamm et al. 2022; Grossmann et al. 2021; Harris and Oliver 2021).

3. Other researchers expressed uncertainty about the direction of high school graduation rates during the pandemic. For example, in December 2020 the College Board reported that the pandemic "introduces substantial uncertainty" into projections of high school graduation. Also, an article published in August 2021, more than a

Second, how did educational attainment patterns vary by student subgroup and sector? We found that the improvement in high school graduation was broad based. Though marginalized groups saw larger drops in 2021, they also saw larger rebounds in 2022. For every subgroup, high school graduation rates were at least as high in the spring of 2022 as in the prepandemic spring of 2019—and in some groups notably higher.

College entry, however, saw sharp drops, especially in two-year colleges serving high percentages of Black and Hispanic students. The changes were more muted at the four-year college level, and change seemed to be associated with colleges' racial and ethnic composition rather than their economic levels. The rise in racial and ethnic inequality in college entry is a sign that COVID may have long-lasting effects on economic inequality.

Third, what policy and environmental factors explain variation in the pandemic's effects in different institutions and states? Prior studies have focused on how schools and colleges varied in their COVID instructional modes. But, especially with high school graduation and the transition to college, the human capital model suggests that a variety of other factors were likely at play, including a change in academic standards and opportunity cost (labor-market opportunities) for teenagers. We include proxies for these and other explanations in an interrupted time series analysis that includes district-institution fixed effects and unit-specific time trends. Despite the noted differing trends in high school graduation and college entry, variation in these trends nationally can be explained by common factors. Lower numbers of COVID cases and higher levels of in-person instruction led to increased college entry and possibly increased higher graduation. Relaxation of high school graduation standards is the one factor that seems to explain the differing trends because, anecdotally, high school educators were directed to ease the burden on students during the difficult pandemic period. We find some direct evidence of this in states with high school graduation exams that also reduced their academic standards and saw higher graduation rates during the pandemic. Finally, differential labor-market opportunities do not seem to explain variation in any of the attainment measures.

Fourth, why are the results so different across the various age groups and levels of the educational system? We observe four main patterns when we juxtapose our results with prior studies: smaller enrollment declines in high school than in earlier grades; larger declines in kindergarten than in other elementary grades (Dee and Murphy 2021; Dee et al. 2021; Musaddiq et al. 2022); small increases in high school graduation but large declines in the transition from high school to college; and larger declines in two-year than in four-year college enrollment.

We offer three plausible explanations for these patterns based on social science research. First, entry, persistence, and completion are different processes. Both kindergarten and college entry are forms of entry and were negatively affected by the pandemic, whereas high school graduation, a form of persistence, was much less affected. Second, one reason for the difference between entry and persistence is that teenagers' social bonds to their friends make them likely to persist in and complete high school and college once they have entered. Last, two-year colleges and students differ from those at the four-year college level in multiple ways that may explain the larger drops in two-year college enrollment.

THEORY

In addition to empirically focusing on the effects of the pandemic and pandemic-related education policies, we use human capital theory to identify COVID-related factors that

year into the pandemic, analyzed the responses of sixteen- to eighteen-year-olds to the Current Population Survey, reporting that "The pandemic reduced the likelihood of students reporting that they were enrolled in high school by about 1.8 percentage points in April 2020 vs. in the same month in prior years, although enrollment rebounded back to typical levels by October 2020" (Chatterji and Li 2021). Our results suggest nearly opposite patterns for high school graduation.

might have affected educational attainment. The theory highlights factors that changed during the pandemic and are theoretically connected to education attainment decisions.

One key economic factor in the standard human capital model is the opportunity cost of missed work. This certainly changed during the pandemic—first with a decline in opportunity as the economy shut down and then with an upward spike in later years as firms had trouble hiring workers. In addition to opportunity cost, a more direct cost of education was the threat to physical health posed by COVID to individuals and their vulnerable friends and family members.[4] This is not a cost normally considered in the human capital model because, under normal circumstances, this cost is miniscule, but the health risks were higher for some jobs during the pandemic.[5]

The return to education is also central to the human capital model and may also have changed during the pandemic. Research consistently shows that students learn less online (Xu and Jaggers 2013; CREDO 2023) and young people may have realized that education credentials under these conditions would have less value. Similarly, labor economists emphasize the consumption value of education (psychic costs). If remote instruction, or in-person instruction with masking, is less engaging, then the consumption value may have declined in parallel with the decline in investment value.

Expected economic returns are also affected by the probability of competing credentials, conditional on starting an education investment. One factor affecting this probability is government- and institution-imposed academic standards. For example, many states require that high school students pass a graduation exam in order to receive a credential.[6] As we explain, there are also reasons to expect that standards changed during the pandemic in a variety of ways that may have affected the education decisions of young people.

This discussion suggests four main factors that changed as a result of the pandemic that, according to human capital theory, might have affected students' education choices during this unusual period: instructional mode, relaxation of academic standards, economic opportunity, and actual levels of COVID infection. We discuss our measures of these constructs in the following section. Our analysis focuses especially on the mechanisms behind attainment changes during the 2020–2021 school year (what we simply call 2021).

DATA

This section discusses the data for the high school and college analyses, respectively. In each section, we start with a discussion of the educational attainment measures, followed by the potential explanatory factors associated with the respective outcomes.

4. In general, the direct cost of education did not change during the pandemic. The federal government did institute loan forbearance, which allowed students to delay payments. However, even without forbearance, interest on student loans does not generally accumulate while students are still in college and it seems unlikely students considering entering college would have expected loan forbearance to continue beyond their college exit. Debt accumulation and repayment on loans taken out during the pandemic would thus have been unaffected by loan forbearance. President Biden's loan forgiveness program was not announced until August 2022, after the period of analysis.

5. The cumulative return to education might also have been affected by the noted health effects. COVID not only incurred high immediate costs but also reduced life expectancy and therefore the potential work years during which students could benefit from the return to education. The effect here is similar to that on older workers choosing less in education because they too have fewer working years from which to reap the benefits.

6. The evidence on high school graduation exam effects is fairly mixed and generally finds small or null effects, except perhaps among very low performing students (Jacob 2001). Reardon and colleagues (2010) note the possibility of a discouragement effect among very low-performing students. This means that, during the pandemic, students who thought they might not pass the test might have stayed in high school when the requirement was relaxed. Finally, the relaxation of graduation exam requirements could also proxy for broader relaxation of standards.

High School Data

Graduation Rates

We study high school graduation rates, by school district, at both traditional public and charter schools. Forty-four U.S. states have made graduation data available through the spring of 2021, and twenty-four have also provided graduation data for the spring of 2022.[7] The 2021 sample includes essentially the entire country. The 2022 sample overrepresents southern and politically conservative states, covering less of the Northeast, upper Midwest, and Great Plains. This is worth noting given that remote instruction and other COVID-cautious policies were more common in politically liberal states (Grossman et al. 2021; Harris and Oliver 2021). In all, of roughly ten thousand regular school districts, we have data for 7,789 in 2021 and 3,661 in 2022. The smaller figure, for 2022, encompasses 53 percent of total national enrollment.[8]

One advantage of using high school graduation data is that states are required to use a single measure, the adjusted cohort graduation rate (ACGR), which is standardized and mandated for all states by the federal government. The ACGR divides the number of graduates by the number of students enrolled in the same school or district in their freshmen year or who transferred in, subtracting from the denominator the legitimate exits, such as transferring out of the district or into homeschooling. Nonlegitimate exits count against the school or district (that is, they reduce the graduation rate) and dropout is the most common example. Missing data are also counted as nonlegitimate exits and reduce the graduation rate.

The question arises whether graduation trends could be influenced by pandemic-related trends in legitimate exits. Transfers to private schools or homeschooling increased during the COVID pandemic, changing the denominator of official graduation statistics.[9] Students transferring to private schools likely had higher family incomes and achievement levels than those who stayed in the public sector, which implies that private school transfers deflated the public school graduation rates—that is, the increase in public school graduation rates would be larger if adjusted for student achievement and family incomes. The effect of increased homeschooling on public school graduation rates is not as clear because we do not know the dropout probabilities of families who chose to homeschool during the pandemic. During normal times, homeschooling families tend to be more religious, with fewer mothers in the paid workforce than other families, but during the pandemic, when schools were perceived as dangerous and many employed parents stayed home, the demographics of new homeschoolers were very likely different. Although we cannot observe outcomes for transfer students and homeschoolers, we do approximate the total number of high school students transferring out of each district by examining changes in the cohort size.[10]

7. For the spring of 2022, the included states are Alabama, Alaska, Arkansas, California, Colorado, Georgia, Iowa, Indiana, Kansas, Maine, Maryland, Missouri, Mississippi, Nebraska, Nevada, New York, Ohio, Oregon, South Carolina, South Dakota, Tennessee, Virginia, Washington, and Wyoming. For the spring of 2021, the only omitted states are the District of Columbia, Hawaii, Michigan, Montana, Oklahoma, Utah, and Vermont (for a summary, see table A.1).

8. Although the percentage of enrollment is the most important figure, it translates into a smaller percentage of school districts. This is because our sample disproportionately includes southern states, which have a smaller number of larger, county-level districts. Also, our focus on high school graduation limits us to secondary and unified districts, excluding elementary districts that exist in some states and do not enroll high school students. Data are also missing for roughly 15 percent of districts in the included states.

9. The meaning of homeschooling under the pandemic is somewhat ambiguous. If students are enrolled in a school and attended classes in some form (synchronous or otherwise), they would not be counted as homeschoolers. Instead, homeschooling is supposed to be limited to students who are not receiving instruction of any kind from district schools.

10. As noted, when students formally transfer to private schooling or homeschooling (legitimate exits), they are removed from the cohort and therefore from the graduation rate calculation.

Among the state policies that might also have affected high school graduation rates during COVID are accountability and school funding. All states are required to include high school graduation as part of school accountability, giving schools incentives to make these percentages as high as possible, either through genuine school improvement or strategic behavior (Harris et al. 2023). Schools also usually have incentives to keep students enrolled to the extent that total funding comes from state and federal sources where revenue is based on enrollment levels. This could create some incentive to hold students back and have them repeat grades, but mechanisms for retaining children were limited because high-stakes tests were suspended in 2020 and 2021. In addition, emergency federal aid flowed to schools during the pandemic, reducing incentives to game enrollment to achieve revenue gains; and some states instituted hold-harmless provisions that delinked enrollment and funding in the short run.

We note three issues of data quality. First, federal rules require schools and districts to provide documentation to states to verify transfers, but doing so may have been more difficult during the pandemic. If transfers were undercounted, then true graduation rates may have been even higher than our estimates. Also, high school graduation data are missing at much higher rates for subgroups. Many states that report overall graduation by district do not report any data for subgroups such as Black students, Hispanic students, or economically disadvantaged students. Even in states that do report subgroup graduation rates, we cannot report results for groups defined by two variables—for example, Black students who are not economically disadvantaged. In other states, cell-size requirements lead to some additional missing data; however, we show later that missing data likely does not explain our findings. Last, the criteria for receiving free lunch—a common indicator of poverty—broadened during the pandemic and we are unsure how this affects the definition of subgroups in the outcome data.

Instructional Mode

For high school instructional mode, we use data from the Return to Learn (R2L) project of the American Enterprise Institute (AEI), which monitored more than 8,500 public school districts' instructional status on a weekly basis. With data collection and validation assistance from the College Crisis Initiative (C2i) at Davidson College, R2L began scraping websites of regular, noncharter, public school districts with at least three schools in September 2020. Each week, AEI and C2i then validated the results of the algorithm by calling districts and manually searching district websites and social media pages to confirm district mode of instruction when needed. R2L categorizes school districts as in-person, hybrid, or remote. Districts are categorized as in-person if all grade levels can attend school in the buildings five days per week and families can still opt for fully remote instruction or a hybrid model. Hybrid districts either allow students in some grades to return to buildings in person whereas other grades can only return in a hybrid or remote model or all students can return to buildings for four days or less each week while learning remotely the rest of the time. Finally, a district is defined as remote when all grade levels above first grade participate in virtual instruction five days per week, with no option for in-person or hybrid learning.

Our specific treatment variable is the share of days that schools were in each instructional mode during 2021.[11] High school graduation comes at the end of the school year, so the instructional modes used throughout the year are relevant. Consistent with prior research using national samples, our data show that the hybrid category is most common, followed by in-person and fully remote. We code each district's instructional modes in terms of the share of weeks in each mode for the academic year (that is, as a continuous variable).

Academic Standards

For the high school analysis, we use data regarding state standards from *Education Week* (2021), which summarize three main types of

11. We assume that the total number of instructional days did not change because the minimum number of days is specified in state laws.

standards that could have been relaxed: time in school, testing and grading, and credit hours.

Time flexibility. Two types of time-related policies emerged: allowing students to delay completion of requirements (such as to later in the summer), or allowing students reduced attendance during the academic year. Of the states that are part of our 2021 analysis, all but one reported some type of time flexibility. In the vast majority of cases, the laws are written to give districts more flexibility than they would normally have, but we cannot observe district decisions.

Testing flexibility. Almost all states eliminated testing requirements at least for the 2020 school year. Some state policies also mentioned relaxation of grading policies. We did not count these in the index, however, because grading is already at the discretion of school districts, and state guidance on this dimension does not bind school practices. We also ignored relaxation of rules pertaining to high school equivalency because GEDs (general educational development) are not counted in the high school graduation rate data we are reporting. For some states in the *Education Week* data, relaxation of standards was evident for a single, noncore test such as civics, but we did not count this as a relaxation of standards because of the narrow flexibility this entailed.

Seventeen states had graduation exams before COVID and may have eliminated these as a requirement for graduation.[12] Of these states, six are in our sample: Florida, Indiana, Nevada, Ohio, Virginia, and Washington. In our regression estimates, we include a variable for *GradExam* (interacted with the relaxation of standards) because the effects of a relaxation of standards is likely to have a stronger effect when graduation exams exist.

Credit flexibility. Other than testing requirements, the main connection between state and local policy is credit hours and course requirements. Many states instituted policies indicating that students on track to pass classes before COVID could pass their courses in the spring of 2020 based on that past performance.

Creating a single measure of relaxed standards. We first coded each state as having relaxed each of the three forms of standards (time, tests, and credits) and then took the simple sum of these as an index of relaxation of standards (min = 0, max = 3). Some states offered blanket flexibility on graduation requirements and we code these states with the maximum of 3 on the index.

These measures of academic standards are imperfect in several ways. First, we cannot observe district standards or enforcement, the latter of which might have been more lax at the district level even without a relaxation of state standards, especially in a pandemic. Also, in most cases, districts are already allowed to impose standards that are stricter than those imposed by the state. Thus some districts might have relaxed standards even without state action.

An additional source of uncertainty pertains to the years for which the policies apply. Some states explicitly limited the policy to the graduating class of 2020, but in others it is unclear. It is possible, for example, that the states relaxing their standards in 2020 also did so for the 2021 graduating class, but we do not observe this.

External Validity

We are interested in drawing conclusions about student outcomes and their pandemic-related causes for the nation as a whole. Although we have nearly complete national data on high school graduate through the spring of 2021 (N = 44 states), we do not for 2022 (N = 24 states; 53 percent of national enrollment). To address this missing data, we calculated the differences in mean covariates for the included and ex-

12. This number comes from the Education Commission of the States based on 2016 data (https://www.ecs.org/wp-content/uploads/Info_Request_States_with_exit_exams.pdf). The states with EOC-based requirements are Florida, Indiana, Louisiana, Maryland, Massachusetts, Mississippi, New Mexico, New York, Oklahoma, Texas, Virginia, and Washington. States with other graduation exams are Florida, Idaho, Massachusetts, Nevada, New Jersey, New Mexico, Ohio, Oregon, and Washington. As the overlap between the lists implies, some states require both: Florida, Massachusetts, New Mexico, and Washington.

cluded states. Shown in table A.2, these show that the excluded states are generally quite similar on these measures. We provide additional tests of external validity in the following section using the high school graduation measures themselves. We do not provide comparable tables for the college data because the Integrated Postsecondary Education Data System (IPEDS) data include essentially all colleges in the United States.

College Data

Similar to the discussion of high school data, this section discusses our college outcomes and the factors we study that might explain variation across institutions.

Enrollment

College enrollment data come from the National Center on Education Statistics (NCES) IPEDS, which includes essentially all public and private colleges in the United States. We focus particularly on first-time, full-time degree or certificate-seeking undergraduate students who graduated from high school in the past twelve months, collected by NCES as part of the fall enrollment survey—what we call immediate entry or the transition to college.[13] We focus on college entry in part because most analyses have focused on total college enrollment; entry is one part of enrollment that is closely related to our other focus—on high school graduation.

Unlike the high school graduation data, IPEDS provides no breakdown by racial/ethnic or income subgroups for postsecondary entry. But we can still address equity of outcomes by reporting the results by institution-level demographics. We break institutions into four racial-ethnic categories: >50 percent Black, >50 percent Hispanic, >50 percent White, and Other. By construction, the Other category includes institutions that are racially diverse so that no group exceeds 50 percent. We also break institutions into two categories indicating whether Pell grant dollars per student—a proxy for financial need—are above or below average.

Instructional Mode Data

The College Crisis Initiative panel dataset captures nearly three thousand two-year and four-year institutions' daily instructional modes during the fall of 2020 (Marsicano et al. 2020). To collect data, C2i built a web crawler to check institutional websites and announcements every day and code information into seventeen instruction categories. Data was then validated by C2i student employees for quality assurance. We condense the seventeen categories into a four-category version that is similar to the K–12 data, which facilitates comparability across these education institutions.

We focus on college instructional mode as of September 15, 2020. This is because, as noted, the college analysis focuses on the transition from high school to college in the fall semester and we expect those decisions to be based on the instructional mode at the beginning of the school year.

Data Common to High School and College

Labor-Force Participation

Our analysis is mainly focused on teenagers leaving high school or entering college. The pandemic affected work opportunities for this group in complex ways, which varied over time. Early in the pandemic, in the spring of 2020, the unemployment rate spiked as businesses were forced to shut down. Businesses that employ large numbers of teenagers, such as restaurants and stores, were exceptionally hard hit. The job market then gradually improved as businesses began to reopen.

We considered several measures of economic opportunity. We ruled out the unemployment rate because the denominator of this rate includes only those in the labor force and participation in the workforce dropped precipitously during the pandemic and remained well

13. These first-time freshmen data include students attending across state lines (for example, Central Piedmont Community College on the NC/SC border). Two-year colleges sometimes give cross-border residents from local areas in-district tuition (for example, College of Southern Nevada in Las Vegas for students from Arizona and California, less than an hour's drive away from the borders with both).

below prior trends throughout the years in our analysis. We also consider job openings to get around this problem, but these data are only available down to the state level.

As a result, we view the labor-force participation (LFP) rate as the best indicator of job opportunities, relying on county-by-year data from the U.S. Bureau of Labor Statistics (BLS). Because the BLS reports calendar years instead of academic years, the main pandemic period data we have is for the 2020 calendar year, which covered the first nine months of the pandemic. The 2021 LFP data were not available at the county level as of this writing.

COVID Community Spread and Risk

For institutions that were in-person, students might have been concerned about the health effects of attending school or college in-person. We measure this perceived risk using the county case rate data from the *New York Times*. Although actual risk is likely better reflected in hospitalization data (Harris, Ziedan, and Hassig 2021), COVID cases were more widely reported and therefore were likely a better measure of the risk perceptions that weighed on educational decisions. Given the possible connection between COVID transmission and instructional mode, we test for an interaction between the two, as described in the next section.

ECONOMETRIC FRAMEWORK

In this section, we outline the model we estimate. As our intent is to estimate the causal effects of these various factors on educational attainment, we also discuss associated threats to identification.

Model

The previous discussion suggests that many factors, or treatments, might have affected educational attainment during the pandemic. This rules out methods such as difference-in-differences (DID) and comparative interrupted time series (CITS), which are premised on the existence of a single, usually dichotomous, treatment. In this case, however, we have multiple, continuous treatment measures. CITS and DID are infeasible in this setting and we therefore use an interrupted time series design with an untreated comparison group. When the high school graduation rate is the dependent variable, we specifically estimate as follows:

$$\begin{aligned} Grad_{dt} = {} & \beta_1(InstrMode_{dt}) + \beta_2(LFP_{kt}) \\ & + \beta_3(StdRelax_{st}) + \beta_4(StdRelax_{st} \\ & * GradExam_s) + \beta_5(COVID_{kt}) \\ & + \beta_6(COVID_{kt} * InstrMode_{dt}) \\ & + \beta_6 Time_{dt} + \theta_d + \varepsilon_{dt} \end{aligned} \quad (1)$$

where $Grad_{dt}$ is the graduation rate for district d in year t. $Time_{dt}$ is a district-specific linear trend, and θ_d is a district-specific fixed effect. These account for differences in pre-pandemic district outcome levels and trends that might have been correlated with the explanatory variables of interest. We also cluster standard errors at the district level.

The variable LFP_{kt} is the labor-force participation rate in county k and year t. The change in negative in almost all counties under the pandemic, so the variable really captures the degree to which LFP dropped. The variable $InstrMode_{dt}$ is a vector of variables indicating the share of weeks in-person and remote (with hybrid is the omitted category).

$StdRelax_{st}$ is an index of standards in state s where higher values reflect greater relaxation of standards (see above). $GradExam_s$ is an indicator for whether a state had a graduation exam before COVID. Coded in this way, $GradExam_s$ is time constant, so we do not include the variable separately, but do include the interaction with $StdRelax_{st}$ because the extent of standards relaxation is most likely to play a role in states that had a state graduation exam.

$COVID_{kt}$ is of the number of reported COVID cases in the county. We include this separately and interact this with instructional mode because we might expect COVID prevalence to play a larger role in schools and colleges that are operating in-person.

The model is slightly different for college entry. The dependent variable is now initial college entry and the state standards and graduation exams are no longer relevant. Also, the unit of analysis shifts from districts to colleges c, so we cluster standard errors at the college

level and we include college fixed effects and college-specific linear time trends. We identify the counties that each college officially serves and aggregate LFP_{kt} to this level. These adjustments yield the following equation:

$$\begin{aligned} ln(Entry_{ct}) = {} & \beta_1(InstrMode_{ct}) + \beta_2(LFP_{kt}) \\ & + \beta_3(COVID_{kt}) + \beta_4(COVID_{kt} \\ & * InstrMode_{ct}) + \beta_5 Time_{ct} \\ & + \theta_c + \varepsilon_{ct} \end{aligned} \quad (2)$$

where $ln(Entry_{ct})$ is the natural logarithm of the number of immediate entry enrollments at college c in the fall of 2020, θ_c is now a college fixed effect, and $Time_{ct}$ is the college-specific linear time trend.

As in equation (1), hybrid is the excluded category, but the C2i data include more categories that we combine into an Other category that is included along with in-person and remote. Although these specifications do not have an explicit post indicator for the start of COVID, most of the estimates are implicitly identified from pre–post changes. To see why, note that the COVID variable is zero, and the $InstrMode_{ct}$ variable is coded as entirely in-person for all the pre-COVID periods.[14] We also estimate more extensive versions of equations (1) and (2), adding interactions between school/college race and the other variables.

Threats to Identification

Including state and district fixed effects accounts for time-invariant unobserved district characteristics, which research shows to be strong predictors of school reopening decisions; in particular, the strongest predictors have been demographics and local politics (such as percentage Republican vote), which are largely constant within local geographic units over this short time frame (Grossman et al. 2021; Harris and Oliver 2021). These and other time-constant factors, such as neighborhood composition, are accounted for with unit-specific time trends and district or college fixed effects in equations (1) and (2), respectively.

By including multiple treatment variables, we further reduce the possibility that our results reflect some other mechanism. For example, if we only included instructional mode, and this is correlated with COVID cases, then we would conflate the role of these two factors. We make no claim that we have accounted for everything that might have affected high school graduation and college entry. For example, some working parents chose to move and live with family members who could support for remote learning for their children. This could bias our estimates as such moves are time-varying shocks that are contemporaneous to the start of the pandemic and the changes in the various treatment variables.

RESULTS: TRENDS IN ATTAINMENT

In this section, we provide results for trends in high school outcomes, overall and by subgroup, then do the same for college outcomes.

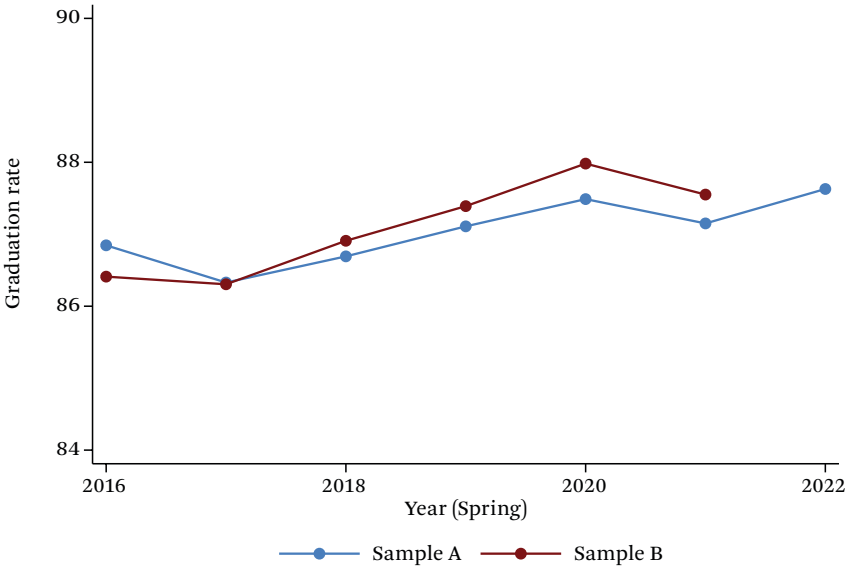
High School Graduation Trends

We are interested, first, in the change in overall graduation rates that can be reasonably attributed to the COVID pandemic. We have three post-treatment years: 2020 graduation occurred just a few months after the start of the COVID crisis; the 2021 and 2022 school years followed entire school years of COVID-affected learning.

Figure 1 shows the annual trends in high school graduation from 2016 to 2022. High school graduation rates increased every spring from 2017 to 2019, continued increasing in 2020 despite the pandemic, dropped slightly in 2021, then rebounded in 2022 to a new record high. Although the 2022 figure is still below what we might have expected based on the pre-pandemic trend, it is still the only education outcome to our knowledge

14. An exception is with LFP, which has variance across all years within districts and counties. This is desirable in the sense that it allows us to use more information about the covariance of LFP and educational attainment, though it does require an assumption that we can extrapolate the pre-COVID covariance to the post-COVID period, even though LFP changed in a sharp and discontinuous way. In any event, the issue is likely a small one because most of the changes over time occur at the time of the pandemic.

Figure 1. Trends in High School Graduation Rates



Source: Authors' tabulation.
Note: Sample A includes 3,163 districts with no missing data on the dependent variable or covariates for 2016 through 2022. Sample B includes 4,841 districts with no missing data for 2016 through 2021. All estimates are weighted by graduate cohort size.

that improved, in absolute terms, during the pandemic.

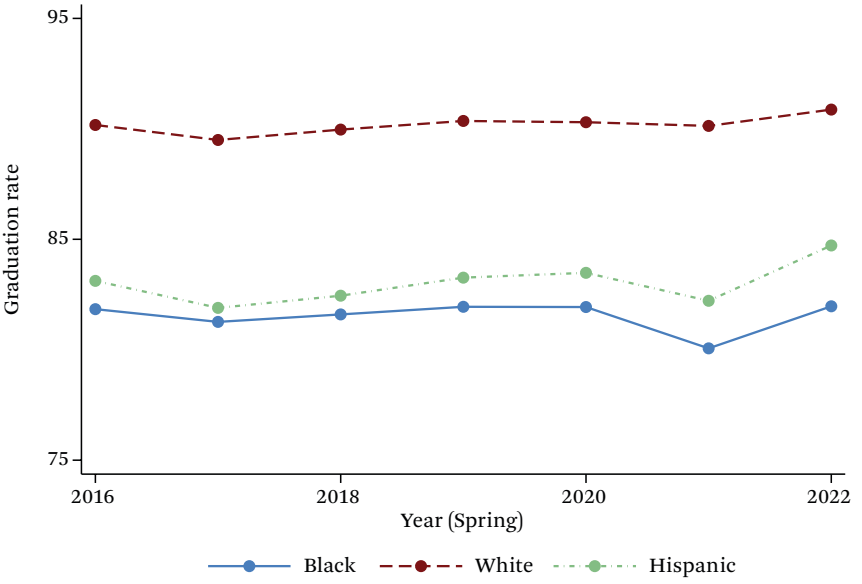
We show the results for two samples of states. Sample A has data through 2022 for twenty-four states. Sample B has data for forty-four states, but only through 2021. We compare the trends as a check on external validity of the less complete 2022 data. The results show that both the level and trends in high school graduation were very similar between the two samples. In each year, the high school graduation rates of the two groups of states are within one percentage point of each other. We also found that the covariate means are quite similar in the two samples (see table A.2). For this reason, it seems likely that the 2022 results, though based only on the twenty-four states in sample A, are representative of the nation as a whole (see also appendix figure A.1).

Another potential problem with these trend lines is the transfer of high school students from publicly funded schools to homeschooling and private schools. Graduation rates may have increased because either the numerator (number of graduates) increased or because the cohort sizes decreased, or both. For example, if eleventh graders with lower-than-expected graduation rates transferred to homeschooling, then that alone could account for the increased graduation rate among students who stayed in public school. Moreover, we might have expected this type of transfer to be especially high in certain kinds of districts. Tareena Musaddiq and her colleagues (2022) find that transfers to homeschooling were most common in in-person districts, though this finding pertains to Michigan and might not apply to this broader sample or at the high school level.[15]

We tested whether the change in graduation rates was an artifact of a change in the denominator by plotting the trends in the number of

15. Some students also transferred to private schools, but we would expect these students to have higher-than-expected graduation rates, so this could not explain the observed pattern.

Figure 2. Trends in High School Graduation Rates by Race



Source: Authors' tabulation.
Note: 368 districts weighted by graduate cohort size.

graduates, which track the changes in rates (see figure A.2).[16] In other words, if the continued rise in graduation rates had been due to a continued decline in the cohort sizes, then this would have implied that the trends were presenting a misleading picture of graduation. Our results therefore reinforce that the increase in high school graduation was not mainly due to transfers.

High School Graduation Trends by Subgroup

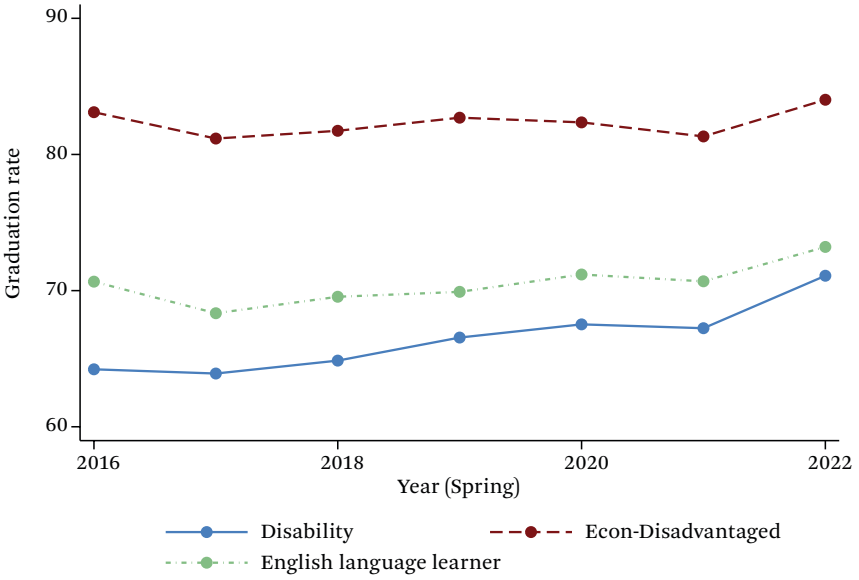
Figure 2 shows high school graduation trends by race; figure 3 shows graduation trends for students by free lunch eligibility and for English-language learners and students with disabilities. Students in certain racial subgroups (such as Asian Americans) are not included because very few districts had large enough samples to support such reporting.

For every reported subgroup, high school graduation rates were at least as high in 2020 as 2019—and reached an all-time high in 2022. In fact, the largest increases seem to have occurred for the most disadvantaged groups. Black and Hispanic students, as well as students with disabilities, economically disadvantaged students, and English-language learners, all saw larger increases than White students.

A limitation of the analyses in figures 2 and 3 is that subgroup high school graduation data are missing for most states in recent years. To test whether our results may be nonrepresentative of the nation as a whole, we reconstructed the figures, assigning the district-level demographics to the district's overall graduation rate, so that essentially no data are missing. Predictably, this tends to even out the graduation levels and attenuate spikes and creates some deviations from the prior results (see figures A.5 and A.6). Although graduation bounced back in 2022 for all subgroups in the earlier results, this was not the case for those with high percentages of disabled students in the additional appendix figures. Finally, although high school graduation generally rebounded to reach all-time highs, this was not

16. We note that four states did not report the number of graduates and cohort sizes: Illinois, Mississippi, North Carolina, and North Dakota. We examined the overall trends in graduation in the full-data sample and they are similar to the four excluded states, so the smaller sample we analyze is likely not due to the smaller sample.

Figure 3. Trends in High School Graduation Rates by Poverty, Disability, and Language Status



Source: Authors' tabulation.
Note: 476 districts weighted by graduate cohort size.

the case for every subgroup. Thus the results are broadly robust, but the missing data problem makes it difficult to interpret these exceptions.

One reason for the disproportionate increases in high school graduation among students with disabilities was suggested to us by a state education administrator in charge of special education who argued that these groups had a harder time meeting high school graduation requirements before COVID. The relaxation of these standards in many states may therefore have had a disproportionately positive impact on their ability to graduate. The same argument may apply to English-language learners.

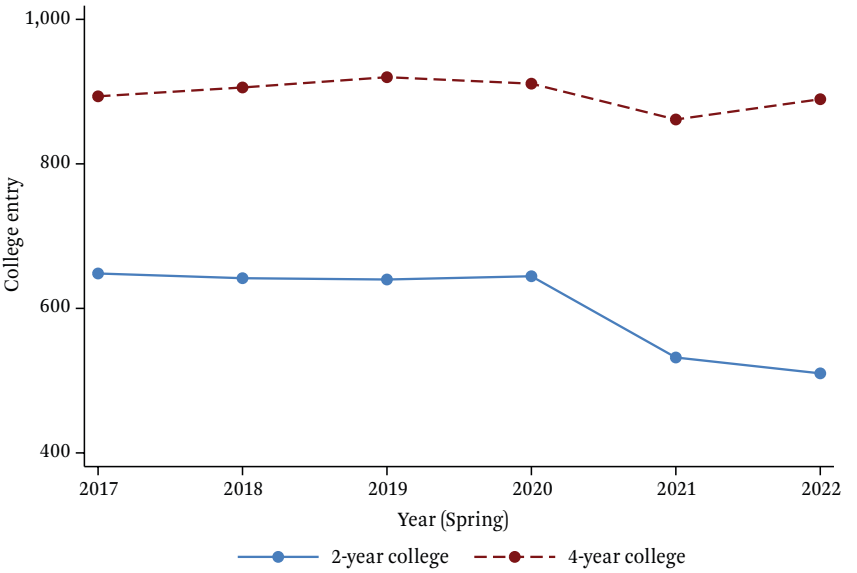
College Entry Trends

We report immediate college entry for all colleges reported in IPEDS, separately by two- and four-year sectors. The years attached to the data always refer to the spring, so the college data need to be interpreted differently than the data for high school graduation. The number 2020, for example, refers to the 2019–2020 school year in both the high school and college analyses, but the high school data are based on spring 2020 graduation and the college entry outcome is based on fall 2019 enrollment. This means that we only have two post-treatment years, 2021 and 2022, for the college entry data and the 2020 school year is entirely pre-pandemic. We use only the sample of colleges with complete data.

Figure 4 shows that after four years of stability before the pandemic, college entry dropped sharply in the first pandemic year. The drop was 16 percent in two-year colleges and 6 percent in four-year colleges. In four-year colleges, there was a rebound in 2022, when enrollments were only 2 percent below 2020 levels, but entry for two-year colleges continued to drop in 2021 to 21 percent below 2020 levels. Juxtaposed with rising high school graduation rates, the drop in college entry is even worse than it looks. The number of potential college entrants was rising, but fewer of them were deciding to proceed.

A drop of this size is unusual, especially in recent decades. The 21 percent drop at the community college level is almost as large the entire 27 percent drop in initial entry from 2008

Figure 4. Trends in College Entry



Source: Authors' tabulation.
Note: The sample included 874 two-year colleges and 1,860 four-year colleges. The y-axis is the average college entry size.

to 2019 (Garrett 2019). It is difficult to compare with earlier decades because initial college entry was not commonly tracked until recent years. However, even the smaller 10 percent drop in total enrollment appears at least as large as any other dip dating back to 1970 (U.S. Census Bureau 2023).

College Entry Trends by Subgroups

IPEDS does not report college entry by demographic subgroups, so instead we report entry trends by institution-level characteristics: average Pell grant dollars per student and the percent from each race-ethnicity. Figures 5 and 6 show that, in the two-year college sector, entry declined across all demographic groups, but declined most steeply at Hispanic- and Black-serving institutions.[17] We also see no evidence of a 2022 rebound for any subgroup. COVID reduced college entry and those low levels have continued.

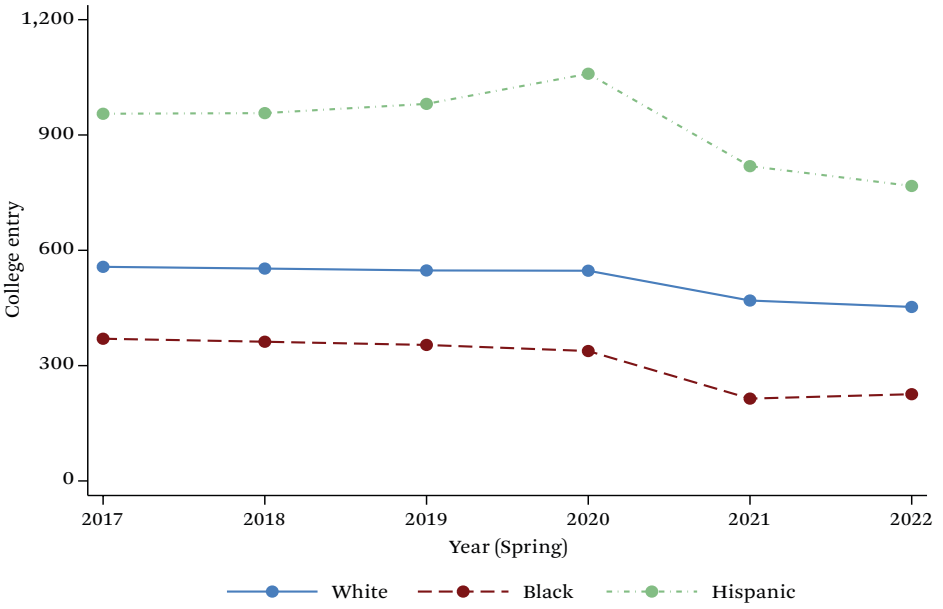
The smaller drop in four-year sector entry, noted earlier, also shows up as less extreme changes in subgroups (figures 7 and 8). Hispanic-serving institutions again saw the largest relative drops in entry, but low- and high-Pell institutions both saw similar drops in entry. For reasons that are unclear, high-Pell four-year colleges saw a slight but persistent decline, whereas low-Pell institutions saw a larger drop followed by a similar-size rebound.

We also calculated how college entry changed for public, private-nonprofit, and for-profit institutions (figures A.3 and A.4). In the two-year sector, the drop in overall entry was concentrated in public institutions, and for-profits saw no decline at all. This is another sense in which the long-term consequences for students are worse than they appear. For-profit colleges are known to have very low economic returns for students (Cellini and Chaudhary 2014).

In this discussion, we interpret these results

17. We also reran the results for Pell based on median Pell dollars per student and mean-median Pell dollars per new entrant and the results were very similar.

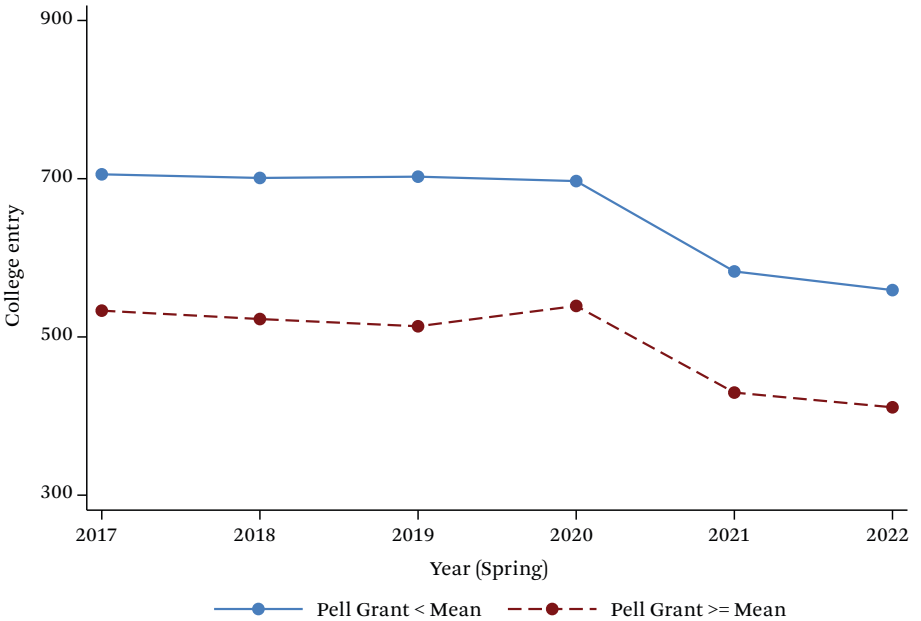
Figure 5. Trends in Two-Year College Entry by Race



Source: Authors' tabulation.

Note: Colleges are grouped by the race of the majority of students. For example, a White college is one at which at least 50 percent of students are White. By this definition, the sample has 533 White, 39 Black, and 78 Hispanic-serving two-year colleges. Colleges where no group accounts for 50 percent of enrollment are not shown. The y-axis is the average college entry size.

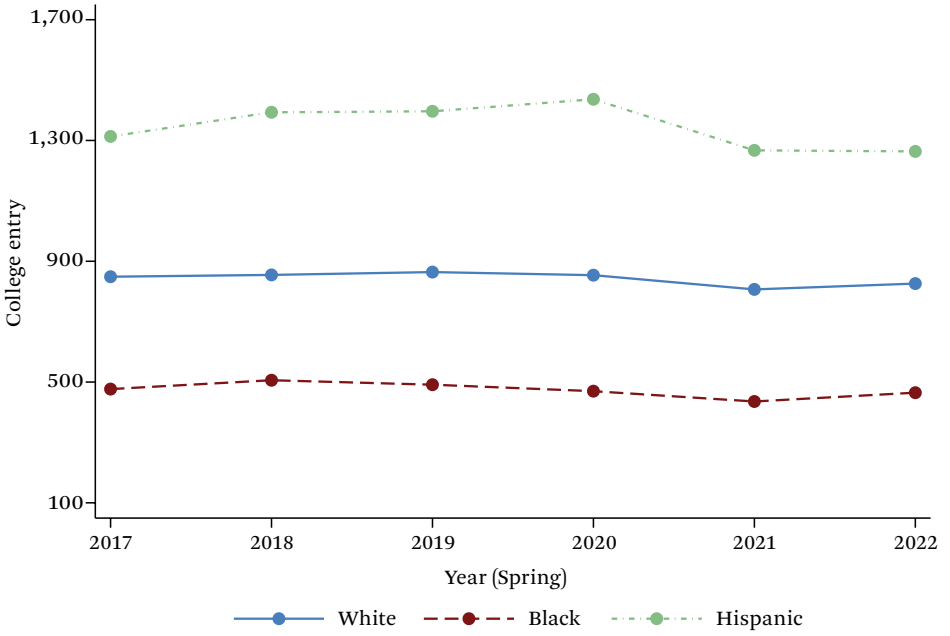
Figure 6. Trends in Two-Year College Entry by Pell



Source: Authors' tabulation.

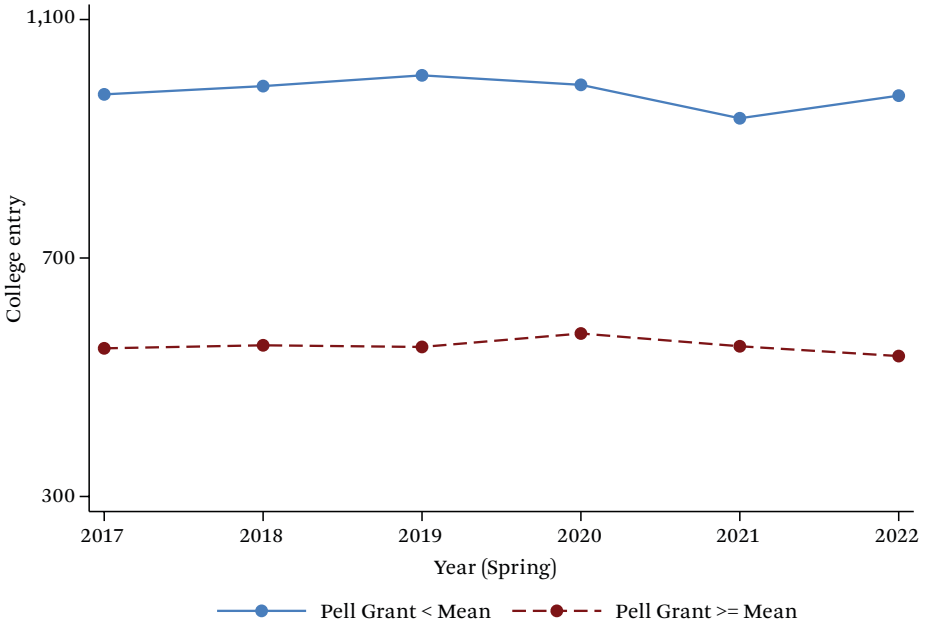
Note: 590 two-year colleges have Pell grant per first-time student below the national average, and 282 colleges are above the average. The y-axis is the average college entry size.

Figure 7. Trends in Four-Year College Entry by Race



Source: Authors' tabulation.
Note: The sample includes 1,240 White, 103 Black, and 60 Hispanic-serving colleges.

Figure 8. Trends in Four-Year College Entry by Pell



Source: Authors' tabulation.
Note: See figure 6 for more detail. *N* (Pell Grant < Mean) = 1,518, *N* (Pell Grant >= Mean) = 333.

as the result of effects of the COVID pandemic. Although normally this would be questionable with simple trend lines, it is difficult to conceive of any other factor that could have had nearly the impact of COVID during this period. Even factors such as changes in the economy were themselves driven by COVID and COVID responses. Thus, in this unusual case, we see the simple deviations from the prior trends as causal estimates of the total impact of the pandemic and related policies.

RESULTS: MECHANISMS OF ATTAINMENT VARIATION

In the previous section, we showed how the trends in outcomes changed. In this section, we explore the specific mechanisms behind the increase in high school graduation and drop in college entry by estimating equations (1) and (2), leveraging variation across locations. For all outcomes, we can provide evidence regarding the roles of instructional mode, opportunity cost, and COVID spread and risk. In addition, with high school graduation, we provide evidence regarding the role of academic standards.

For the post-treatment period, we focus on the 2021 school year for three reasons. First, this is the year we have the most covariate variation to work with, especially on instructional mode. Second, some of the covariates, such as relaxation of standards, were only available for 2021. Third, the 2021–2022 outcome data became available too late in the publication schedule for us to incorporate them.

High School Mechanisms

In this section, we examine the specific COVID-related factors shaping the changes in educational attainment shown in the prior section. We begin with high school graduation and continue on to immediate college entry.

Overall Influence of High School Mechanisms

Our estimates of equation (1) are shown in table 1 for the forty-four states from which we have high school data for 2021 graduation effects. All estimates report standard errors clustered at the district level. All specifications shown include district fixed effects and district-specific linear time trends, as outlined in equation (1).

We start with a model that includes only the instructional mode variables. The first coefficient in column (1) shows that increasing in-person learning from 0 to 100 percent is associated with a small (0.856 percentage point) rise in the high school graduation rate, relative to the omitted hybrid category. But this appears to reflect correlation among the covariates, as instructional mode is no longer related to high school graduation when we include LFP, standards, and COVID cases. This highlights the value of including proxies for all the factors theoretically related to attainment.

In models (2) and (3), academic standards are the only statistically significant predictor of the changes in high school graduation. More precisely, the states with graduation exams that also relaxed their standards saw larger increases in high school graduation rates. This result requires some clarification because our media searches indicate that the official relaxation of standards occurred only in 2020 and these results focus on the 2021 graduating class. One possible explanation is that graduation exams are normally taken before the senior year of high school. Thus canceling tests in the spring of 2020 would have had a delayed effect on students who were high school juniors at the time. Another possibility is that schools and districts followed the leads of their states and kept relaxing standards after 2020. When we estimated the effects for the 2020 graduating class (available on request), the relaxation of standards more clearly increased high school graduation.

None of the other factors is associated with changes in high school graduation in the main specification. As a robustness check, we drop the district linear trends (table A.3) and, in that case, COVID cases are negatively associated with high school graduation. In another version (available on request), we also reestimated the appendix model while centering the interactions on the global means.[18] This specifica-

18. For discussion of this method, see Schuetze and von Hippel (2023).

Table 1. Regression Results for High School Graduation

	(1)	(2)	(3)
In-person	0.856***	−0.053	0.858
	[0.216]	[0.319]	[1.422]
Remote	−0.315	−0.787	1.545
	[0.659]	[0.666]	[3.272]
LFP		−0.088	−0.089
		[0.068]	[0.068]
StdRelax		−0.290**	−0.266*
		[0.136]	[0.142]
StdRelax* GradExam		0.304***	0.301***
		[0.099]	[0.099]
COVID cases		−0.004	0.006
		[0.004]	[0.015]
In-person* COVID cases			−0.011
			[0.015]
Remote* COVID cases			−0.026
			[0.035]
Total R^2	0.879	0.879	0.879
Observations	34,245	34,245	34,245
District FE, Year FE	Y	Y	Y
District-specific time trend	Y	Y	Y

Source: Authors' tabulation.
Note: The dependent variable is the high school cohort graduation rate, ranging from 0 to 100. Learning mode has three categories: in-person, hybrid, and remote (hybrid was the reference group). The sample period ranges from 2016 to 2021, excluding 2020. COVID cases were defined as cases per thousand people. Standard errors in parenthesis are clustered at the district level.
* $p < .1$; ** $p < .05$; *** $p < .01$

tion increases precision considerably and shows a clearer role for in-person instruction in increasing high school graduation. Given the inconsistency across specifications, we conclude that higher numbers of COVID cases and higher levels of in-person instruction may have increased high school graduation, but we cannot be sure. In none of these specifications, however, do we see any role for the labor-force participation rate.

High School Mechanisms by Subgroup

The earlier figures showed high school graduation trends were more negative for Black students, Hispanic students, and economically disadvantaged students for the year of interest here 2021. This could be due to two factors: that the groups differ in the mean values of covariates such as instructional mode, sometimes called the endowment effect and the differences in group responses to those covariates, sometimes called the coefficient effect.

We can gauge the endowment effect by examining the differences in means by subgroup. Because the interaction between graduation exams and relaxation of standards is the strongest predictor of changes in high school graduation, we focus on those descriptives in table 2 as an example. Graduation exams are more common in states with fewer Black and Hispanic students. This suggests that the sharper drops in high school graduation may be because more advantaged groups saw greater relaxation of standards.

To understand the coefficient effects, we also reestimated the regression models, interacting each term in table 1 with race. This

Table 2. High School Covariate Means by Subgroup, 2021

Group		In-person	Remote	LFP	StdRelax	Grad Exam	COVID Cases	*N* (districts)
FRL	>=0.75	0.22	0.39	46.54	1.77	0.10	91.99	1,010
	<0.75	0.35	0.20	49.26	1.85	0.24	85.48	5,728
White	>=0.5	0.36	0.13	48.82	2.05	0.21	87.43	5,009
	<0.5	0.29	0.33	48.69	1.66	0.21	86.11	1,729
Black	>=0.5	0.20	0.40	47.59	2.32	0.16	83.22	286
	<0.5	0.33	0.23	48.82	1.80	0.21	86.94	6,452
Hispanic	>=0.5	0.28	0.37	47.73	1.31	0.09	96.02	645
	<0.5	0.33	0.21	48.97	1.95	0.24	84.69	6,093

Source: Authors' tabulation.

yields a large number of coefficients (available on request). In summary, we do not see much evidence of differences in coefficients between racial groups. We also implemented a Blinder-Oaxaca decomposition to more precisely determine the role of coefficients and endowments, but these turned out to be difficult to interpret.[19] Overall, then, we conclude that the differential effects of COVID on high school graduation by race are due mainly to differential relaxation of academic standards.

College Mechanisms

Our analysis of college mechanisms focuses on the 2020–2021 school year, meaning the college entry in the fall of 2020.

Overall Influence of College Mechanisms

Our analysis of college instructional mode parallels the high school graduation analysis. Tables 3 and 5 report estimates of equation (2) for two- and four-year colleges, respectively.

Compared with high school, the role of college instructional mode is closer to what we expected. In-person instruction was associated with increased entry and remote instruction shows the opposite pattern. Hybrid, again, is the omitted category.[20]) This positive role for in-person instruction is not surprising for several reasons. Many two-year college programs, like welding and nursing, are hands on and cannot be carried out remotely (Schanzenbach and Turner 2022). Table 4 shows that Hispanic-serving institutions were more likely to have remote instruction, so instructional mode seems like a clearer contributor to declining enrollment in Hispanic-serving institutions noted earlier (see figures 5 and 6).

We also see some evidence that two-year college entry was driven partly by COVID spread, but we see no significant interactions between instructional mode and COVID spread. LFP is unrelated to two-year college entry. As with instructional mode, it appears that some of the racial differences in COVID trends can be explained by the COVID case "endowment."

The relationship between instructional mode and entry is weaker at the four-year col-

19. The Blinder-Oaxaca decomposition is designed to quantify the degree to which the group differences in the outcome (in this case, high school graduation) are due to the endowment and coefficients. Unfortunately, the results of this method were difficult to interpret, especially in high school, because the coefficients on both in-person and remote instruction were of the same sign and magnitude. Also, when there are many coefficients, as in the present case, seeing the net effect of all the coefficients combined is somewhat uninformative. Finally, the Blinder-Oaxaca also includes a third interaction term that adds further complexity to the interpretation.

20. The Other category is so rare in the data that the interpretation of these coefficients is not meaningful.

Table 3. Regression Results for Two-Year College Entry

	(1)	(2)	(3)
In-person	0.208***	0.139***	0.174***
	[0.030]	[0.039]	[0.059]
Remote	−0.020	−0.024	0.030
	[0.035]	[0.035]	[0.067]
Other	0.070	0.083	−0.113
	[0.078]	[0.079]	[0.192]
LFP		−0.003	−0.003
		[0.008]	[0.008]
COVID cases		−0.004***	−0.002
		[0.001]	[0.003]
In-person* COVID cases			−0.002
			[0.003]
Remote* COVID cases			−0.003
			[0.003]
Other* COVID cases			0.008
			[0.010]
Total R^2	0.986	0.986	0.986
Observations	4,495	4,495	4,495
College FE, Year FE	Y	Y	Y
College-specific time trend	Y	Y	Y

Source: Authors' tabulation.
Note: Linear regressions of two-year college entry (logged) on the learning mode and other covariates. Learning mode has four categories: in-person, hybrid, remote, and other (hybrid was the reference group; reported in shares from 0 to 1). The sample period is school years 2017 to 2021. The *COVID Cases* variable is defined as cases per thousand people. Standard errors in parenthesis are clustered at the college level.
* $p < .1$; ** $p < .05$; *** $p < .01$

Table 4. Two-Year College Covariate Means by Subgroup

Group		In-person	Remote	Other	LFP	COVID Cases	*N* (Colleges)
Pell	> Mean	0.09	0.75	0.05	46.84	23.72	235
	< Mean	0.16	0.69	0.02	48.67	18.18	669
White	>50%	0.21	0.58	0.03	48.38	16.90	546
	<50%	0.08	0.83	0.02	48.42	21.41	358
Black	>50%	0.08	0.64	0.13	46.84	30.28	45
	<50%	0.15	0.70	0.02	48.44	18.75	859
Hispanic	>50%	0.03	0.93	0.00	46.79	24.23	81
	<50%	0.17	0.66	0.03	48.66	18.17	823

Source: Authors' tabulation.
Note: The Pell variable is defined as Pell dollars per entering student.

Table 5. Regression Results: Four-Year College Entry

	(1)	(2)	(3)
In person	0.081***	0.052***	0.048
	[0.017]	[0.020]	[0.033]
Remote	−0.037	−0.037	−0.058
	[0.025]	[0.025]	[0.048]
Other	−0.129**	−0.127**	−0.167**
	[0.064]	[0.064]	[0.073]
LFP		−0.001	−0.002
		[0.007]	[0.007]
COVID Cases		−0.002***	−0.002
		[0.001]	[0.002]
In-person* COVID Cases			0.000
			[0.002]
Remote* COVID cases			0.001
			[0.003]
Other* COVID cases			0.002
			[0.004]
Total R^2	0.990	0.990	0.990
Observations	9,528	9,528	9,528
College FE, Year FE	Y	Y	Y
College-specific time trend	Y	Y	Y

Source: Authors' tabulation.
Note: Linear regression of four-year college enrollment (logged) on learning mode and other covariates. Learning mode has four categories: in-person, hybrid, remote, and other (hybrid as the reference group). The sample period is school years 2017 to 2021, and all years are spring years. COVID Case was defined as cases per thousand people. Standard errors in parenthesis are clustered at the college level.
* $p < .1$; ** $p < .05$; *** $p < .01$

lege level (table 5). In addition to having fewer hands-on programs than two-year colleges, social life is a more central feature of four-year institutions, which are typically residential. For this reason, instructional mode may matter less than the "social mode" or ability to socialize with classmates. Many colleges allowed on-campus social life to continue even as classes were remote and they had little control over off-campus activities. The other coefficients are similar to the two-year college results; again, we see some evidence that COVID spread reduced entry, but no interactions between COVID cases and mode. While the subgroup college entry changes were relatively small in this sector, this is despite similar endowment differences in instructional mode and some other factors (table 6), which reinforces that students were simply less responsive to those differences compared with two-year colleges.

College Mechanisms by Subgroup

As in the high school analyses, we interacted race with the other covariates and found no substantive differences across the racial subgroups. We see less in-person instruction in the Hispanic-serving institutions, suggesting that the endowment effect might be the driving force behind the college entry differentials for this group trends (see figure 5).

To summarize, instructional mode was a key driver of the large drop in two-year college attendance; COVID cases also played a smaller role in both two- and four-year colleges. Moreover, as at the high school level, the differential

Table 6. Four-Year College Covariate Means by Subgroup

Group		In-Person	Remote	Other	LFP	COVID Cases	*N* (Colleges)
Pell	>=mean	0.14	0.72	0.04	48.91	21.46	330
	< mean	0.26	0.45	0.01	49.65	19.12	1,606
White	>=0.5	0.34	0.39	0.01	49.70	17.80	1,271
	<0.5	0.13	0.59	0.02	49.45	21.67	665
Black	>=0.5	0.24	0.40	0.03	47.96	23.58	108
	<0.5	0.26	0.47	0.02	49.65	19.13	1,828
Hispanic	>=0.5	0.08	0.67	0.08	46.25	30.36	63
	<0.5	0.27	0.46	0.01	49.77	18.70	1,873

Source: Authors' tabulation.
Note: Pell is defined as the amount of Pell grant per entering student.

attainment trends by subgroup appear to be driven more by endowments of instructional mode and COVID cases than coefficient differences.

DISCUSSION

In this study, we estimate the effects of COVID on high school graduation and immediate entry to two- and four-year colleges, filling out the picture that others started to create regarding K–12 enrollment (Dee and Murphy 2021; Musaddiq et al. 2022) and overall college enrollment (NSC 2021, 2022). The results, combined with those of prior studies, suggest considerable heterogeneity in COVID effects on enrollment across levels of education (such as K–12 versus college) and across types of enrollment (initial enrollment, persistence, and completion). In this discussion, we propose some plausible explanations that may explain some of this heterogeneity and provide a more complete picture of the pandemic's effects on educational attainment.

Patterns Across Institution Types

Figure 9 summarizes the results for high school graduation and college entry alongside evidence from other studies on the other educational institutions and levels, from kindergarten through college for the 2021 school year. We see four key patterns and associated explanations.

First, we see smaller enrollment declines in high school than in earlier grades. Figure 9 shows, for example, that enrollment increased slightly in grades 10 through 12 but decreased significantly in grades 1 through 5. We offer two general explanations for the smaller enrollment declines in high school, compared with earlier grades: teenagers' autonomy and their need for nonfamilial social interaction.

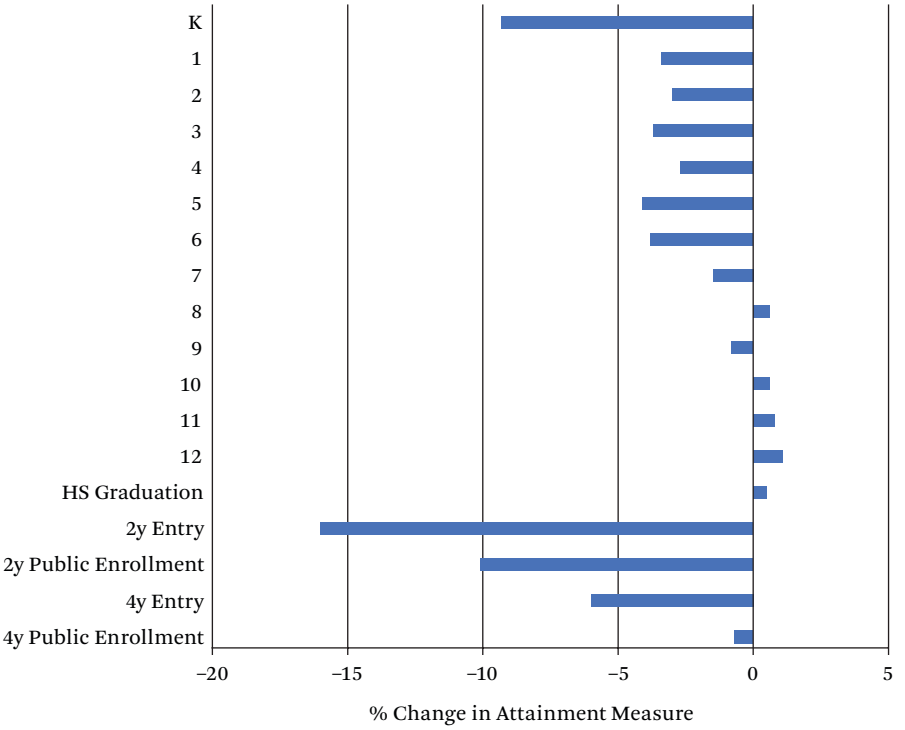
We combine the second and third patterns: kindergarten enrollment dropped more than twice as much as other elementary grades—and the transition from high school to college dropped more than high school enrollment and, even more so, high school graduation. We treat these together because, as we argue, they may have a common origin. Kindergarten and the start of college both involve entering and starting in a new education institution and, especially during a pandemic, entry is fundamentally different from persistence and completion.

Fourth, we see larger declines in two-year college enrollment than in four-year college enrollment. We explain below how this is due to differences between two-year colleges and their students vis-à-vis those in four-year colleges, as well as elaborating on all of these patterns and potential explanations.

Mechanisms for Cross-Institution-Type Variation

The first pattern is smaller enrollment declines in high school than in earlier grades. One reason for it is likely that teenagers depend more on their friendships than preado-

Figure 9. Change in Enrollment and Entry, K–16 (2021 minus pre-COVID)



Source: Authors' tabulation.

Note: All data for figure 9 are for the 2021 school year. The K–12 numbers are enrollment changes based on analysis reported in the *New York Times* based on data from the National Center for Education Statistics. The high school graduation and college entry numbers are from figures 1 and 2 in our analysis. The college enrollment numbers are from the National Student Clearinghouse.

lescents do (Buhrmester and Furman 1987; Claes 1998; Gehring and Feldman 1988; McNelles and Connolly 1999; Noller 1994; Valkenburg and Peter 2007). The quality of adolescent relationships is important to social adjustment (Waldrip et al. 2008).[21] As Michel Claes (1998, 167) puts it, "intense relationships with same-sex peers constitutes a universal reality of adolescence." Conversely, as friendship bonds strengthen, closeness between children and their parents begins to weaken as they move from preadolescence to adolescence (Claes 1998; Gehring and Feldman 1988; Noller 1994).

In a pandemic, this creates a distinctive challenge for teenagers. The pandemic simultaneously increased anxiety (because of the health risk posed to loved ones, uncertainty about the future, and economic hardship), but also made it more difficult to cope as pandemic lockdown reduced the extent and depth of friend interactions that are so important to them. Staying enrolled in high school and college was one of the few steps teenagers and young adults could take to address the problem. Isolation from friends may be partly why teenagers suffered worse depressive symptoms than younger children during the pandemic (Panchal et al. 2021). Staying in high school likely attenuated these symp-

21. Closeness as a psychological concept refers, first, to interdependent interactions in range of settings and activities and, second, to the qualitative experience, such as emotional communication and self-disclosure (Collins and Repinski 1994).

toms, but not enough to prevent them entirely.[22]

Similarly, adults report seeking support from friends and family when they experience anxiety (Addison et al. 2007).[23] During the SARS outbreak, researchers found that people coped by seeking support, that is, using emotional and other support from friends or family to comfort them (Lee-Baggley et al. 2004). This type of support-seeking is more feasible when people are in direct contact, such as attending schools and colleges in-person. This coping strategy might be even more common among teenagers given the importance of friendships for this group.

A second broad explanation for more stable enrollment in high school is that teenagers have greater autonomy with which to continue attending school, in three respects. First, they can complete their schoolwork more autonomously. Parents are less able to help older children academically because of the higher complexity of material, making homeschooling less effective. Second, and partly for the same reason, teens exert more control over educational decisions, such as whether to attend school. Third, once they reach age sixteen, many high schoolers also have access to cars, directly or indirectly through their friends, making it easier to attend high school, if they choose. The higher levels of autonomy on these dimensions mean that teenagers had more control over the decision to continue in school and, given the many reasons why they would wish to continue, that autonomy may have combined with their own personal motivation to stay in school.

We also considered the possible role of COVID vaccines, which were approved for adolescents before they were approved for younger children. Specifically, the Pfizer-BioNTech vaccine was approved for individuals sixteen years and older on December 11, 2020, but was not approved for ages twelve to fifteen until May 10, 2021, and was only approved on an emergency basis for ages five to eleven on October 29, 2021. Even though vaccines might have played a role in theory, it is unlikely given that COVID spread itself did not predict high school graduation (see table 1). We simply do not see evidence that high school attainment was related to health, which would seem to eliminate vaccines as an explanation.

Patterns two and three involve larger drops for entry versus persistence and completion. One reason for this is likely the high cost of delayed completion. High school students are expected to graduate at a specific time—all students are labeled as Class of YEAR— and failing to graduate in that year could stigmatize students among their peers and make it difficult to continue. Such a clear expected date of completion is less pronounced at other levels of education. Also, students who are held back or who drop out of high school have a very low likelihood of future completion and the costs of noncompletion are considerable (Levin et al. 2006). High school graduation is critical to opening up long-term life options even for those who do not plan to attend college.

Second, completion of a degree usually comes with requirements. Especially at the high school level, the requirements for completion are higher than the requirements for entry and continuation. Essentially anyone who has completed eighth grade is guaranteed admission to a public high school. The higher standard for completion than entry also applies at the college level; although public discourse focuses on hypercompetitive elite colleges, the vast majority of college goers attend nonselective institutions. At both the high school and college level, students are required to take certain courses and maintain minimum grade point averages, especially in core courses.

Why then did high school graduation stay stable? One reason may be that states relaxed many of the standards they have in place for this form of high school completion. As shown

22. This logic also aligns with the way teenagers and adults cope with anxiety. Research on teenagers who have been physically abused, for example, shows that friends more consistently buffer teenagers from the negative side effects of abuse (Folger and Wright 2013; Runtz and Schallow 1997).

23. This is based on the Coping Strategies Inventory. Three of the sixteen items pertain to social relationships and, in one study (Addison et al. 2007), respondents report these as common strategies.

in table 1, states with graduation exams who relaxed their standards saw larger increases in high school graduation (other things equal).[24] Anecdotally, high school teachers were also told to allow students to pass their courses with quite minimal forms of participation. Colleges might also have relaxed graduation standards, but this is harder to observe.[25]

Persistence and completion might also have remained more stable because of the coping explanation discussed earlier. Persistence and completion mainly involve maintaining social relationships, which are especially important in a pandemic (Addison et al. 2007; Lee-Baggley et al. 2004), whereas entry involves creating new relationships, which was difficult to do under pandemic social distancing.

The fourth pattern was larger entry and enrollment drops in two-year versus four-year colleges. This pattern cannot be explained by either of the described factors because college entrants are of roughly the same ages and face the same general decision: whether to enter or continue in college.[26] However, two-year colleges are different in important ways from four-year colleges. First, as Diane Schanzenbach and Sarah Turner (2022) show, many two-year college programs require hands-on activity, which makes them particularly difficult to carry out remotely. These include mechanical trades and nursing, which encompass a much smaller share of students at the four-year college level. Thus the large drop in two-year college entry and enrollment may just reflect that these hands-on activities were not available or that hands-on learning was more significantly hindered.

A final difference is that students at two-year college have a more tenuous connection to higher education than do students at four-year colleges. Relative to four-year students, two-year students are more likely to be older, to be enrolled part time, and to stop out for both academic and nonacademic reasons. For those reasons, it should not be surprising that the enrollment and progress of two-year students was more disrupted by the pandemic.

CONCLUSION

Considerable attention has been paid to learning loss during the pandemic. Here we extend the literature to focus more on educational attainment. Our preliminary results suggest that high school graduation did not decline during the pandemic—in fact, it increased to an all-time high. In contrast, the immediate transition to two-year colleges was the most negatively affected outcome, dropping by 21 percent two years after the onset of the pandemic. The results were consistently worse for students of color across types of attainment—high school graduation, two-year college entry, and four-year college entry.

We also examined variation in outcome trends across schools and colleges. Instructional mode and COVID cases both predicted educational attainment, especially college entry but perhaps in high school as well. The reduction in academic standards also seems to have propped up high school graduation rates, perhaps especially for white students and those with disabilities.

In addition to trying to understand heterogeneity between educational institutions (such as variation in graduation across high schools), we have identified distinctive patterns in attainment across ages and levels from K–16: high school enrollment and graduation increased while other forms of attainment decreased; entry dropped more than persistence and completion; and entry and enrollment dropped more in two-year colleges. We pose hypotheses for each pattern, and additional research is necessary to test them, but the analy-

24. Appendix tables and figures can be found online at https://www.rsfjournal.org/content/10/1/152/tab-supplemental.

25. Many colleges also eased admissions standards, such as waiving SAT and ACT requirements, but this was less important because these scores are not binding constraints for the vast majority of potential college entrants.

26. Our data only allow us to identify new college entries of students who just finished high school. The college enrollment numbers, however, include students of all ages. Two-year college students are also more likely to be nontraditional.

sis provides a general sense that these patterns that initially seem erratic were actually fairly predictable.

We note some limitations of the present analysis. COVID created a complex set of interconnected reactions that make it difficult to tease out cause and effect. We have advanced on prior research by considering a variety of factors simultaneously but recognize the difficulties involved in isolating the role each played. Also, even though the IPEDS college data include almost all colleges, we do note issues, especially with the subgroup trends in high school graduation, where missing data are especially high and where robustness checks yield some different conclusions.

The social welfare implications of all of this are a bit unclear. Of course, young people (and older people) are worse off because of COVID, educationally and otherwise. But the relevant question is whether the educational system could have responded better, given the pandemic circumstances. The actual policy response, at both the high school and college level, entailed educational institutions trying to serve students in ways as near as possible to the prior norm, given social distancing rules. One alternative would have been to engage in much less social distancing (more in-person instruction) and serve students exactly as before, but many families were worried about the pandemic and many students—and their teachers—simply would not have shown up; and spread the virus more when they did. Another option might have been to require students, at least at the high school level, to repeat the year and try to catch up. This, too, would have come at considerable cost as high schools would have had to continue serving both incoming and repeating students at the same time. Adding a year also likely would have led some students, eager to finish their schooling and move on, to drop out. Good options were simply not available.

What do these results mean for long-term educational attainment? Will students return to their prior patterns? It seems quite likely that the kindergarteners who redshirted over the past two years will eventually enter school and that these students will continue through the schooling system. But students who have already started school learned less and will therefore be less prepared for higher grades. Also, research suggests that students who do not start college immediately after high school have a lower probability of ever entering or graduating. The lower entry rates we observe therefore signal a likely persistent decline in attainment.

What we do know with more certainty is that human capital declined during the pandemic. Even with high school graduation, which is now at an all-time high, the reduction in standards means that this, too, is a signal of repercussions to come—for students, schools, and college alike—and especially for the most disadvantaged among us.

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Politics Matter: How Political Experience Mitigates Learning Losses Caused by Natural Disasters

MANUEL ALCAINO AND PABLO ARGOTE

Growing evidence warns about the detrimental effects of the stress induced by natural disasters on learning outcomes. Yet less is known about how political leadership could mitigate the adverse exposure to these events. Exploiting a natural experiment—the massive 2010 earthquake in Chile—as an exogenous shock and using fine-grained student data, we find that school disruption has a short and long-term impact on students' test scores. Moreover, our results indicate that learning losses were more pronounced in municipalities with a first-term mayor, in contrast to a nonsignificant effect in municipalities with a reelected one. We show that one of the pathways accounting for these effects is the ability of experienced bureaucrats to mobilize educational resources, highlighting the relevance of managerial capacities in times of crisis.

Keywords: natural disasters, 2010 Chilean earthquake, student achievement, political experience

The impact of natural disasters on human development has been extensively studied. Scholars have found that the stress induced by such disruptions negatively affects human capital accumulation (Caruso 2017), income (Pleninger 2022), birth weight (Torche 2011), migration (Drabo and Mbaye 2015), posttraumatic stress (Zubizarreta, Cerdá, and Rosenbaum 2013), employment (Jiménez Martínez, Jiménez Martínez, and Romero-Jarén 2020), productivity (Boustan et al. 2020), and especially educational attainment (Paudel and Ryu 2018; Herrera-Almanza and Cas 2021)—for small children (Gomez and Yoshikawa 2017) and children exposed in-utero (Caruso and Miller 2015; Caruso 2017; Torche 2018; Berthelon, Kruger, and Sanchez 2021).

The United States is by no means exempt from this problem. In the last years, the economic damage and the number of Americans affected by natural disasters have exhibited an upward trend (Ritchie, Rosado, and Roser 2022) partly because of the increasing number of people living in risky zones (Iglesias et al. 2021). In

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addition, scholars have found that natural disasters particularly affect educational outcomes, including test scores (Sacerdote 2012; Fuller 2014), educational attainment (Harris et al. 2024, this issue), and several other emotional and psychological variables (Ward and Shelley 2008; Osofsky et al. 2009; Dogan-Ates 2010).

Natural disasters do not occur in a vacuum (Cohen and Werker 2008). In the aftermath of such events, local governments undertake numerous actions to mitigate its disruption—establishing shelters, enabling critical infrastructure, disbursing aid, and so on—which depends, to a large extent, on institutional factors. Scholars in political science have addressed these institutional variables, finding that state capacity (Lin 2015), regime type (Keefer, Neumayer, and Plümper 2011), and welfare state generosity (Brady, Finnigan, and Hübgen 2017; Cylus, Glymour, and Avendano 2015; Rodriguez, Lasch, and Mead 1997) are key mitigators of these disruptions.

Political variables are not limited to macro-level institutions. Indeed, a prompt and efficient response from local leaders could mitigate the consequences of these disruptions. Hence, from a theoretical and practical point of view, it is essential to explore how political leadership and the characteristic of local governments could mitigate the consequences of such events. Based on the political economy literature, we consider political experience, namely, the number of periods in office of elected officials as a potential mitigating factor of natural disasters. Scholars have argued that later-term incumbents are, on average, more qualified than newcomers, partly given the knowledge acquired in office or because effective politicians are more likely to be reelected, or both (Ashworth and Bueno de Mesquita 2008; Alt, Bueno de Mesquita, and Rose 2011). As a result, an experienced mayor could be better able to navigate the different layers of the bureaucracy to secure extra resources for repairing public infrastructures. Previous studies have shown that the effectiveness of bureaucracy depends highly on the stability of crucial personnel (Akhtari, Moreira, and Trucco 2014; Toral 2021), which in turn may depend on the continuity of political leadership at the top.

This article asks two research questions. What are the short and long-term impacts of an educational disruption caused by a large-scale earthquake on student learning outcomes? Are experienced mayors able to mitigate potential learning losses caused by such events? As these questions suggest, our primary focus is understanding how political leadership mitigates the expected impact of natural disasters, which could give us essential theoretical and practical lessons about this increasingly relevant topic. In addition to these questions, we explore mechanisms explaining a potential mitigating effect by looking at the ability of local bureaucracies to execute educational spending.

Chile is an optimal case to tackle these questions. In 2010, the country suffered a catastrophic earthquake, 8.8 on the moment magnitude scale, which devastated one-third of its territory.[1] Although the epicenter was in the south, the earthquake had an extensive range, covering more than a thousand kilometers on the north-south axis.

The 2010 earthquake can be considered an educational disruption, namely, a sudden change in the schooling experienced by children caused by an unexpected macro-level event (Torche, Fletcher, and Brand 2024, this issue). According to the Chilean Ministry of Social Development, approximately six thousand schools experienced some damage, affecting 1.25 million students (Gobierno de Chile 2010b). The event caused school closures, concentrated in three regions, and 70 percent of students experienced a delay at the beginning of the school year (Sehnbruch et al. 2017).

The Chilean school governance structure allows us to focus on political variables at the local level. Public schools were managed by municipalities whose mayor is elected every four years. The mayor has discretion over several areas of school administration, such as managing personnel and executing educational spending, among others. Thus a mayor's ac-

1. It was the sixth strongest earthquake ever measured (U.S. Geological Survey, Earthquake Hazard Program, 2016).

tions can directly impact students of local public schools.

Using fine-grained administrative data on individual student achievement and exploiting a precise school-level indicator of earthquake intensity using the local ground-shaking level—peak ground acceleration (PGA)—we find that school disruption induced by the earthquake negatively affects student achievement, especially math test scores in the short term. Indeed, among schools with medium and high-intensity exposure to the earthquake, short-term math test scores decreased between 0.04 and 0.05 standard deviations. Second, using electoral data, we include the mayor's tenure in office to explore whether experienced politicians could mitigate such detrimental effects. We observe that learning losses due to school disruption were significantly larger in municipalities with a first-term mayor, both in math and Spanish, in contrast to a null impact in municipalities run by a reelected one (second period in office or more). We provide evidence that differential exposure to the earthquake does not drive this heterogeneous effect. Likewise, our results are robust to restricting the sample to competitive races, which may account for the characteristics of the median voter per municipality, a placebo test using nonmunicipal schools located in the same municipalities, and after adjusting for observables through a nearest neighbor matching model.

What are the mechanisms underpinning these disparate effects? One of the pathways, we claim, is the ability of experienced bureaucrats to mobilize resources and public spending. We find that schools in municipalities with a newly elected official experienced an approximately ten percentage points drop in public spending, in sharp contrast to a short-term increase in educational spending among schools with a reelected mayor. An experienced mayor likely implied more continuity in key personnel, reflected in a more efficient resource disbursement.

These findings indicate that competent political leadership has the potential to alleviate the destructive consequences of a natural disaster. Despite relying on an imperfect measure of managerial ability (time in office), our study reveals that political experience played a significant role in minimizing learning losses. Intuitively, we would expect experienced mayors to be better able to secure or execute public resources for their constituencies. However, it is surprising that they also mitigated learning losses, a variable that strongly predicts the social and economic outcome of individual trajectories.

The main focus of this article—the role of continuity of local leadership as a plausible mitigating factor—has important implications for the United States, where the administration of schools is also decentralized and dependent on local elected officials. Indeed, our results highlight the importance of continuity of effective local personnel—such as superintendents—independent of political cycles, as their knowledge in managing local bureaucracies could make a big difference in learning outcomes. However, we should state the scope conditions for this argument. Even if our findings underline the relevance of leaders, this does not imply that they face the same type of constraints across localities. Indeed, as Douglas Massey and Mary Fischer (2003) show, American society is characterized by high spatial segregation and concentration of affluence, creating inequality in local capacities—which is also the case in Chile (OECD 2017). Research in the United States has shown that states with greater decentralization of natural disaster spending correlate with higher economic losses because decentralization could lead to disparities in resource allocation (Miao, Shi, and Davlasheridze 2021). Consequently, capable politicians may decide to run for office in more affluent zones, which eventually could reinforce inequality after a natural disaster. Alternatively, the few capable leaders in poorer localities may not have enough resources to make a difference, given human and financial constraints.

In sum, the reliance on leaders seems like a double-edged sword; on the one hand, it is encouraging to see that political action can make a difference for victims of catastrophic events. Nonetheless, it is also concerning to note significant disparities based on local leadership, as these may be unevenly distributed across the United States.

CHILEAN EDUCATIONAL SYSTEM

The Chilean educational system has three distinctive characteristics. First, since 1981, public schools have been managed by the 345 local municipalities, which became administrators of state-owned kindergartens, primary, and secondary schools (Raczynski and Serrano 2001). Even if local municipalities make most managerial decisions, the central level still plays an important role. Indeed, the Ministry of Education (MINEDUC) is in charge of defining macro-level policies, and supervising educational institutions.

Second, municipalities are led by a mayor, who is elected every four years in a first-past-the-post electoral system. The mayor has discretion over several administration areas, including school management, personnel hiring, budget planning, execution of ministerial programs, and infrastructure-related tasks. According to the PISA school principal survey of 2018, more than 80 percent of administrative, financial, and staffing decisions in Chile are made locally, ahead of countries such as Colombia (60 percent), Peru (50 percent), Uruguay (10 percent).[2]

In addition, the educational system is strongly market-oriented. Chilean schools—both public and private—are funded by a per-student voucher, delivered from the central level, based on student attendance (Torche 2005). This funding scheme allows private-voucher schools, namely, private schools funded by state subsidies. Thus, in a given locality, private and public options, both funded by the central level, compete to attract students. The prevalence of private-voucher schools has steadily increased in the past forty years.

Regarding funding, two types of vouchers comprise almost 90 percent of the total educational spending: the per-student voucher and a targeted voucher program called Subvención Escolar Preferencial (SEP), which targets poor students, allocating significantly more resources to schools for each eligible student (Mizala and Torche 2017). In addition, municipalities are allowed to allocate some resources from local revenues from other sources on top of these vouchers, which typically happens in affluent local governments (Bellei 2009).

THE 2010 EARTHQUAKE

The 8.8-moment magnitude scale earthquake occurred offshore of southern Chile at 3:34 a.m. local time on February 27, 2010. The epicenter was located in the Biobío region, near the city of Concepcion, the second largest urban area after the capital Santiago. The earthquake caused a damaging tsunami thirty-five minutes later, extending 500 kilometers along the coast with maximum wave heights of up to 10 meters. The earthquake and tsunami caused 521 fatalities, and thousands of people were seriously injured (Gobierno de Chile 2010a). Approximately half a million buildings were severely damaged, and almost 10 percent of the population in the affected areas lost their homes. The event caused nationwide disruptions to public infrastructure such as electric lines, roads, cell phone lines, and other communications networks (Castaños and Lomnitz 2012). The country's critical infrastructure was significantly affected, including airports, railroads, ports, and highways.[3] In the aftermath, the government declared a state of emergency to control the rise of looting and crime. The government and civil society took immediate action prioritizing fulfillment of basic needs, access to basic supplies, and the reconstruction of public infrastructures such as schools, hospitals, and roads.

Regarding school infrastructure, a survey conducted after the earthquake revealed that 24.6 percent of the school children were delayed in starting the school year, concentrated in the six regions most affected by the event. In particular, in the most affected regions—Biobío, Maule, and O'higgins—this number reaches 70 percent (Sehnbruch et al. 2017). Moreover, according to government sources, more than two million students faced damage in their schools; in regions directly affected by the disaster, 74 percent of schools suffered

2. The average for OECD countries (70 percent).

3. It has been estimated that the total economic cost of the earthquake was 18 percent of the country's GDP (Aguirre et al. 2022).

some damage and 48 percent experienced moderate, severe, or disqualifying damage (Gobierno de Chile 2010b).

DATA AND MEASURES

First we describe the relevant measures and data sources in our empirical strategy. We then present a timeline of the relevant events to clarify the temporal gap between the earthquake and the outcomes.

For individual academic performance and student enrollment data, we use individual-level data from the Chilean System for Measuring Educational Quality (SIMCE), including fourth- and eighth-grade math and language test scores for all students in the system from 2008 to 2011. Across models, we use a standardized version of test scores, each year's mean and standard deviation. In some specifications, used to estimate long-term effects, we also included eighth-grade test-takers in 2014. In addition, we use enrollment records from the Ministry of Education (MINEDUC) as pretreatment covariates, including total enrollment, average attendance, whether the student graduated, and grade point average. We also use the SIMCE parent surveys to obtain information on students' socioeconomic backgrounds.

As a proxy for institutional performance, we use a measure of educational spending based on a program called Subvención Escolar Preferencial. This new regulation was implemented in 2008 and created a new voucher for the poorest students, allocating significantly more resources to schools for each eligible student. Through a four-year improvement plan, each school has to spend these new resources on teaching material, hiring educational specialists, contracting external support, or extending teachers' contract hours. The Chilean Superintendency of Education collects this spending data, allowing it to construct a precise measure of the percentage of public spending for each school by year, defined as (SEPspending/total SEPbudget).

We measure earthquake affectation using peak ground acceleration, which accounts for local geological effects. This is a widely used measure in earthquake engineering because, unlike global measures such as Richter, PGA represents the maximum shaking acceleration registered in a specific location. In addition, it accounts for regional propagation effects or local amplifications that other measures, such as the epicentral distance, fail to capture (Aguirre et al. 2022; Zubizarreta, Cerdá, and Rosenbaum 2013). We use peak ground acceleration shapefiles provided by the U.S. Geological Survey (2016), allowing us to precisely construct PGA values using the latitude-longitude plane of the universe of Chilean schools. We then divide our sample into three categories of earthquake intensity by schools: low exposure (PGA<0.092), medium exposure (PGA>0.092 and PGA<0.34), and high exposure (PGA>0.34) to define the treatment and control groups.[4]

As explained, we measure exposure to the earthquake at the school level defined by the school's location. To determine enrollment in a given school, we used the 2009 student registration records, the year preceding the earthquake. Thus a treated (control) student is defined as an individual enrolled in an exposed (nonexposed) school in 2009, regardless of any subsequent school transfers following the 2010 earthquake. Thus we ensure that our results were not influenced by earthquake-induced migration.

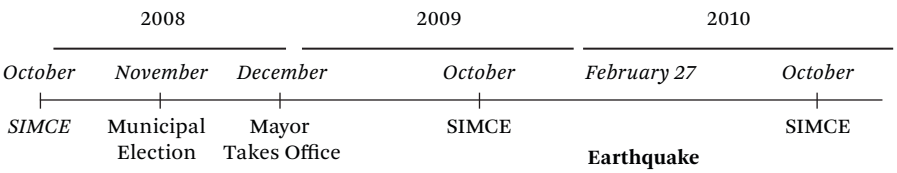
Finally, we use data from the 2008 municipal election from the Chilean Electoral Service (SERVEL) to determine the period in office of each mayor. This measure is an indicator variable equal to one if the mayor were reelected at least once and zero otherwise. Table A.1 displays descriptive statistics of all the described variables.

Timeline

We focus on educational and electoral data around the year of the earthquake. As the timeline in figure 1 shows, the earthquake occurred at the end of February 2010, at the beginning of the school year that starts in March and ends in December. The Chilean System for Measur-

4. These cutoff points are based on the potential damage of earthquake exposure based on the Mercalli scale. In the low-exposure category, the damage ranges from note to light; in medium exposure, it ranges from light to moderate; in the high-exposure category, it ranges from moderate to very heavy (see Zera and Nafian 2018).

Figure 1. Timeline of Election and Education Data



Source: Authors' compilation.

ing Educational Quality is collected annually in October. Therefore, our short-term effects measure the consequences of exposure to the earthquake roughly eight months after. In addition, we compare outcomes by the political experience of the mayor in office. Municipal elections took place in October of 2008 and the mayor took office in December of the same year. Hence the earthquake affected Chile when mayors elected in 2008 had approximately fourteen months in office.

SAMPLE AND DATA STRUCTURE

Our data structure can be best described as repeated cross-sectional, given that it follows schools over time but with different cohorts of students each time. Concretely, we include fourth and eighth-grade students who took the test in 2008, 2009, 2010, 2011, 2012, and 2014. For instance, in 2009—the baseline year—a given cohort of fourth-grade students took the SIMCE test; then, in 2010—the year of the earthquake—a different cohort within schools took these tests, and so on. Thus, we tracked the same schools over time but not the same students.

For our core findings, we restrict the sample to fourth-grade students who met three conditions. First were those who took the SIMCE test during the study period, encompassing 98.9 percent of students from schools recognized by the state. Second were those in a school exposed to the 2010 earthquake. The latter restriction implied that we discarded students that entered the educational system after the earthquake. For the heterogeneous effects using the mayor's tenure in office, we added a third condition, those students enrolled in municipal schools, excluding private and private-voucher schools, because their direct exposure to the mayor's managerial decisions is limited. In 2010, 43.5 percent of students in the fourth-grade cohort were enrolled in public schools.[5]

EMPIRICAL STRATEGY

The study of natural disasters offers excellent potential to researchers in that, by definition, such events are unpredictable and random. Certainly, some geographical areas are more susceptible than others, implying that potentially affected people would differ from subjects in other areas. Therefore, researchers cannot use any nonaffected group as the comparison group. Nonetheless, it is plausible to find variation in exposure within a geographic unit susceptible to these events, allowing researchers to identify a treatment group and counterfactual created through natural circumstances. In other words, natural disasters constitute natural experiments, that is, events in the real world where treatment is "as if" randomly assigned by forces other than a researcher (Dunning 2008).

Even if the intensity of a natural disaster is perfectly random, researchers typically use panel data to study its effects, which allows adjusting for any baseline difference between treated and control units.[6] In other words, panel data allows comparing changes between affected and unaffected units through a difference-in-difference model or a fixed-effect

5. To be precise, for 2010, we retained 104,056 of the 241,332 students.

6. If we assume that the natural disaster is entirely exogenous, we can identify its effect through a simple difference in means or through a comparison of the change over time. In the latter procedure, we could gain efficiency because variation is less in changes than in level differences.

specification. The latter model typically allows for the inclusion of geographic fixed effects, adjusting for heterogeneity across regional variables, such as states, counties, and cities. In our review, we found that this approach is prominent: about 75 percent of the cited papers use a panel or repeated cross-sectional data structure. Moreover, most of these papers show robustness checks satisfying the assumptions of these models, such as parallel trends of the pretreatment outcome or baseline similarities between treatment and control groups.

A second approach considers the natural disaster as a random instrument of some treatment. For instance, earthquake intensity could severely affect public infrastructure. If a researcher is interested in the impact of public infrastructure on other outcomes, they can instrument the treatment with the natural disaster.

A third methodological approach is to create a counterfactual through a weighted average of nonaffected units. This approach allows for comparing similar units based on observable characteristics, restricting the sample to a zone of overlap, that is, a region where treated and control units have a similar probability of treatment.

In our case, along with most of the literature, we estimate a difference-in-difference model, mainly for two reasons. First, the earthquake's exact location is plausibly random, given that the whole Chilean territory is vulnerable to these events. Second, we have six waves of cross-sectional data on student achievement at the individual level, which allows for comparing variation over time, adjusting for school and regional fixed effects. The estimand—the quantity of interest—is the average treatment effect (ATE), given that we are measuring the direct average impact of this macro-level disruption on educational outcomes.

Our first empirical analysis looks at the short-term effect of the earthquake on student achievement through a difference-in-difference model (DID). Here, we estimate a traditional DID regression, which can be described as follows:

$$Scores_{ismrt} = \beta_0 + \sum_{y=2007}^{2012} \beta_y(y)_t + \eta_1(med)_{smr} + \eta_2(high)_{smr} + \sum_{y=2007}^{2012} \tau_y(y) * (med)_{smr} + \sum_{y=2007}^{2012} \lambda_y(y) * (high)_{smr} + \delta_r + \varepsilon \quad (1)$$

The outcome $Scores_{ismrt}$ represent the standardized test scores in math and Spanish of student i, in school s, in municipality m, in macro-region r, in year y. Then, the predictor $\sum_{y=2007}^{2012}$ are indicator variables of the years between 2007 and 2012, using 2009 as the reference category;[7] the parameter δ represents macro-region fixed effects. The variables $(med)_{smr}$ and $(high)_{smr}$ indicate medium and high earthquake intensity, respectively, using PGA—low intensity is omitted. The key parameters are τ_y and λ_y, the interaction terms between the year dummies and the earthquake's intensity indicators, which accounts for the DID estimate. The models include the following pretreatment covariates: Parents' average education, parents' income (log), baseline schools' math and language academic achievement, and school type (municipal, private, or private-voucher).

The identifying assumption is that exposure to earthquake intensity was as-if-randomly assigned across schools.[8] We hypothesize that $\tau < 0$ and $\lambda < 0$ imply a negative effect of both moderate and high intensity on student achievement. Note that the counterfactual scenario is the change in test scores among schools with low exposure to the earthquake.

Our second empirical strategy estimates long-term effects. In these models, we estimate a similar DID, but instead of computing the outcome in 2010, we use outcome data for 2014 obtained from the eighth-grade SIMCE test. Such a model can be described as follows:

7. We included 2007 and 2008 to check for a pre-trend in the model. We expect to find a null effect on those years.

8. We observe evidence in this direction because there are no differences among exposed and nonexposed schools on key student outcomes in the preearthquake period. To this end, we regressed five baseline covariates on our indicator of earthquake intensity, finding, as expected, null results (see table A.2).

$$Scores_{ismrt} = \beta_0 + \beta(2014)_t + \eta_1(med)_{smr} + \eta_2(high)_{smr} + \tau(2014) * (med)_{smr} + \lambda(2014) * (high)_{smr}\,\delta_r + \varepsilon \quad (2)$$

The difference from equation (1) is the inclusion of a dummy variable indicating 2014.

In addition, we estimate an interacted DID model, multiplying earthquake intensity with a variable indicating whether a mayor was reelected.

$$Scores_{ismrt} = \beta_0 + \sum_{y=2007}^{2010} \beta_y(y)_t + \eta_1(med)_{smt} + \eta_2(high)_{smt} + \sum_{y=2007}^{2010} \tau_y(y) * (med)_{smr} + \sum_{y=2007}^{2010} \lambda_y(y) * (high)_{smr} + \omega(re)_{mt} + \sum_{y=2007}^{2010} \alpha_y(y) * (re)_{mt} + \phi_1(re * med)_{smt} + \phi_2(re * high)_{smt} + \sum_{y=2007}^{2010} \theta_y(y) * (re * med)_{smt} + \sum_{y=2007}^{2010} \kappa_y(y) * (re * high)_{smt} + \delta_m + \varepsilon \quad (3)$$

Here, the variable *re* represents a dummy indicator equal to one if the mayor was reelected at least once, zero otherwise. This indicator interacts with all the relevant variables of the model. The parameters of interest are τ, λ , θ and κ. τ and λ represent the effect of moderate and high earthquake intensity for municipalities led by a first-time mayor; meanwhile, θ and κ are the impacts of moderate and high earthquake intensity in places with reelected mayors. We hypothesize that $\tau < 0$, $\lambda < 0$, but $\tau + \theta = 0$ and $\lambda + \kappa = 0$ meaning that an experienced mayor has a mitigating effect.

Finally, we also estimated the long-term model, adding the interaction term of political experience:

$$Scores_{ismrt} = \beta_0 + \beta(2014)_t + \eta_1(med)_{smt} + \eta_2(high)_{smt} + \tau(2014 * med)_{smr} + \lambda(2014 * high)_{smr} + \omega(re)_{mt} + \alpha(2014 * re)_{mt} + \phi_1(re * med)_{smt} + \phi_2(re * high)_{smt} + \theta(2014 * re * med)_{smt} + \kappa(2014 * re * high)_{smt} + \delta_m + \varepsilon \quad (4)$$

As in equation 3, the parameters of interest are τ and θ .

In addition, in the mechanisms section, we estimate identical DID models such as the ones presented in these equations but with a different outcome: the SEP educational expenditure.

Before presenting the results, we discuss the challenges in estimating heterogeneous effects. Although we have an arguably exogenous treatment—which allows identifying the main effect causally—it is always difficult to estimate heterogeneous effects given the typical perils of working with observational data: endogeneity problems, lack of statistical power, and ad hoc selection of any characteristic that may show heterogeneity (Torche, Fletcher, and Brand 2024, this issue). Let us address these points one at a time.

We can discard the problem of ad hoc selection because the inclusion of political experience is based on theoretical grounds. Indeed, the main focus of this article is political experience as a mitigating factor, and we have good theoretical and practical reasons to believe this will be the case. Regarding statistical power, our data set is considerably large, as we have the universe of Chilean students who took the test in the included years. We acknowledge that we may have an endogeneity problem due to the nonrandom selection of mayors. Indeed, because mayors are not randomly assigned, it is plausible that municipalities with reelected mayors differ from the ones with newcomers in variables that may also be related to test scores. To address this problem, we restricted the sample to close races to adjust for the characteristic of the median voter across localities. In addition, we use inverse probability weighting matching in order to better adjust for observable among municipalities with and without a reelected mayor. Our results are practically identical after these adjustments (for a longer explanation of both procedures, see the following section).

RESULTS

We present our results in four stages. First, we explore the consequences of school disruption induced by the earthquake on student achievement. Second, we examine how the political experience of municipal mayors potentially mitigates the effects. Third, we discuss mechanisms, looking at educational spending. Fourth, we present several robustness checks.

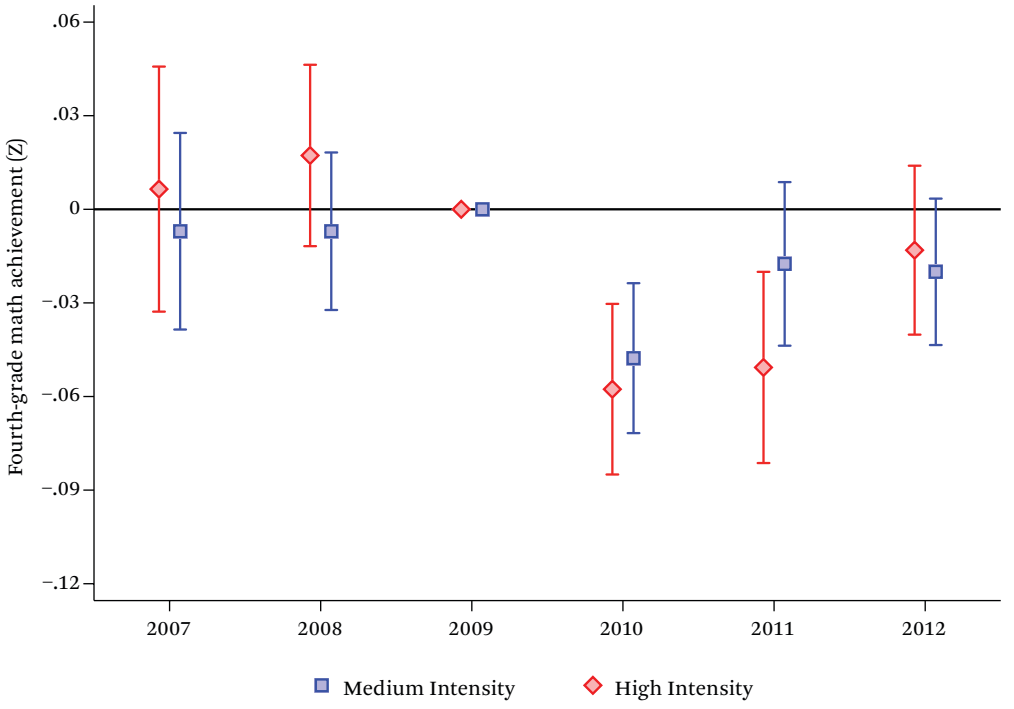
Short- and Long-Term Effects of School Disruption on Student Achievement

In figure 2, we present a coefficient plot with the DID estimates for moderate and high intensity, using math scores at the outcome and 2009 as the reference category. The educational disruption created by the earthquake had a meaningful negative impact on students, both for moderately and severely affected schools, relative to the nonaffected ones (low-intensity). Indeed, medium- and high-intensity exposure to the earthquake decreased math test scores between about 0.04 to 0.05 standard deviation units in 2010; the effect lingers for 2011 among the high-intensity group.

Relative to other benchmarks, the effect on math scores is quite substantial. For example, successful school programs implemented in Chile, such as lengthening the school day (Jornada Escolar Completa) increased test scores between 0.05 to 0.12 standard deviations (Bellei 2009). Nonetheless, when comparing with targeted interventions—such as supporting teachers, which yields a positive impact of around 0.17 and 0.27 standard deviations—our effects look smaller (Muralidharan and Sundararaman 2011).

In table 1, we present the findings of the DID interaction for both short- and long-term outcomes. We display the results for the entire sample in models 1 and 2 and then restrict the analysis to municipal schools in models 3 and 4. In model 2, panel A of table 1, there is no immediate impact on Spanish-language scores, in contrast to math scores. This discrepancy may be attributed to the fact that math performance relies more on school-related factors, whereas reading skills can be influenced, to a greater extent, by family or cultural capital. Indeed, research in the United States demonstrated that a larger variance of math scores, relative to English scores, are explained by teacher effects

Figure 2. Short-Term Effect of 2010 Earthquake on Math Academic Achievement



Source: Authors' tabulation based on SIMCE (2007–2012); MINEDUC (2006–2012).
Note: The coefficients representing the DID estimates using 2009 as the baseline year and low-exposure schools as the reference category. These are equivalent to model 1 in table 1. The models are covariate-adjusted and encompass the entire sample of students from all types of schools. Standard errors are clustered at the school level. Coefficients 95 percent confidence intervals.

Table 1. Short and Long-Term Effect of 2010 Earthquake on Math and Spanish Academic Achievement

	All Students		Municipal Schools	
	Math (Z) (1)	Spanish (Z) (2)	Math (Z) (3)	Spanish (Z) (4)
Panel A. 8 months after fourth-grade test score				
Year 2010 x Med intensity	−0.04***	−0.00	−0.03	0.02
	(0.01)	(0.01)	(0.02)	(0.02)
Year 2010 x High intensity	−0.05***	−0.00	−0.05**	0.02
	(0.01)	(0.01)	(0.02)	(0.02)
Observations	379,037	377,771	157,763	157,151
Clusters	6,772	6,772	3,616	3,616
Controls	Yes	Yes	Yes	Yes
Panel B. 4.6 years after eighth-grade test score				
Year 2014 x medium intensity	0.01	−0.03	−0.01	−0.06***
	(0.02)	(0.02)	(0.01)	(0.01)
Year 2014 x high intensity	0.00	−0.07***	0.02	−0.07***
	(0.02)	(0.02)	(0.02)	(0.02)
Observations	172,365	171,249	395,267	393,196
Clusters	4,782	4,785	8,328	8,334
Controls	Yes	Yes	Yes	Yes

Source: Authors' tabulation based on MINEDUC (2004–2014); SIMCE (2005–2014).
Note: The table presents the interaction term τ as in equation 1 for the entire sample in models 1 and 2, and restricted for students in municipal schools in models 3 and 4. The short-term results in models in panel A include fourth-grade student achievement using 2009 as the baseline year and low-exposure schools as the reference category. The long-term results in panel B include eighth-grade student achievement using 2009 as the baseline year and low-exposure schools as the reference category. Models 1 and 3 include a standardized version of math test scores using, while models 2 and 4 use a standardized version of language test scores. Standard errors are clustered at the school level.
* $p < .1$; ** $p < .05$; *** $p < .01$

(Chetty, Friedman, and Rockoff 2014a, 2014b). Our findings suggest a similar pattern in Chile.

Panel B of table 1 demonstrates that, over the long run, the detrimental effect on math diminishes. We, however, observe a negative long-term impact on Spanish. This persistent effect is primarily concentrated among high-intensity schools. However, in the case of students attending municipal schools, the effect is also noticeable in medium-intensity schools. A plausible explanation is that language development is a cumulative process, relying heavily on early childhood experiences (Austin et al. 2017). If the earthquake occurred during a critical period of language development, it could have had lasting effects on their ability to acquire and use language effectively. Additionally, the earthquake may have created economic instability, in turn affecting the long-term development of language skills.

Finally, table A.3 shows that the negative short- and long-term effects of school disruption were larger among high-performing students, using baseline grade point average relative to the school-grade median, in the short-term (panel A). Most likely, these students were more engaged in school activities, all disrupted after the earthquake.

HETEROGENEOUS EFFECTS BY MAYOR'S TENURE IN OFFICE

Can reelected mayors potentially mitigate the impact of the earthquake on learning outcomes? To address this inquiry, we examine our difference-in-differences estimates in conjunction with a binary variable that indicates

whether the mayor was reelected. By interacting with these variables, we can assess whether the reelection of mayors has any moderating effect on the consequences of the earthquake.

In table 2, we display the results of our interacted DID model, both for the short and long-term outcomes (equations 3 and 4). For the sake of simplicity, we include three coefficients: the impact of the earthquake on municipalities with a first-term mayor, the impact on municipalities with a reelected mayor, and the difference between the two.

Columns 1 and 2 show that the learning losses due to school disruption were substantially higher in municipalities with a first-term mayor, both in math and Spanish, among highly exposed schools. Indeed, among schools with a first-term mayor, the earthquake decreased math test scores by 0.13 standard deviations, in contrast with places with an experienced mayor, where the impact is essentially zero. Moreover, the interaction coefficient—indicating the difference between municipalities with a reelected and a first-term mayor among the high-intensity group—is substantial (0.10 standard deviations) and statistically signifi-

Table 2. Short and Long-Term Effect of 2010 Earthquake on Math and Spanish Academic Achievement by Mayor's Reelection Status

	Short-Term Outcomes 8 Months After Fourth grade		Long-Term Outcomes 4.6 Years After Eighth grade	
	Math (Z) (1)	Spanish (Z) (2)	Math (Z) (3)	Spanish (Z) (4)
Medium intensity (not reelected)	−0.07***	−0.01	−0.00	−0.03
	(0.02)	(0.02)	(0.03)	(0.03)
Medium intensity (reelected)	−0.02	−0.00	0.01	−0.04
	(0.03)	(0.03)	(0.02)	(0.03)
Difference	0.05	0.01	0.01	−0.01
	(0.04)	(0.03)	(0.04)	(0.04)
High intensity (not reelected)	−0.13***	−0.06**	−0.04	−0.10***
	(0.04)	(0.03)	(0.03)	(0.03)
High intensity (reelected)	0.03	0.04	0.03	0.06*
	(0.03)	(0.02)	(0.03)	(0.03)
Difference	0.10**	0.10**	0.07	0.04
	(0.05)	(0.04)	(0.04)	(0.04)
Observations	174,161	174,500	172,290	171,175
Clusters	339	339	344	344
Controls	Yes	Yes	Yes	Yes
Macroregion F.E.	Yes	Yes	Yes	Yes

Source: Authors' tabulation based on MINEDUC (2008–2010); SIMCE (2009–2010); SERVEL (2008).
Note: The table presents the results of our DID model, incorporating whether the incumbent mayor was reelected in the previous municipal election (2008). The model includes three parameters: τ, $+ \theta$, and θ (as outlined in equation 2). Models 1 and 3 include as outcome a standardized version of math test scores using SIMCE; models 2 and 4 use a standardized version of Language test scores. The short-term results, displayed in models 1 and 2, focus on fourth-grade student achievement with 2009 as the baseline year. The reference category for exposure is low-exposure schools. The long-term results, presented in models 3 and 4, uses eighth-grade student achievement with 2009 as the baseline year. The reference category for exposure is low-exposure schools. The analysis is restricted to students in municipal schools. Standard errors are clustered at the municipal level.
* $p < .1$; ** $p < .05$; *** $p < .01$

cant for both math and Spanish in the short term.

We notice, though, that the heterogeneous effects tend to dissipate over time. Columns 3 and 4 of table 2 show that the achievement gap between students with an experienced mayor (relative to a first-term mayor) narrows significantly, especially for Spanish test scores. Consequently, our results suggest that experienced mayors were particularly relevant in the immediate aftermath of the catastrophic 2010 earthquake.

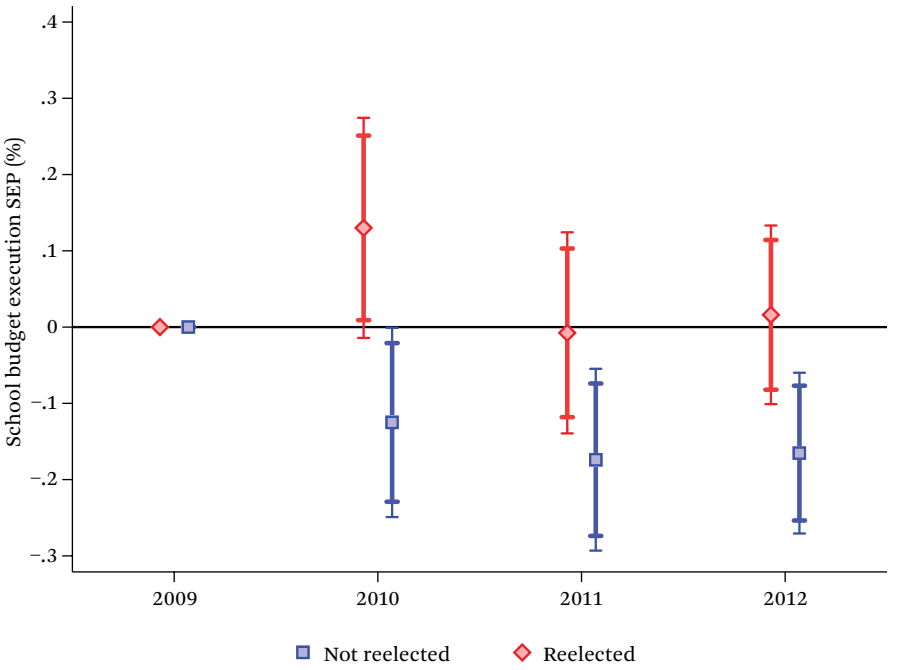
MECHANISMS

What are the mechanisms driving these disparate effects? We argue that one of the pathways is the ability of experienced bureaucrats to mobilize educational resources. To explore this channel, we use administrative data on educational expenditures of the SEP program, the aims of which we defined in previous sections. We observe that SEP spending generally declined due to the earthquake, which is mainly driven by first-term mayors (figure 3). Concretely, exposed first-term mayors spent approximately 10 percentage points (twice the average) fewer SEP resources in 2010 than reelected ones. Thus, we show suggestive evidence that experienced mayors were more effective at executing educational resources after the earthquake.

ROBUSTNESS CHECKS

We focus on five main validity threats: i) whether our results are driven by differential exposure to the earthquake between municipalities with a first-term and reelected mayor; ii) whether contextual factors, other than the

Figure 3. Short and Long-Term Effect of 2010 Earthquake on School Budget Execution



Source: Authors' tabulation based on MINEDUC (2008–2012); SIMCE (2009–2012); SERVEL (2008).
Note: The figure shows the interacted DID model plotting two parameters: τ, $\tau + \theta$ as equation (2) shows. Coefficients represent the effect of high-intensity exposure on school budget execution (as percentage of the total public resources assigned to the school) using 2009 as the baseline year and low-exposure schools as the reference category. The analysis is restricted to students in municipal schools. Coefficients include 90 percent and 95 percent confidence intervals. Standard errors are clustered at the municipal level.

municipal management, explain our heterogeneous effects (we test this threat using non-municipal schools as a placebo); iii) whether our results hold after adjusting by the margin of victory of incumbent mayors; iv) whether our heterogeneous effects hold after adjusting by inverse probability weighting; and v) whether our results are robust when using an alternative measure of earthquake intensity.

(i) Potentially, an earthquake could differentially affect municipalities where incumbents were reelected. To rule this out, we examine whether municipalities with experienced mayors have different levels of exposure to the earthquake than municipalities with a first-term mayor in 2010. To this end, we regress an indicator variable equal to one if the mayor was reelected, zero otherwise, on a set of indicators related to the exposure to the earthquake: PGA, log of distance to the epicenter in kilometers, number of casualties at the municipal level, and the damage induced by the earthquake to the sewer system (as percentage and quantity). As shown in table A.4, we observe no signs that differential exposure to the earthquake could drive our documented heterogeneous effects.

(ii) Our main finding is that political experience mitigates the earthquake's impact on student achievement and budget spending. However, other unobserved variables among municipalities with experienced mayors may be causing the mitigating effect. To discard this possibility, we exploit a special feature of the Chilean educational system, namely, the important presence of private schools funded by a per-student voucher paid by the central state. Our logic is that if political experience and managerial capacities drive the mitigating effect, then such effect should not exist among schools not managed by the municipality. In table A.5, we replicate table 2 but restrict the sample to private-voucher schools. We do not find a mitigating effect on nonmunicipal schools, which gives us more confidence that no other contextual factor other than municipal management explains the heterogeneous effect.

(iii) Moreover, we test if our heterogeneous political effect persists after restricting the sample to municipalities where the mayor won by a smaller electoral margin. Narrowing the sample to competitive electoral races is common practice in the political science literature, in which authors argue that politicians elected by a small margin are "as if random" (Lee, Moretti, and Butler 2004). Consequently, the margin of victory can be used as a running variable for a regression discontinuity design, implying that municipalities where the incumbent mayor barely won are similar to those where they barely lost.[9] Even if the as-if-random assumption may be questionable, restricting the sample to close electoral races allows one to compare municipalities where the median voter is similar, which may account for a variable that could affect both political experience and learning outcomes. In table A.6, we show the results of this exercise, using 25 and 18 percentage points as the margin of victory around the cutoff and restricting the sample to municipalities where the incumbent ran for office in 2008. Furthermore, we apply triangular kernel weights, assigning greater weight to data points closer to the threshold. After narrowing the sample to close races, we observe that our results in schools with high exposure to school disruption are similar for both Spanish and math, although results are statistically significant at a lower confidence level (90 percent), likely due to the sample restrictions.[10]

(iv) In regard to nearest neighbor matching, even if municipalities with and without reelected mayors did not have differential earthquake exposure, reelection status could be capturing something unrelated to managerial capacity, threatening the validity of our heterogeneous effects. We used propensity score matching to better adjust for observable baseline characteristics among municipalities with and without reelected mayors. In particular, we estimate the propensity score of having a re-

9. For an application of this method using mayoral elections in Chile, see Argote 2021.

10. Figure A.1 presents a coefficient plot of the difference between reelected and non-reelected mayors, using a continuous measure of earthquake intensity while employing various bandwidths. These estimates show a significant interaction effect in every bandwidth.

elected mayor using the following individual, school-level, and municipal-level covariates: gender, baseline test scores, school attendance, average school test scores, average family income per school, average family years of education per school, the average number of students per school, average number of students in private-voucher schools, and percentage and number of students in public schools per municipality, average income at the municipal level and math average academic achievement at the municipal level.[11] Then we used the nearest neighbor algorithm to estimate our main DID model. We find similar results (table A.7), suggesting that reelection status did not confound with one of our baseline characteristics.

(v) As an alternative to the main measure of earthquake intensity, we use a continuous measure of exposure based on the Euclidean distance of every school to the epicenter (using the geographical coordinates). We measure earthquake affectation using the following formula: log(max(distances)distances). Inside the parenthesis, we compute the maximum distance in kilometers of any school to the epicenter minus the distance of a given school, which allows assigning higher values to schools closer to the epicenter and smaller values to schools farther away. We then logged this subtraction to normalize the distribution. Table A.8 displays the heterogenous effects by reelection status, using this measure. Again, results are practically identical, especially in the short-term outcomes.

DISCUSSION

Natural disasters do not occur in a vacuum. As Charles Cohen and Eric Werker (2008) claim, "[natural disasters] are not driven by politics, nor are they immune from politics." Do political variables play a role in mitigating adverse exposure to natural disasters? In this article, we argue that experience in office of local leaders can have an important palliative role in the adverse exposure of children to disruptive events.

Exploiting a natural experiment—the 2010 earthquake in Chile—we first show that, in line with previous studies, natural disasters have short and long-term negative consequences on individual-level learning outcomes. We find that school disruption induced by the earthquake detrimentally affects math test scores immediately and in the next few years, although it recovers approximately five years later. In Spanish, though, we find an opposite pattern: negative effects are null in the immediate aftermath of the event and negative later.

There are reasonable explanations for this pattern. As evidence in the United States suggests (Chetty, Friedman, and Rockoff 2014a, 2014b), learning math depends more on school resources, so a shock of this magnitude likely interrupted the learning flow. In turn, given that learning Spanish depends more on household resources and cultural capital, it is normal that these scores would be relatively unaffected at first. But, as school disruption continued over months, and perhaps years, reading and writing problems may manifest years later. Still, this puzzling empirical result could merit further exploration.

Second, we show significant heterogeneous political effects at the local level. Across multiple specifications, we observe that reelected mayors were able to mitigate learning losses caused by the earthquake, for both math and Spanish, especially in the short term. A plausible interpretation of this finding is considering political experience as a proxy of managerial quality. Indeed, as Scott Ashworth and Ethan Bueno de Mesquita (2008) claim, reelected politicians are likely more skilled than those in their first term due to the knowledge acquired in office or because high-quality mayors are more likely to be rewarded with reelection.

What explains this heterogenous effect? We show that a plausible mechanism through which political experience mitigates learning losses is the efficient mobilization of educational resources. This crucial finding suggests that experienced mayors had more capable personnel, in that their resource allocation was not

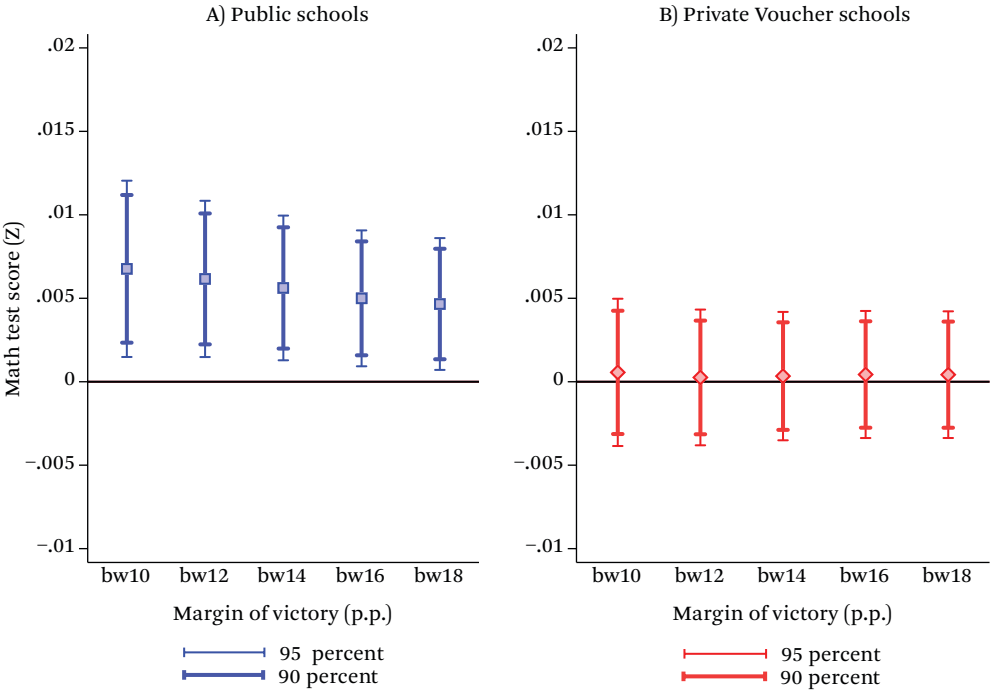
11. We selected these covariates because they could potentially correlate with both having a reelected mayor and student achievement.

affected by the earthquake. Most likely, the years of experience in navigating different layers of the bureaucracy had a positive impact in times of crisis, making a huge difference for students exposed to this disruptive event.

A relevant question that emerges from our findings is what political experience is capturing? Continuity in political leadership could imply stability in bureaucratic personnel, a crucial variable to consider in the aftermath of a natural disaster. Indeed, the evidence related to educational spending strongly suggests better managerial capacities among municipalities with experienced leaders, which probably happened due to bureaucratic stability. This relevance of stability on key personnel is our article's most relevant policy implication because it constitutes an achievable goal, even with turnover in political leadership.

The relevance of local leaders is, in some way, a double-edged sword because it uncovers the pros and cons of a decentralized governance structure, as is the case in Chile and the United States. On the one hand, it is positive to note that leadership matters, even when operating in large bureaucracies. However, in the context of regional inequalities in local capacities, effective leaders may decide not to run for office in poorer localities; or, when they do, they could have too many constraints to do their jobs effectively. In this sense, we may want to celebrate the impact of political leaders. However, we should not assume that these are evenly distributed across the country.

Figure A.1. Differential in Earthquake Effect on Math Scores Between Reelected and Not Reelected Mayors (Different Bandwidths)



Source: Authors' tabulation based on MINEDUC (2008–2010); SIMCE (2009–2010); SERVEL (2008).
Note: Plotted coefficients represent the differential in the earthquake effect on math scores between reelected and not reelected mayors, using a continuous measure of earthquake intensity (described in the robustness checks section). The x-axis represents different bandwidths (margin of victory). Models are weighted using a triangular kernel. Standard errors are clustered at the municipal level. The analysis is restricted to students in municipal schools. Standard errors are clustered at the municipal level.

Table A.1. Descriptive Statistics

	Mean	SD	Min	Max
Municipal level				
Total votes	16,777.88	21,811.41	330.00	135,867.00
Incumbent mayor reelection	0.66	0.47	0.00	1.00
Voucher elementary school enrollment (%)	26.08	22.55	0.00	100.00
Voucher high school enrollment (%)	28.10	27.58	0.00	100.00
Total elementary sch. enrollment	6,205.22	9,238.47	0.00	72,450.00
Total high school enrollment	2,837.30	5,362.67	0.00	56,331.00
Total municipal income (log)	14.98	1.07	9.78	18.33
Total expenditures (log)	14.55	1.76	2.63	18.06
Rural student share	0.04	0.15	0.00	1.00
School level				
Peak ground acceleration (PGA)	0.23	0.13	0.00	0.50
Low exposure (PGA)	0.22	0.42	0.00	1.00
Med exposure (PGA)	0.53	0.50	0.00	1.00
High exposure (PGA)	0.25	0.43	0.00	1.00
Kilometers to earthquake center	432.42	398.03	8.63	2,187.00
Kilometers to earthquake center (log)	2.39	0.70	0.50	6.03
Mean teaching years of experience	17.08	6.08	0.00	52.00
Portfolio teacher evaluation	2.24	0.15	1.20	3.22
Number of teachers	36.01	26.99	1.00	291.00
School spending percentage (SEP)	0.38	0.37	−1.73	10.66
Student level				
Income (log)	5.93	0.81	4.32	8.41
Parents' education	2.75	0.91	1.00	4.00
GPA	5.82	0.59	1.00	7.00
Attendance	93.36	6.24	0.00	100.00
Student graduation	0.98	0.15	0.00	1.00
Student school migration	0.09	0.28	0.00	1.00
Fourth grade math test score	251.19	54.98	101.31	380.55
Fourth grade Spanish test score	262.35	53.29	99.01	382.50
Eighth grade math test score	259.82	48.26	134.61	397.53
Eighth grade Spanish test score	251.28	51.59	107.47	373.24

Source: Authors' tabulation based on MINEDUC (2008–2010); SIMCE (2009–2010); SERVEL (2008).

Table A.2. Balance in Pre-Treatment Outcome and Covariates

	Spanish Test Score (Z)	Math Test Score (Z)	School Failure (%)	GPA	Student Attendance (%)	Student Home Income
Year 2009 x medium intensity	−0.00	−0.00	−0.00	−0.01	0.10	0.62
	(0.01)	(0.01)	(0.00)	(0.01)	(0.08)	(3.81)
Year 2009 x high intensity	−0.02*	−0.02	0.00	−0.01	−0.09	1.28
	(0.01)	(0.01)	(0.00)	(0.01)	(0.16)	(4.19)
Observations	433,236	432,991	483,359	483,355	483,359	473,131
Clusters	7.747	7.752	8.438	8.438	8.438	7.043
Controls	No	No	No	No	No	No
Macroregion F.E.	No	No	No	No	No	No

Source: Authors' tabulation based on MINEDUC (2008–2010); SIMCE (2009–2010).
Note: Coefficients are obtained through a placebo regression of pre-treatment outcomes and covariates on earthquake intensity before the event (2009). Standard errors are clustered at the school level.
*$p < .1$; ** $p < .05$; *** $p < .01$

Table A.3. Short and Long-Term Effect of 2010 Earthquake on Math and Spanish Academic Achievement by Baseline GPA

	All Students		Low GPA		High GPA	
	Math (Z) (1)	Spanish (Z) (2)	Math (Z) (3)	Spanish (Z) (4)	Math (Z) (5)	Spanish (Z) (6)
Panel A. eight months after fourth grade test score						
Year 2010 x medium intensity	−0.04***	−0.00	−0.05***	−0.01	−0.07***	−0.03*
	(0.01)	(0.01)	(0.02)	(0.02)	(0.01)	(0.01)
Year 2010 x high intensity	−0.05***	−0.00	−0.06***	−0.00	−0.08***	−0.04**
	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)
Observations	379,037	377,771	177,108	176,396	201,929	201,375
Clusters	6,772	6,772	6,616	6,613	6,418	6,422
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Panel B. 4.6 years after eighth grade test score						
Year 2014 x medium intensity	−0.01	−0.06***	0.02	−0.03**	−0.04**	−0.08***
	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)
Year 2014 x high intensity	0.02	−0.07***	0.05**	−0.05***	−0.01	−0.09***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Observations	395,267	393,196	179,981	178,949	215,286	214,247
Clusters	8,328	8,334	7,988	7,999	7,563	7,560
Controls	Yes	Yes	Yes	Yes	Yes	Yes

Source: Authors' tabulation based on MINEDUC (2008–2010); SIMCE (2009–2010).
Note: This table presents a similar specifications as table 1 including term τ as in equation (1). Models 1 and 2 include the full sample. In columns 3 to 6, we analyze differential trends by low and high-performing students using baseline GPA (below and above percentile 25 in the same school). Standard errors are clustered at the school level.
* $p < .1$; ** $p < .05$; *** $p < .01$

Table A.4. Earthquake Exposure by Mayor Reelection Status

	Municipalities (N = 345)	
	Coefficient	S.E.
Mean school distance (km) to the epicenter	−0.49	(1.47)
Mean school distance (log) to the epicenter	−0.06	(0.09)
Mean school peak ground acceleration (PGA)	0.00	(0.01)
Mean school high PGA (ref: low)	0.02	(0.04)
Number of people deceased	−0.75	(0.80)
Population with sewer damaged	−354.5	(311.4)
Population with sewer damaged (%)	−0.01	(0.03)

Source: Authors' tabulation based on US Geological Survey (2010); SERVEL (2008).
Note: Each row expresses a different bivariate regression that includes a dummy of reelection and the earthquake exposure indicators in 2010 as outcomes. We restrict the sample only to municipal schools that are directly controlled by local governments. Rows 1 to 4 are estimated at the school level. Rows 5 to 7 are estimated at the municipal level. Standard errors are clustered at the municipal level.
* $p < .1$; ** $p < .05$; *** $p < .01$

Table A.5. Short-Term Effect of 2010 Earthquake on Nonmunicipal Schools by Mayor Reelection

	Fourth grade Math (Z) (1)	Fourth grade Spanish (Z) (2)	Budget School Spending (%) (3)
Medium intensity (not reelected)	−0.06**	−0.01	−0.03
	(0.03)	(0.02)	(0.04)
Medium intensity (reelected)	−0.03	0.00	−0.02
	(0.02)	(0.02)	(0.04)
Difference	0.04	0.02	0.00
	(0.04)	(0.03)	(0.06)
High intensity (not reelected)	−0.03	−0.01	−0.03
	(0.04)	(0.04)	(0.07)
High intensity (reelected)	−0.06*	−0.01	−0.09
	(0.03)	(0.03)	(0.05)
Difference	−0.03	−0.00	−0.06
	(0.05)	(0.05)	(0.09)
Observations	216,933	216,781	91,551
Clusters	265	265	250
Controls	No	No	No
Macroregion F.E.	Yes	Yes	Yes

Source: Authors' tabulation based on SIMCE (2009–2010); MINEDUC (2008–2010); SERVEL (2008).
Note: The table presents the results of our DID model, where we incorporate an interaction term with a dummy variable indicating whether the incumbent mayor was reelected in the previous municipal election (2008). The model includes three parameters: τ, $\tau + \theta$, and θ, as outlined in equation (2). Models restrict the sample to private schools or private-voucher schools. Standard errors are clustered at the municipal level.
* $p < .1$; ** $p < .05$; *** $p < .01$

Table A.6. Short-Term Effect of 2010 Earthquake on Math and Spanish Academic Achievement in Fourth Grade by Mayor Reelection Using Close Electoral Races

	Math (Z) (1)	Math (Z) (2)	Math (Z) (3)	Spanish (Z) (4)	Spanish (Z) (5)	Spanish (Z) (6)
Medium intensity (not reelected)	−0.07	−0.08	−0.08*	−0.03	−0.01	−0.01
	(0.04)	(0.05)	(0.05)	(0.03)	(0.04)	(0.05)
Medium intensity (reelected)	−0.03	0.02	0.03	−0.00	0.02	0.04
	(0.03)	(0.04)	(0.04)	(0.02)	(0.04)	(0.04)
Difference	0.04	0.09	0.11	0.02	0.03	0.04
	(0.05)	(0.06)	(0.07)	(0.04)	(0.06)	(0.06)
High intensity (not reelected)	−0.15**	−0.14**	−0.15**	−0.11**	−0.08	−0.07
	(0.06)	(0.06)	(0.06)	(0.05)	(0.06)	(0.06)
High intensity (reelected)	−0.03	−0.02	−0.02	0.03	0.03	0.02
	(0.03)	(0.04)	(0.05)	(0.02)	(0.04)	(0.04)
Difference	0.12*	0.13*	0.13*	0.15**	0.11*	0.09
	(0.07)	(0.07)	(0.07)	(0.06)	(0.07)	(0.07)
Electoral margin	All	<=25	<=18	All	<=25	<=18
Observations	123,007	82,352	71,371	123,182	82,524	71,523
Clusters	254	192	165	254	192	165
Controls	No	No	No	No	No	No
Macroregion F.E.	Yes	Yes	Yes	Yes	Yes	Yes

Source: Authors' tabulation based on MINEDUC (2008–2010); SIMCE (2009–2010); SERVEL (2008).
Note: The table shows three parameters τ, $\tau + \theta$, and θ, as in equation (2). The model is estimated by weighted ordinary least squares, using a triangular kernel around the margin of victory = 0. Models are restricted to students in municipal schools. Standard errors are clustered at the municipal level.
* $p < .1$; ** $p < .05$; *** $p < .01$

Table A.7. Short and Long-Term Effects of 2010 Earthquake on Math and Spanish Academic Achievement by Mayor's Reelection Status (Nearest Neighbor Matching)

	Short-Term Outcomes Eight Months After		Long-Term Outcomes 4.6 Years After	
	Fourth Grade Math (Z) (1)	Fourth Grade Spanish (Z) (2)	Eighth Grade Math (Z) (3)	Eighth Grade Spanish (Z) (4)
Med intensity (not reelected)	−0.05*	−0.01	0.03	−0.02
	(0.03)	(0.03)	(0.03)	(0.03)
Med intensity (reelected)	−0.02	−0.00	−0.00	−0.07*
	(0.03)	(0.03)	(0.03)	(0.04)
Difference	0.03	0.01	−0.04	−0.05
	(0.04)	(0.04)	(0.05)	(0.05)
High intensity (not reelected)	−0.12**	−0.07*	0.01	−0.08**
	(0.05)	(0.04)	(0.04)	(0.04)
High intensity (reelected)	−0.03	0.03	0.01	−0.10***
	(0.03)	(0.02)	(0.03)	(0.04)
Difference	0.10*	0.10**	0.01	0.02
	(0.06)	(0.05)	(0.05)	−(0.05)
Observations	173,781	174,128	150,964	149,624
Clusters	339	339	338	338
Control	Yes	Yes	Yes	Yes
Macroregion F.E.	Yes	Yes	Yes	Yes

Source: Authors' tabulation based on MINEDUC (2004–2014); SIMCE (2005–2014); SERVEL (2008).
Note: The table presents the results of our DID model, where we incorporate an interaction term with a dummy variable indicating whether the incumbent mayor was reelected in the previous municipal election (2008). The model includes three parameters: τ, $\tau + \theta$, and θ, as outlined in equation (2). The propensity score matching includes the following covariates: individual-student level: female (male), baseline GPA, baseline student mean attendance, baseline grade completion. School level: Income, log income, and average parents' education. Municipal level: voucher school total enrollment, voucher school enrollment share, municipalities total enrollment, fourth grade math SIMCE baseline score, mean municipal income as declared by parents in the schools. Standard errors are clustered at the municipal level.
* $p < .1$; ** $p < .05$; *** $p < .01$

Table A.8. Short and Long-Term Effects of 2010 Earthquake by Mayor's Reelection Status Using an Alternative Measure of Earthquake Intensity

	Short-Term Outcomes Eight Months After		Long-Term Outcomes 4.6 Years After	
	Fourth Grade Math (Z) (1)	Fourth Grade Spanish (Z) (2)	Eighth Grade Math (Z) (3)	Eighth Grade Spanish (Z) (4)
Log intensity (not reelected)	−0.06***	−0.03***	0.03	−0.03*
	(0.02)	(0.01)	(0.02)	(0.02)
Log intensity (reelected)	−0.02	−0.00	−0.02	−0.03
	(0.02)	(0.02)	(0.02)	(0.03)
Difference	0.04*	0.03	0.02	0.00
	(0.02)	(0.02)	(0.03)	(0.03)
Observations	160,394	159,767	166,082	164,951
Clusters	345	345	344	344
Controls	Yes	Yes	Yes	Yes
Macroregion F.E.	Yes	Yes	Yes	Yes

Source: Authors' tabulation based on MINEDUC (2008–2010); SIMCE (2009–2010); SERVEL (2008).
Note: The table presents the results of our DID model, where we incorporate an interaction term with a dummy variable indicating whether the incumbent mayor was reelected in the previous municipal election (2008). The model includes three parameters: τ, $\tau + \theta$, and θ, as outlined in equation (2). As exposure to the earthquake, we use a log continuous measure of exposure based on the Euclidean distance of every school to the epicenter log(max(distances)distances). Models 1 and 3 include as an outcome a standardized version of math test scores; models 2 and 4 use a standardized version of language test scores. The short-term results, displayed in models 1 and 2, focus on fourth-grade student achievement with 2009 as the baseline year; the long-term results, presented in models 3 and 4, concentrate on eighth-grade student achievement with 2009 as the baseline year. The analysis is restricted to students in public municipal schools. Standard errors are clustered at the municipal level.
* $p < .1$; ** $p < .05$; *** $p < .01$

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Racial-Ethnic Heterogeneity in the Relationship Between an Early Elementary School ADHD Diagnosis and Later Child Well-Being

JAYANTI OWENS AND XINYAN CAO

Attention-deficit/hyperactivity disorder (ADHD) is America's most common childhood disorder. Although an ADHD diagnosis can bring positives, recent research uncovers potential negatives associated with diagnosis. This study examines understudied racial-ethnic heterogeneity in the relationships between an early elementary school ADHD diagnosis—with or without medication treatment—and children's future perceived self-competence, teacher-rated school behaviors, and parent-rated educational expectations. Findings are consistent with the notion that diagnosis can trigger racialized patterns of stigma. That is, relative to undiagnosed matches of the same social class and regardless of medication use, diagnosed Black children demonstrate worse teacher-rated school behaviors, diagnosed White children report poorer perceived self-competence, and parents of diagnosed Hispanic children report poorer educational expectations. Racialized patterns of stigma might amplify the consequences of negative-ability stereotyping on Black children, academic pressure on White children, and mental health stigma on Hispanic children. Findings also highlight the challenges of identification posed by differential unobserved selection into diagnosis.

Keywords: education, disability, mental health, medication, stigma

This study examines previously understudied patterns of racial-ethnic variation in the association between a diagnosis of attention-deficit/hyperactivity disorder (ADHD)—with or without accompanying medication treatment—and children's later socioemotional well-being. ADHD is the most common neurodevelopmental disorder of American childhood. ADHD is characterized by difficulty paying attention or controlling impulsive behaviors or both. As of 2016, 2.4 million (9.6 percent) children ages six to eleven and 3.3 million (13.6 percent) American adolescents ages twelve to seventeen were diagnosed with ADHD (Xu et al. 2018). Rates of diagnosis vary across race-ethnicity, from 12.0 percent among White

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children to 12.8 percent of Black children and 6.1 percent of Hispanic children (Xu et al. 2018).

An ADHD diagnosis can be a key disruptive event of childhood. Diagnosis can bring both positives, such as access to medications to help control behavior problems and educational services or accommodations (Molina et al. 2009; Swanson, Baler, and Volkow 2010), and some negatives, such as stigma (Link et al. 2001). Studies show that, when one compares the later test scores and well-being of diagnosed children and their otherwise observably comparable undiagnosed matches, the downsides can outweigh the benefits—even with receipt of medication following diagnosis (Owens 2020a; Owens and Jackson 2017). These negatives are found to be especially salient for diagnosed children who had less severe pre-diagnosis ADHD-related behaviors and for children from high socioeconomic backgrounds (Owens 2020a, 2020b). Yet research has not investigated racial-ethnic heterogeneity in these documented net negative marginal relationships between diagnosis and later child outcomes.[1]

Considering racial-ethnic heterogeneity in the marginal relationship between ADHD diagnosis in early elementary school and later child well-being is important for both substantive and theoretical reasons. Substantively, such heterogeneity could have important implications for inequality since it is unclear whether diagnosis serves as a social and academic support or a further stigma among racial-ethnic minority children, who already face a range of barriers to academic success and socioemotional well-being at school. Theoretically, exploring racial-ethnic variation also provides a valuable case for unpacking a tension in the literature highlighted by Florencia Torche, Jason Fletcher, and Jennie Brand (2024, this issue) for understanding how disruptive events can have heterogeneous effects across different subpopulations. On the one hand, Torche and colleagues point to a large body of social scientific evidence on the compounding effects of cumulative disadvantage for child well-being. Yet, another strand of studies the authors discuss suggests that when "negatively assessed events [are] more normative . . . the stigma associated with them becomes less severe"—thus potentially ameliorating the impacts of these negatively assessed events on later child well-being.

These diverging theories have direct application to the case of racial-ethnic heterogeneity in the marginal relationship between ADHD diagnosis and later child well-being. Much research documents the large negative effects of racial discrimination on the well-being of Black children (Ferguson 2001; Okonofua and Eberhardt 2015; Owens 2022). At the same time, other studies shed light on the resilience of Black children and communities in the face of structural and interpersonal discrimination, partly owing to the normalization of such negatively assessed experiences and thus the lesser stigma associated with them (Burt, Lei, and Simons 2017; Myers and Taylor 1998).

These bodies of research can lead to differing predictions about the marginal relationship between diagnosis and later well-being for Black versus White children, each relative to their undiagnosed counterparts. One possibility is that diagnosis will compound the already negative effects of racial discrimination for Black children. Another is that the diagnosis will ameliorate the negative effects of prior experiences of discrimination among Black children.

To help make sense of these differing predictions, we propose that both theories can be true depending on the outcome (and its rater) of interest. When teachers' negative-ability stereotyping of Black students (Ferguson 2001) is compounded by teachers' diagnostic stigma (Owens 2020a), we predict that teachers will also more negatively rate the behaviors of diagnosed Black children versus diagnosed White children, contributing to cumulative disadvantage. Crucially, medication receipt following diagnosis may not fully offset—and may in

1. By marginal relationships, we refer to the role of the diagnosis rather than that of the pre-diagnosis ADHD-related behaviors and associated factors themselves. We examine the association between diagnosis and later well-being by comparing diagnosed and undiagnosed children who were otherwise comparable on pre-diagnosis ADHD-related behaviors, test scores, and other observed characteristics.

some cases even heighten—the potential negatives associated with diagnosis. Although medication is designed to help control the behaviors of ADHD (Swanson, Baler, and Volkow 2010), it may increase the visibility—and thus the stigma—of the diagnosis, including among teachers.

By contrast, when it comes to children's perceived self-competence, diagnosed Black children (and in some cases, Black parents) may exhibit greater resilience than diagnosed White children, including when receiving medication, given the former's greater likelihood of having previously normalized the experience of being negative labeled, such as through racial stereotyping. We focus on subjective ratings of well-being as a starting point rather than other relevant outcomes such as academic achievement, grade retention, and educational attainment. We suspect that well-being is more proximately related to the psychological processes associated with diagnosis and thus more likely to produce the largest relationships.

Much less is known about relationships between diagnosis and later well-being among Hispanic children in general, and thus between Hispanic versus Black and Hispanic versus White children. However, several studies do find substantial mental health stigma and resistance to the use of ADHD medications on the part of Hispanic families (Cummings et al. 2017; Dosreis et al. 2003; Perry, Hatton, and Kendall 2005). In our study, we include Hispanic children and parents as an important but largely overlooked group in this area of research.

To isolate processes associated with race-ethnicity rather than with family social class given the high correlation between race and class in the United States, we compare diagnosed and undiagnosed matches of the same social class. Research discussed by Torche, Fletcher, and Brand (2024, this issue) highlights social class-based mechanisms that advantage White children—who are on average more socioeconomically advantaged than Black and Hispanic children. By contrast, we focus on the psychological processes that can shape the experiences of ADHD diagnosis for children of a given race-ethnicity across the socioeconomic spectrum. To do so, we use the Early Childhood Longitudinal Study–Kindergarten Cohort of 2010–11 (ECLS-K: 2011). These data include a rich set of pre-diagnosis measures—including lagged outcomes and important child, family, and school context characteristics—which improve matching and limit nonrandom selection on observables.

To explore these potentially heterogeneous relationships requires first contending with the issue of differential selection into diagnosis (and potential medication treatment) on observed and unobserved characteristics. Research emphasizes differential selection into diagnosis by family socioeconomic status and the strictness of school sanctions for poor performance on state-mandated achievement tests—each of which are correlated with race-ethnicity (Fulton, Scheffler, and Hinshaw 2015; King, Jennings, and Fletcher 2014). Black and Hispanic children are respectively 69 percent and 50 percent less likely than White children to be diagnosed even net of differences in family social class, pre-diagnosis behavioral problems, prior academic achievement, family structure, child sex, health insurance coverage or noncoverage, native language, and region (Morgan et al. 2013). Conditional on diagnosis, selection into medication treatment is also nonrandom: Black and Hispanic children are likewise 65 percent and 47 percent respectively less likely to receive medication treatment following diagnosis than White children, net of controls (Morgan et al. 2013). Although a randomized controlled trial would be the ideal method for addressing nonrandom selection into diagnosis and treatment, the experimental gold standard is not feasible in this context (for example, it would be unethical to withhold diagnosis). Yet researchers cannot stop at simply documenting differential selection processes given the important potential implications of diagnosis. We must also examine—albeit descriptively—if and how the benefits and consequences associated with ADHD diagnosis balance out differently by child race-ethnicity.

ASSOCIATIONS BETWEEN ADHD DIAGNOSIS AND FUTURE WELL-BEING

A diagnosis of ADHD can bring potential benefits for children. Diagnosis can connect children to medications that improve attention

and concentration (Swanson, Baler, and Volkow 2010) and to educational accommodations and services (for example, extra time on tests and individualized assignments) that can help improve future academic and social success (Molina et al. 2009). Diagnosis can also offer a medical explanation for children's inattention and hyperactivity that "legitimizes" parents' struggles with their children's behaviors and increases parent-school collaboration (Blum 2015).

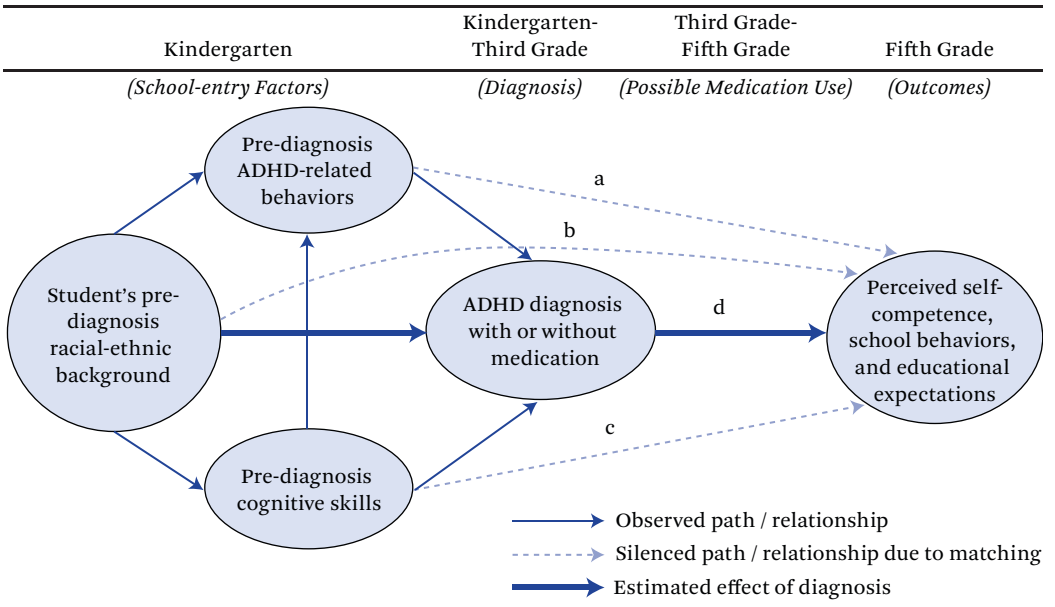
However, an ADHD diagnosis may also be associated with some drawbacks, such as negative stereotyping and labeling (Link et al. 1989), stigma (Goffman 1963), experiences of disgrace (Francis 2012), and lower reading and math scores compared to undiagnosed peers (Owens and Jackson 2017). Diagnosed children may also experience increased scrutiny and lower expectations from teachers compared to undiagnosed peers (Eisenberg and Schneider 2007).

Most research on children with ADHD has compared children with high versus low levels of ADHD-related behavioral problems (path A of figure 1). This work found that children with more severe ADHD-related behavioral problems experience poorer social, educational, and health outcomes (Fletcher 2014; Fletcher and Wolfe 2008). By contrast, only a few studies have begun to describe the association between the ADHD diagnosis itself (path D of figure 1) and children's later socioemotional well-being, net of pre-diagnosis teacher- and parent-reported behavioral problems (path A) and other observed academic and sociodemographic factors (paths B-C) (Owens 2020a; Owens and Jackson 2017). Although these analyses cannot control for all potential differences between diagnosed and potentially medicated children and their undiagnosed counterparts, documenting these associations begins to unpack the broader interrelated social, psychological, and medical factors that can underlie the social meaning of an elementary school ADHD diagnosis.

Potentially Heterogeneous Associations

The potential positive and negative social, psychological, and medical factors associated with a childhood diagnosis of ADHD may balance out differently among children with differing status characteristics. Only one study to date

Figure 1. Framework for Assessing the Relationship between Child Race/Ethnicity, ADHD Diagnosis and Child's Future Socioemotional Well-Being



Source: ECLS-K: 2010–2011 (Tourangeau et al. 2019).

examines such variation in the relationship between an ADHD diagnosis and children's later well-being, in that case based on family socioeconomic status (SES) (Owens 2020b). That study compares diagnosed children and their otherwise comparable undiagnosed counterparts who had the same pre-diagnostic behavioral problems and other observed academic and demographic characteristics. The author descriptively finds that, relative to undiagnosed matches, "diagnosed and medicated" upper- and middle-SES children exhibit significantly poorer perceived self-competence, by 0.41 points (0.53 standard deviations, or SD) and 0.22 points (0.28 SD), respectively. Relative to their undiagnosed matches, diagnosed and medicated upper- and middle-SES children are also rated worse on teacher-rated positive learning behaviors by 0.31 to 0.46 points (0.43 to 0.67 SD) and on negative externalizing problems, by roughly 0.18 points (0.31 SD) each. But diagnosed and medicated low-SES children do not show significant differences relative to their undiagnosed matches. Although these estimates are for diagnosed and medicated children of a given social class, patterns are generally similar among same-SES diagnosed and unmedicated children. Crucially, Owens (2020b) focuses on the relationship between social class privilege and children's well-being but does not examine variation along other important social-demographic factors, such as race-ethnicity.

In the present study, we use the same analytic technique as Owens (2020b) but examine racial-ethnic variation in the relationships between ADHD diagnosis, with or without subsequent medication use, and later child well-being—net of differences in family social class. We hypothesize that these relationships may vary between diagnosed and undiagnosed children of the same social class based on both child race-ethnicity and the outcome (and its rater) of interest.

Within schools, qualitative research finds that an ADHD diagnosis among Black children is likely to be seen as a sign of intellectual deficiency and negative ability (Harry and Klingner 2007). Consistent with the theory of cumulative disadvantage, this negative perception may be compounded by the reality that, in many schools, administrators and teachers are less culturally responsive to the instructional needs of Black students (Ferguson 2001; Owens 2022; Shedd 2015). Many even hold explicit and implicit racial biases toward Black and Hispanic students (Starck et al. 2020; Welch et al. 2011). By contrast, among White students, a diagnosis is more likely to be viewed as signaling an unmet need—a call for additional support in order for the child to reach their full potential (Blanchett 2010; Blum 2015). As a result, regardless of medication receipt, diagnosed Black students may be even more likely to be defined as low achievers with inherently limited school potential, whereas diagnosed White students may be more likely to be seen as having greater school potential despite low school achievement (Blum 2015). Thus:

> Hypothesis 1: Regardless of medication receipt, teachers will rate the behaviors of diagnosed Black children more negatively than those of diagnosed White children, each relative to their otherwise similar undiagnosed counterparts of the same social class.

By contrast, for children's self-perceptions, the normativity of being negatively assessed (such as from teachers' race-based negative ability stereotyping) may increase Black children's resilience and reduce any stigma associated with their diagnosis relative to White children (Owens 2022; Rios 2017; Starck et al. 2020). White children, on the other hand, are less likely to have previously experienced negative-ability stereotyping but are more likely to have experienced academic pressure from young ages (Hinshaw and Scheffler 2014; King, Jennings, and Fletcher 2014; Russell 2011). As a result, White children may be more likely to internalize expectations for high achievement to come "effortlessly" (Mueller and Abrutyn 2016). In this context, an ADHD diagnosis, even with medication treatment, may be perceived by White children as a sign of having failed to meet these high academic expectations, thus leading to lower perceived self-competence. In addition, diagnosed and medicated White children are more likely to concurrently use at least two classes of psychotropic medications

(Comer, Olfson, and Mojtabai 2010). Polypharmacy may also potentially increase negative side effects and lower self-image as compared to diagnosed and medicated minority children (Bussing and Winterstein 2012). Taken together:

> Hypothesis 2: With or without medication treatment following diagnosis, diagnosed White children will experience lower perceived self-competence than diagnosed Black children, each relative to their otherwise comparable undiagnosed counterparts of the same social class.

Parents' educational expectations for their children may also vary across racial-ethnic groups, reflecting differing social meanings underlying ADHD diagnosis. For Black parents, studies suggest that diagnosis can be seen as reflecting the school's beliefs about their child as having a fundamental behavioral or intellectual deficiency and thus using the diagnosis to "displace" their child from school learning opportunities (Blum 2015; Harry and Klingner 2007). As a result, Black parents may experience skepticism toward—and resist—the diagnosis by maintaining equally high expectations of their diagnosed child. Alternatively, Black parents may view the diagnosis as reflecting the added barriers their child will face at school and thus lower their academic expectations for their child in turn. For Hispanic parents, similar competing processes may be at play, but the greater average presence of stigma toward mental health diagnoses and treatment within Hispanic immigrant communities may further lower Hispanic parents' educational expectations relative to Black parents (Cummings et al. 2017; Dosreis et al. 2003; Ji et al. 2018). On the other hand, given the greater average academic pressure from young ages within White communities, White parents may be more likely to view diagnosis and medication treatment as a route for their child to gain additional academic supports (Hinshaw and Scheffler 2014; King, Jennings, and Fletcher 2014; Schwarz 2017). Thus:

> Hypothesis 3a: Hispanic parents will report lower educational expectations for diagnosed children relative to their undiagnosed matches of the same social class, regardless of medication receipt following diagnosis.
>
> Hypothesis 3b: Regardless of medication receipt, Hispanic parents' educational expectations for their diagnosed children will be lower than White and Black parents' expectations for their diagnosed children; Black parents will report either comparable or lower expectations as White parents, also regardless of medication.

DATA AND METHODS

To explore racial-ethnic heterogeneity in the patterns of association between ADHD diagnosis and future child well-being, we use the restricted-use ECLS-K:2011, an initially nationally representative sample of kindergarteners in 2010 followed through fifth grade. Our longitudinal sample includes the 8,700 children who remained in the study through fifth grade, were not missing data on the outcomes, diagnosis, or race-ethnicity, and were either diagnosed ($N = 820$) or plausible undiagnosed matches who had comparable early ADHD-related behavioral problems despite not being diagnosed ($N = 7{,}880$). Sample restrictions, sample trimming, and attrition are detailed in the online appendix; cell sizes are rounded to the nearest 10 per the restricted-use data agreement.[2]

These data offer several substantial strengths for examining the role of ADHD diagnosis (path D of figure 1)—defined as the average difference in the outcomes of diagnosed and otherwise comparable undiagnosed children who had the same propensities to be diagnosed. First, given the dramatic rise in diagnosed ADHD prevalence in recent decades, these data offer the most updated estimates of social class differences in the marginal effects of ADHD diagnosis on future well-being among U.S. children. Second, given that ADHD diagnoses require functional impairment from inattention or hyperactivity-impulsivity in at least two set-

2. See online appendix (https://www.rsfjournal.org/content/10/1/205/tab-supplemental).

tings (American Psychiatric Association 2013), both teachers and parents rate children's behaviors. Moreover, ratings occur in children's naturalistic settings (school and home), independent of diagnostic evaluation and less subject to reporting bias than might be the case if these ratings were collected when parents or teachers were making the case for or against the child's needing diagnosis.

Third, these reports capture the core behaviors of ADHD—inattention and hyperactivity-impulsivity—as well as conduct or oppositional defiance disorder and depression, ADHD's two most common comorbid conditions (Hinshaw and Scheffler 2014). Although imperfect, items resemble those used in ADHD screeners such as the Connor's, SNAP-IV, and DSM-IV (Currie and Stabile 2006; Swanson, Baler, and Volkow 2010). Fourth, these ratings are provided for all sample children, including the roughly 91 percent of children with developmentally normal behaviors who are never diagnosed with ADHD, thus providing a wide range of suitable undiagnosed "matches." Table A.1 presents counts of children by race-ethnicity and diagnosis and medication treatment status. Finally, behavior ratings are collected in the wave before diagnosis, offering an advantage to measuring pre-diagnosis behaviors in a static period. Because behavior problems typically decrease with age, exclusively measuring behaviors in kindergarten would understate behavior problems for children whose problems worsen after school entry and before diagnosis. Conversely, drawing exclusively on third grade measures (the end of the diagnosis observation period) could introduce reverse causality if diagnosis prompts behavior change.

We use multiple imputation of twenty datasets to address item-missingness on matching variables for the implicated 17 percent (N = 1,740/9,990) of the longitudinal sample (Rubin 2004). Item-missingness is more common among children who are Black, uninsured, have low baseline academic achievement, have high baseline behavioral problems, or come from low-SES, single-mother families. ADHD diagnosis and the outcomes are included in the imputation equation but children originally missing on these measures are excluded from all analyses (following Von Hippel 2007).

Analytic Strategy: Doubly Robust Matching for Sample Balance

To contend with the fact that neither diagnosis nor subsequent medication receipt are randomly assigned, matching techniques are used to help address key observed confounders that may influence both diagnosis-medication treatment and the outcomes. In addition to race-ethnicity (Morgan et al. 2013), potential confounders include differences in diagnosed and undiagnosed children's social class; insurance coverage status; pre-diagnosis ADHD-related behaviors; baseline academic achievement; sex; age-for-grade, whether they are older or younger than their classmates (Layton et al. 2018); internalizing behavior problem score, because internalizing is a common comorbidity of ADHD; parents' concerted cultivation child-rearing styles; kindergarten classroom type; average peer classroom behavior, which might shape reference group effects; the presence of strict state-mandated consequential educational accountability, given that strict accountability standards create pressure for ADHD diagnosis (Bokhari and Schneider 2011; King, Jennings, and Fletcher 2014); and region of residence, given well-established regional differences in ADHD diagnostic prevalence (Hinshaw and Scheffler 2014). If unobserved, differences along these child, family, classroom-school, and state-region factors may influence both diagnosis and the outcomes and yield biased estimates of the marginal effect of diagnosis, both with or without subsequent medication receipt.

To address some of these potential observable confounders, standard multiple regression techniques would introduce controls to adjust for consequential observable differences between diagnosed and undiagnosed children. However, standard controls within ordinary least squares (OLS) regressions may not be adequate if overlap, or balance, is insufficient in the distributions of characteristics between diagnosed and undiagnosed children (Imbens and Rubin 2015). Thus researchers have turned to matching techniques to help achieve sample

balance on key observed variables for which OLS models may yield estimates that lack sample support or balance (Gangl 2010).

This study uses two types of matching to obtain estimates that are "doubly robust" to confounding between diagnosed and undiagnosed children on observed variables: coarsened exact matching (CEM) and propensity score matching (PSM) (Stuart et al. 2009). First, we use the CEM package in Stata 14 to pre-process the data and ensure that diagnosed and undiagnosed children are "exact matches" on three theoretically motivated characteristics on which differences in diagnosis and future well-being are well established: race-ethnicity (three groups); quartile of pre-diagnosis behavioral problems based on parent- and teacher-rated subscales for inattentive or hyperactive-impulsive behavioral type (sixteen groups); and child sex (two groups).

Temporarily "coarsening" the continuous variables for social class and pre-diagnosis ADHD-related behaviors into the categories means that matching occurs within the ninety-six groups (3x16x2 = 96). Figure A.1 highlights substantial overlap in the pre-diagnosis ADHD-related behaviors distributions of both diagnosed and undiagnosed children. With 9.4 percent of sample children ages four through ten diagnosed with ADHD, 90.5 percent of children are not diagnosed, offering many potential undiagnosed matches who nonetheless had the same propensity to be diagnosed. Both groups' pre-diagnosis behavioral ratings span the full range from never to almost always. All 820 diagnosed children are successfully matched to otherwise comparable undiagnosed children. By contrast, three hundred undiagnosed children (3.3 percent) are implausible matches because their ADHD behaviors fall below those of diagnosed children. They are trimmed to improve sample balance and efficiency and reduce bias (Iacus, King, and Porro 2011).

Nonetheless, CEM is limited by the number of exact matching dimensions it can accommodate. Even after CEM, additional differences are observable between diagnosed and undiagnosed children within coarsened groups (Imbens and Rubin 2015). Thus, as detailed in the appendix, PSM is used after CEM to help address additional possible confounding by achieving balance between diagnosed and undiagnosed children on thirty-four child, family, classroom, and state or region variables included in the PSM equation: all seven behavioral measures and the twenty-seven other variables detailed in table 1. The doubly robust combination of CEM followed by PSM does not remove the risk of selection on unobserved variables and measurement error.

Models

To examine racially and ethnically heterogeneous associations between an early elementary school ADHD diagnosis and future child well-being, we match diagnosed children with their undiagnosed counterparts who are otherwise comparable on observed characteristics within racial-ethnic group. To investigate whether medication treatment status following diagnosis further internally moderates these associations, we additionally match diagnosed and undiagnosed children within racial-ethnic group based on whether they received medication treatment following diagnosis. Balance statistics are presented in table A.2. Sample stratification by child race-ethnicity occurs after CEM but before PSM (Stuart et al. 2009).

Key Measures

Table 1 provides summary statistics for all variables used in the analyses: *child perceived self-competence, teacher-rated school behaviors, and parent-rated educational expectations from fifth grade ("outcomes").* Teacher-rated frequency of "positive approaches to learning," or attentiveness, task persistence, eagerness to learn, learning independence, flexibility, and organization is a subscale from the social rating scale (Tourangeau et al. 2019). Child-reported self-competence is from the following (reverse-coded) self-description questionnaire items: worry about doing well in school, finishing homework, and taking tests; struggle to finish schoolwork; and feeling ashamed about mistakes at school. Both teacher and child ratings were reported from 0 = rarely to 3 = always. Ratings were averaged across items to construct the final scales. Parent-rated educational expectations come from an item asking parents about how far they expect their child to go in school, with responses ranging from 0 = less

than high school, 1 = high school diploma, 2 = attend two-year college, 3 = complete two-year college, 4 = bachelor's degree, 5 = master's degree or equivalent, 6 = PhD, MD, JD, Other advanced degree.

ADHD diagnosis between kindergarten-third grade (primary predictor) was identified when the parent answered yes to all three of these questions in a given wave: (1) Has the child been evaluated by a professional in response to a problem in paying attention, learning, behaving, or in activity level? (2) Has the child received a diagnosis by this professional? (3) Was the diagnosis for ADHD, ADD, or hyperactivity? (see Morgan et al. 2013; Tourangeau et al. 2019). Children whose parents answered no to any item were coded as "not diagnosed with ADHD." Diagnosis was confirmed using parent report of "year of first [ADD/ADHD] diagnosis." Children first diagnosed with ADHD after third grade were coded as undiagnosed.

Medication treatment receipt between third and fifth grades (moderator) comes from parent report of whether the child was taking medication to control their behavior in third or fifth grade. In fifth grade, 90 percent of children receiving medication were taking one of three ADHD medications, based on parent report: Ritalin, Adderall, or Concerta.

Child race-ethnicity from kindergarten (predictor-moderator) comes from the primary caregiver's report of the child's race-ethnicity: Black, not Hispanic; Hispanic; White, not Hispanic; Asian, not Hispanic; Native Hawaiian or Other Pacific Islander, not Hispanic; American Indian or Alaska Native, not Hispanic; or Two or More Races. Dummy variables were constructed for Black, Hispanic, White, and Other, and Other was dropped prior to analyses given the theoretical focus of this study.

Pre-diagnosis ADHD-related behavioral problems from first grade or wave prior to diagnosis (behavior problems or ADHD behaviors; predictors). Teacher and parent behavioral ratings are taken as shortly before diagnosis as possible, usually earlier in the same school year or the previous spring to help guard against inappropriate matches resulting from possible increases in behavior problems after school entry and before diagnosis. Undiagnosed children's behavior problems came from first grade, nearly the midpoint of the kindergarten through third grade diagnostic observation period, given that behavior problems among typically developing children decrease with age. Nevertheless, estimates change by less than 10 percent when all behaviors are measured in kindergarten. ADHD-specific items were separated from the externalizing problems and positive approaches to learning scales of the psychometrically validated social rating scale (following Owens 2020b), but sensitivity analyses using the complete externalizing behaviors and approaches to learning scales yielded virtually identical results (Tourangeau et al. 2019). The inattentive subscale included two items measuring attention and concentration skills, which were reverse coded so that higher values reflected more problems. The hyperactive subscale included two items on impulsiveness (acts without thinking) and restlessness (overly active, cannot sit still). Subscales averaged across their items and ranged from 0 = rarely to 3 = always (–1 to 2 after sample mean centering).

Commonly co-occurring pre-diagnosis behavioral problems from first grade or wave prior to diagnosis (predictors). The oppositional defiant disorder (ODD) subscale involves separate teacher and parent reports of seven behaviors: arguing, fighting, getting angry, throwing tantrums, ease in joining in play (reverse-coded), ability to make and keep friends (reverse-coded), and positive interactions with peers (reverse-coded). The internalizing problems scale includes eight items measuring sadness, loneliness, and anxiety (for details, see Tourangeau et al. 2019). Timing of measurement and item ranges are the same with those for ADHD-related behavioral problems.

Other predictors in PSM equation from kindergarten. To help ensure that diagnosed and undiagnosed children are as comparable as possible on observed characteristics, thirty-four key child, family, classroom, and school state-region context covariates from table 1 are included in the PSM. These include pre-diagnosis academic achievement, family social class (a composite, standardized scale of female and male guardians' educational attainment, household income, and occupational prestige; the bottom quartile representing lower-SES,

the middle two quartiles middle-SES, and the top quartile upper-SES [per Tourangeau et al. 2019]), average classroom behavior (teacher-rated, from 0 = extremely poorly behaved to 4 = extremely well behaved), whether the child's school is in a state with strict consequential accountability standards using the dummy variable from King, Jennings, and Fletcher (2014), and the child's region of residence.

RESULTS

The primary goals of this analysis are to examine any racial-ethnic heterogeneity in the patterns of association between an early elementary school ADHD diagnosis and children's fifth-grade perceived self-competence, teacher-reported school behaviors, and parent education expectations; and to explore the role of medication treatment receipt following diagnosis in further moderating any of these racial-ethnic differences in the associations between diagnosis and later well-being.

Descriptive Differences by Child Race-Ethnicity

To understand racial-ethnic differences in the relationships between an ADHD diagnosis and later child well-being in the ECLS-K: 2010–11 sample, table 1 presents descriptive statistics for all variables used in the analysis by child race-ethnicity. Consistent with prior research (Owens and McLanahan 2020), both Hispanic children and, in particular, Black children have significantly poorer outcomes on average than White children on three of the four fifth-grade outcomes of interest—two teacher-rated school behaviors and child-rated perceived self-competence (two-tailed tests). Specifically, Black and Hispanic children exhibit significantly lower positive approaches to learning scores in the fifth grade than their White counterparts. Black children exhibit significantly higher negative externalizing behavioral problems than both their White and Hispanic counterparts. Likewise, both Black and Hispanic children on average report significantly lower self-competence than their White peers. By contrast, both Black and Hispanic parents hold significantly higher educational expectations for their children on average than do White parents, with Hispanic parents holding even higher expectations than Black parents.

Consistent with previously documented prevalence rates (Xu et al. 2018), rates of ADHD diagnosis between kindergarten and third grade are highest among Black children (14 percent) followed by White children (11 percent). Hispanic children are significantly less likely to receive an ADHD diagnosis (6 percent) than either Black or White children. Similarly, absolute rates of medication receipt following diagnosis are highest among Black children (8 percent) and White children (7 percent), and lowest among Hispanic children (3 percent). However, when it comes to proportions receiving medication of those diagnosed, Whites have the highest rates of medication use (63 percent of those diagnosed), followed by Blacks (57 percent of those diagnosed), and then Hispanics (50 percent of those diagnosed).

Racial-Ethnic Variation in the Associations Between an Early Elementary School ADHD Diagnosis and Later Child Well-Being

To test for racial-ethnic variation in the patterns of association between an early elementary school ADHD diagnosis and later child well-being, table 2 presents estimates of differences in the future outcomes between diagnosed children and their undiagnosed counterparts of the same racial-ethnic group who had comparable propensities for diagnosis but were not diagnosed. Estimates are irrespective of medication use. On teacher-rated school behaviors, results are partially consistent with hypothesis 1. An ADHD diagnosis is associated with significantly poorer later teacher-rated positive approaches to learning in fifth grade among both Black and White children (models 1 and 3). The magnitude of the relationship, however, is 62 percent smaller among White children than among Black children. Diagnosed Black children are rated 0.29 points (0.29/0.79 = 0.37 SD) significantly lower on positive learning-related behaviors than their undiagnosed matches (model 1), whereas diagnosed White children are rated a significant 0.11 points lower (0.11/0.76 = 0.14 SD, model 3). Moreover, consistent with hypothesis 1, White children do not differ significantly on negative externalizing problems from their same-race

(*text continues on p. 219*)

Table 1. Descriptive Statistics for All Variables Used in the Analyses, by Race-Ethnicity (*N* = 8,700)

	Black (*N* = 950)		Hispanic (*N* = 2,820)		White (*N* = 4,930)		Overall	
	Mean	SD	Mean	SD	Mean	SD	Min	Max
Outcomes (fifth grade)								
Positive approaches to learning behaviors score (teacher report)	1.79[a, d]	0.79	2.07[b, d]	0.78	2.19[a, b]	0.76	0	3
Negative externalizing behavior problems score (teacher report)	0.87[a, d]	0.77	0.47[d]	0.65	0.50[a]	0.64	0	3
Perceived self-competence score (child report)	1.60[a]	0.81	1.58[b]	0.77	1.80[a, b]	0.75	0	3
Parent educational expectations for child (parent report)	4.07[a, d]	1.38	4.32[b, d]	1.31	3.90[a, b]	1.14	0	6
ADHD diagnosis (K–third grades) and medication treatment status (third-fifth grades)								
Diagnosed with ADHD	0.14[d]		0.06[b, d]		0.11[b]		0	1
Diagnosed with ADHD and receiving medication following diagnosis	0.08[d]		0.03[b, d]		0.07[b]		0	1
Pre-diagnosis ADHD-related and co-occurring behaviors (from wave prior to diagnosis or first grade for undiagnosed)								
Inattentive behaviors score (teacher report)	0.23[a, d]	0.92	0.05[b, d]	0.93	−0.03[a, b]	0.91	−1	2
Hyperactivity behaviors score (teacher report)	0.24[a, d]	0.76	−0.05[b, d]	0.68	0.00[a, b]	0.70	−1	2
ODD or CD behaviors score (teacher report)	0.20[a, d]	0.71	0.02[b, d]	0.71	−0.04[a, b]	0.71	−1	2
Internalizing problems score (teacher report)	0.10[a, d]	0.65	0.00[d]	0.61	0.00[a]	0.61	−1	2
Inattentive behaviors score (parent report)	0.12[a]	0.88	0.08[b]	0.83	−0.07[a, b]	0.78	−1	2
Hyperactivity behaviors score (parent report)	0.16[a, d]	0.77	−0.04[d]	0.74	0.00[a]	0.66	−1	2
ODD or CD behaviors score (parent report)	0.08[a]	0.61	0.10[b]	0.57	−0.07[a, b]	0.51	−1	2

(*continued*)

Table 1. (*continued*)

	Black (*N* = 950)		Hispanic (*N* = 2,820)		White (*N* = 4,930)		Overall	
	Mean	SD	Mean	SD	Mean	SD	Min	Max
Early cognitive development (kindergarten)								
Average reading achievement scores (standardized)	−0.15[a, d]	0.89	−0.31[b, d]	0.87	0.17[a, b]	0.97	−3	10
Average math achievement scores (standardized)	−0.36[a]	0.83	−0.39[b]	0.89	0.28[a, b]	0.99	−3	8
Early school context (kindergarten)								
Average behavior of students in kindergarten class (teacher report)	2.26	0.84	2.26[b]	0.82	2.34[b]	0.82	0	4
Child received any special education services in kindergarten	0.09[d]		0.06[b, d]		0.09[b]		0	1
School in state with consequential educational accountability standards	0.67[a, d]	0.47	0.77[b, d]	0.42	0.54[a, b, c]	0.50	−1	2
Early concerted cultivation at home, parent educational expectations, and parental involvement in education-schooling (kindergarten)								
Child age (months) at kindergarten entry	65.48[a]	5.25	65.62[b]	4.50	66.80[a, b]	4.38	34	87
Parental participation in educational institutions	3.73[a]	1.52	3.72[b]	1.50	4.45[a, b, c]	1.27	0	7
Child activities and leisure time	3.03[a, d]	1.79	2.55[b, d]	1.79	3.24[a, b]	1.82	0	10
Parent perceptions of responsibilities toward child cognitive and social development	17.04[a, d]	4.42	16.06[b, d]	4.58	17.68[a, b]	3.94	0	27
Number of books at home	54.60[a]	62.47	55.76[b]	89.09	113.45[a, b, c]	114.8	0	1,000
Parent educational expectations for child	<0.01	0.42	0.02[b]	0.36	−0.02[b]	0.44	−2	0
Family demographic and other child characteristics (kindergarten)								
Male	0.54		0.51		0.52		0	1
Lower-class family	0.35[a, d]		0.51[b, d]		0.10[a, b, c]		0	1
Middle-class family	0.52[d]		0.40[b, d]		0.56[b]		0	1
Upper-class family	0.13[a, d]		0.09[b, d]		0.34[a, b, c]		0	1
Child not covered by insurance	0.03[d]		0.10[b, d]		0.03[b]		0	1

Child been in childcare outside home	0.25[d]		0.17[b, d]		0.26[b]		0	1
Number of other children in household	1.57[d]	1.22	1.73[b, d]	1.17	1.51[b]	1.04	0	13
Child born weighing less than 5.5 lbs. (low birthweight)	0.13[d]		0.08[d]		0.08		0	1
Age of social mother	32.99[a]	7.75	33.07[b]	6.70	35.47[a, b]	6.36	18	77
Mother has CES-D score >9 (clinically depressive symptoms)	0.21[a, d]		0.16[b, d]		0.13[a, b]		0	1
Single-parent household	0.52[a, d]		0.24[b, d]		0.13[a, b, c]		0	1
Social father present in household	0.05		0.06		0.06		−1	1
Other family type in household	0.05[a, d]		0.02[d]		0.01[a]		−1	1
Two biological parents in household	0.38[a, d]		0.71[b, d]		0.81[a, b, c]		0	1
Lives in Midwest	0.24[d]		0.10[b, d]		0.29[b, c]		0	1
Lives in West	0.05[a, d]		0.40[b, d]		0.18[a, b, c]		0	1
Lives in Northeast	0.18[d]		0.11[b, d]		0.18[b]		0	1
Lives in South	0.51[a, d]		0.38[d]		0.34[a]		0	1

Source: ECLS-K: 2010–2011 (Tourangeau et al. 2019).
Note: Children who were eligible for sampling and present at all waves used in the analyses, who had complete information on ADD or ADHD diagnosis, race-ethnicity, and the outcome measures, and whose composite pre-diagnosis ADHD-related behaviors score did not fall below that of the diagnosed child with the least severe pre-diagnosis ADHD-related behaviors composite score or above that of the diagnosed child with the most severe pre-diagnosis ADHD-related behaviors composite score. Multiple imputation was used to produce twenty datasets to address item-missingness on variables other than the outcomes and ADHD diagnosis. ADHD = attention deficit/hyperactivity disorder; CD = compulsive disorder; ODD = oppositional defiant disorder; SD = standard deviation.
[a] Statistically significant difference between Blacks and Whites, $p < .05$ (two-tailed test).
[b] Statistically significant difference between Hispanics and Whites, $p < .05$ (two-tailed test).
[c] Statistically significant difference between Others and Whites, $p < .05$ (two-tailed test).
[d] Statistically significant difference between Blacks and Hispanics, $p < .05$ (two-tailed test).
* $p < .05$; ** $p < .01$; *** $p < .001$

Table 2. Relationships Between an Early Elementary School ADHD Diagnosis and Future Teacher-Rated Social and Academic Behaviors, Child Perceived Self-Competence, and Parent Educational Expectations in Fifth Grade, By Child Race-Ethnicity (*N* = 8,700)

	Positive Approaches to Learning (Teacher Report)			Externalizing Behavior Problems (Teacher Report)			Perceived Self-Competence (Child Report)			Parent Educational Expectations for Child (Parent Report)		
	(1) Black (*N* = 950)	(2) Hispanic (*N* = 2,820)	(3) White (*N* = 4,930)	(4) Black (*N* = 950)	(5) Hispanic (*N* = 2,820)	(6) White (*N* = 4,930)	(7) Black (*N* = 950)	(8) Hispanic (*N* = 2,820)	(9) White (*N* = 4,930)	(10) Black (*N* = 950)	(11) Hispanic (*N* = 2,820)	(12) White (*N* = 4,930)
Diagnosed with ADHD	−0.29**	−0.10	−0.11**	0.23*[a]	0.01	0.02[a]	0.09[a]	0.10[c]	−0.22***[a,c]	−0.07	−0.32***[c]	−0.07[c]
	(0.09)	(0.07)	(0.04)	(0.09)	(0.07)	(0.05)	(0.08)	(0.07)	(0.03)	(0.16)	(0.07)	(0.09)

Source: ECLS-K: 2010–2011 (Tourangeau et al. 2019).

Note: See table 1 for details. Displaying propensity score matching estimates with coarsened exact matching on (1) race-ethnicity (3 groups), (2) severity of pre-diagnosis behavioral problems (in quartiles) of the parent- and teacher-rated subscales for inattentive and hyperactive behavioral types (sixteen groups) and (3) child sex (two groups). Standard errors in parentheses. Propensity scores generated from pre-diagnosis or kindergarten child, family, and school characteristics shown in table 1. Models estimates examine the role of ADHD diagnosis without consideration of medication use or non-use following diagnosis (in all cases compared to undiagnosed children).

[a] Statistically significant difference between Black and White at $p < .05$ (two-tailed test).

[b] Statistically significant difference between Black and Hispanic at $p < .05$ (two-tailed test).

[c] Statistically significant difference between Hispanic and White at $p < .05$ (two-tailed test).

* $p < .05$; ** $p < .01$; *** $p < .001$

undiagnosed matches (model 6) in fifth grade, whereas Black children are rated 0.23 points (0.23/0.65 = 0.35 SD) significantly worse than their undiagnosed matches (model 4). Diagnosed Hispanic children do not score significantly differently from their undiagnosed matches on either positive approaches to learning (model 2) or negative externalizing problems (model 5).

When it comes to child perceived self-competence, results are consistent with hypothesis 2. Estimates shown in models 7 through 9 of table 2 reveal that an early elementary ADHD diagnosis is correlated with significantly lower perceived self-competence in fifth grade, but only among White children. White children exhibit 0.22 points (0.22/0.75 = 0.29 SD) significantly lower perceived self-competence than their undiagnosed matches (model 9). As predicted, this 0.22 points is significantly lower than that among diagnosed Black children. Neither diagnosed Black nor diagnosed Hispanic children score significantly differently from their undiagnosed matches (models 7 and 8).

Finally, in terms of parent educational expectations, results are consistent with hypothesis 3a. Estimates shown in models 10 through 12 reveal that an ADHD diagnosis is associated with significantly lower education expectations, but only for Hispanic children. Hispanic parents report 0.32 points (0.32/1.31 = 0.24 SD) statistically significantly lower education expectations for diagnosed children than Hispanic parents of undiagnosed children do (model 11). Also consistent with hypothesis 3b, Hispanic parents report significantly lower educational expectations for their children than White parents do of their children (–0.32 points versus –0.07 points). Findings are also directionally consistent with lower expectations among Hispanic than Black parents (also –0.32 points versus –0.07 points), but the difference does not reach statistical significance due to the larger standard error around the estimate for Black parents.

Altogether, results in table 2 reveal that the relationships between an early ADHD diagnosis and later well-being differ based on both child race-ethnicity and the outcome-rater under consideration. Consistent with literature suggesting that behavioral diagnoses may function as mechanisms of social control that further marginalize Black children at school (Blanchett 2010; Harry and Klingner 2007), teachers evaluate diagnosed Black children's behaviors more poorly than they do either diagnosed White or diagnosed Hispanic children. By contrast, only diagnosed White children report lower perceived self-competence relative to their undiagnosed matches, perhaps because they are least likely to have previously experienced negative labeling. Finally, on parent education expectations, Hispanic parents report lowered expectations for diagnosed children, perhaps owing to greater mental health stigma in Hispanic communities (Perry, Hatton, and Kendall 2005). We return to this point in the discussion.

Differing Associations Between an ADHD Diagnosis and Later Well-Being, by Child Race-Ethnicity and Medication Treatment Status Following Diagnosis

Table 3 further distinguishes between children who did versus did not receive medication following diagnosis, relative to undiagnosed matches. Consistent with hypothesis 1, diagnosis with medication is associated with significantly lower teacher- and parent-rated outcomes among Black children. Relative to undiagnosed matches, diagnosed and medicated Black children appear 0.20 points (0.25 SD) lower on positive learning behaviors, 0.18 points (0.23 SD) higher on externalizing problems, and 0.21 points (0.15 SD) lower on parent education expectations (models 1, 4, and 10). Diagnosed and unmedicated Black children are also rated 0.44 points (0.56 SD) lower than undiagnosed matches on positive learning behaviors and 0.32 points (0.42 SD) higher on externalizing problems than undiagnosed matches (model 1 and 4). Although teachers likewise rate diagnosed and unmedicated White children significantly worse than undiagnosed matches on positive learning behaviors (by 0.14 points, or 0.18 SD, per model 3) and on negative externalizing problems (by 0.12 points, or 0.19 SD, per model 6), these estimates are 68 percent and 63 percent smaller than those for diagnosed and unmedicated Black children. The difference between diagnosed and unmedi-

Table 3. Average Relationships Between an ADHD Diagnosis and Future Teacher-Rated Social and Academic Behaviors, Child Perceived Self-Competence, and Parent Educational Expectations in Fifth Grade, by Child Race-Ethnicity and Medication Treatment Status Following Diagnosis (N = 8,700)

	Positive Approaches to Learning (Teacher Report)			Externalizing Behavior Problems (Teacher Report)			Perceived Self-Competence (Child Report)			Parent Educational Expectations for Child (Parent Report)		
	(1) Black (N = 950)	(2) Hispanic (N = 2,820)	(3) White (N = 4,930)	(4) Black (N = 950)	(5) Hispanic (N = 2,820)	(6) White (N = 4,930)	(7) Black (N = 950)	(8) Hispanic (N = 2,820)	(9) White (N = 4,930)	(10) Black (N = 950)	(11) Hispanic (N = 2,820)	(12) White (N = 4,930)
Diagnosed with ADHD, receiving medication	−0.20*	−0.13	−0.08	0.18*	0.04	0.02	0.15[a]	0.07[c]	−0.25***[a,c]	−0.21*[,†]	−0.45**	−0.20**[†]
	(0.09)	(0.08)	(0.05)	(0.09)	(0.09)	(0.05)	(0.12)	(0.04)	(0.04)	(0.10)	(0.15)	(0.06)
Diagnosed with ADHD, not receiving medication	−0.44***[a,b]	−0.02[b]	−0.14**[a]	0.32**[b]	−0.06[b]	0.12*	−0.04	0.10[c]	−0.14*[c]	0.27*[b,†]	−0.30**[b,c]	0.06[c,†]
	(0.09)	(0.07)	(0.05)	(0.11)	(0.08)	(0.05)	(0.12)	(0.09)	(0.06)	(0.11)	(0.11)	(0.08)

Source: ECLS-K: 2010–2011 (Tourangeau et al. 2019).

Note: Displaying propensity score matching estimates with coarsened exact matching on (1) race-ethnicity (3 groups), (2) severity of pre-diagnosis behavioral problems (in quartiles) of the parent- and teacher-rated subscales for inattentive and hyperactive behavioral types (16 groups) and (3) child sex (2 groups). Standard errors in parentheses. Propensity scores generated from pre-diagnosis or kindergarten child, family, and school characteristics shown in table 1. Models separately examine the role of ADHD diagnosis for children who subsequently receive medication and those who do not (in all cases relative to undiagnosed children).

[a] Statistically significant difference between Black and White at $p < .05$ (two-tailed test).

[b] Statistically significant difference between Black and Hispanic at $p < .05$ (two-tailed test).

[c] Statistically significant difference between Hispanic and White at $p < .05$ (two-tailed test).

[†] Statistically significant within-model difference by medication treatment status at $p < 0.05$ (two-tailed test).

* $p < .05$; ** $p < .01$; *** $p < .001$

cated Black and diagnosed and unmedicated White children reaches statistical significance (model 1 versus model 3).

By contrast, and consistent with hypothesis 2, neither diagnosed and medicated nor diagnosed and unmedicated Black or Hispanic children report significantly lower perceived self-competence relative to their undiagnosed matches, whereas both groups of White children do. This difference in difference reaches statistical significance for diagnosed and medicated White children versus their Black counterparts (model 7 versus model 9). Specifically, diagnosed and medicated White children fall a significant 0.25 points (0.33 SD) lower on perceived self-competence than their undiagnosed matches (model 7), whereas diagnosed and unmedicated White children fall 0.14 points (0.19 SD) lower (model 9).

When it comes to parent educational expectations, results are also consistent with hypothesis 3a. Parents of diagnosed and medicated Hispanic children report significantly lower educational expectations (by 0.45 points, or 0.34 SD) than their undiagnosed matches (model 11). Diagnosed and unmedicated Hispanic children likewise appear worse on parent education expectations by 0.30 points (0.23 SD) relative to undiagnosed matches (model 11). When it comes to comparisons across racial-ethnic groups, results are directionally consistent with hypothesis 3b, even though diagnosed and medicated Hispanic children do not fall significantly lower than either their Black or White counterparts. Parents of diagnosed and medicated Black and White children also report significantly lower educational expectations than undiagnosed matches (by roughly 0.20 points, or 0.18 SD, each), but this estimated magnitude is approximately 50 percent that among Hispanic parents (models 10 and 12). When it comes to parents of diagnosed and unmedicated children, results are significant and consistent with hypothesis 3b: Hispanic parents report significantly lower expectations for their children than both Black and White parents. In fact, Black parents actually hold 0.27 points (0.20 SD) higher expectations for their children than their undiagnosed matches (model 10); parents of diagnosed and unmedicated White children do not hold different expectations than their undiagnosed matches (model 12).

Overall, these results are consistent with the idea that medication can help control ADHD-related behavioral problems without necessarily addressing potential downsides, such as labeling and stigma. Labeling and stigma can vary based on both the child's race-ethnicity and the outcome under consideration. Even when medicated, diagnostic associations are consistent with the possibility of negative disability labeling by teachers toward Black (but not White) children. Although diagnosed and unmedicated White children do experience worse teacher-rated behavioral ratings than undiagnosed matches, consistent with some teacher-based negative disability labeling, these estimates are one-third the size as among diagnosed and unmedicated Black children.

Nonetheless, both diagnosed and medicated and diagnosed and unmedicated White children experience lowered perceived self-competence. For Black children, despite lower behavioral ratings by teachers, neither diagnosed and medicated nor diagnosed and unmedicated Black children experience lowered perceived self-competence than their undiagnosed matches, and diagnosed and unmedicated Black children also do not experience lowered parent expectations. Although diagnosed and medicated Black children and diagnosed and medicated White do experience lowered parent expectations relative to undiagnosed matches, these lower expectations are half as large as those experienced by Hispanic children.

Contextualizing the Magnitude of Diagnostic Relationships Across Race-Ethnicity

To contextualize the magnitude of these estimates, we note that the variation we document by race-ethnicity is comparable with previously documented variation by social class (Owens 2020b). For example, diagnosed Black children experience 0.29 points (0.37 SD) lower teacher-rated positive approaches to learning, similar to the 0.36 points (0.52 SD) previously documented among upper- and middle-SES children (Owens 2020b). Likewise, diagnosed White children report 0.22 points (0.28 SD)

lower perceived self-competence, similar to the 0.25 to 0.27 points (0.32 to 0.34 SD) lower perceived self-competence previously documented among upper- and middle-SES children (Owens 2020b).

Our estimates are also comparable to other studies examining similar outcomes, but different predictors. For instance, we found that diagnosed and unmedicated Black children are rated 0.42 SD worse on teacher-rated externalizing behaviors than their undiagnosed matches. Comparably, Adam Wright, Michael Gottfried, and Vi-Nhuan Le (2017) find that teacher-student race matching was associated with 0.40 SD lower teacher-rated externalizing behaviors for Black children. Jennifer Jennings and Thomas DiPrete (2010) find that moving a student from a below-average to an above-average kindergarten teacher could increase students' social and behavioral skills by 0.28 SD.

Our estimates include as potential undiagnosed matches those children who develop ADHD later in childhood. Doing so likely underestimates diagnostic relationships because these children may have had undiagnosed ADHD during our diagnostic observation period and were thus more similar to our diagnosed children than other undiagnosed matches.

A Descriptive Look at Overall Winners and Losers Based on Predicted Scores

Figure 2 shows how the marginal relationships between diagnosis and later well-being shape overall predicted scores on each outcome, by race-ethnicity, diagnostic status, and medication treatment status following diagnosis. Figure 2 summarizes three main descriptive findings. First, Black children fare significantly worse overall on both future teacher-rated school behaviors than both Hispanic children and White children, irrespective of diagnosis and medication treatment status (figure 2, panels A and B). However, medication is associated with positive school behaviors among Black children: diagnosed and medicated Black children fare similarly to undiagnosed Black children on both school behaviors, whereas diagnosed and unmedicated Black children fare worse than undiagnosed Black children, on average.

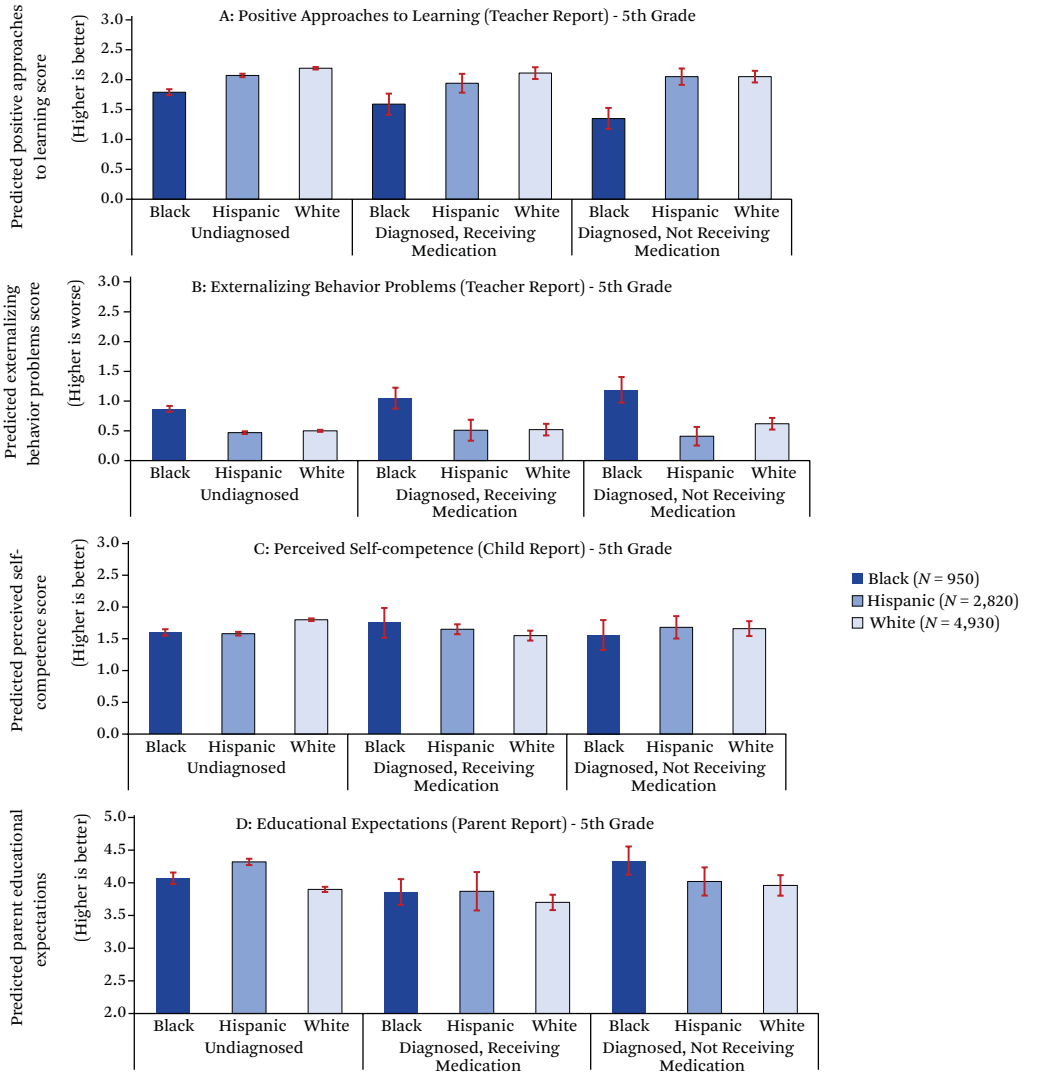
Second, on perceived self-competence, undiagnosed Black and Hispanic children report significantly lower perceived self-competence than undiagnosed White children (figure 2, panel C). Consistent with the negative relationship between diagnosis and perceived self-competence among White children, this pattern does not hold among diagnosed children. Diagnosed White children report statistically similar levels of perceived self-competence as their diagnosed Black and Hispanic counterparts, regardless of medication treatment status.

Third, on education expectations, parents of diagnosed and medicated Hispanic and White children report significantly lower expectations for their children than their same race-ethnicity undiagnosed counterparts do (figure 2, panel D). Yet parents of diagnosed and unmedicated Hispanic children and of diagnosed and unmedicated White children report statistically similar expectations as parents of undiagnosed Hispanic and White children, respectively. Furthermore, parents of diagnosed Black children do not report different expectations from parents of undiagnosed Black children, regardless of medication treatment status.

Sensitivity Analyses

Research documents the underdiagnosis and lesser medication receipt of Black and Hispanic children relative to White children net of observed characteristics (Morgan et al. 2013), highlighting the risk of unobserved selection into diagnosis and potential medication receipt. To gauge how large the unobserved effect would need to be to nullify our findings, we conducted the bounding analysis proposed by Kenneth Frank and his colleagues (2013). Results summarized in table A.3 reveal that, depending on the group and outcome under consideration, estimates would have to be biased by between 2 percent on the low end, for teacher ratings of diagnosed and medicated Black children's externalizing problems, to 69 percent on the high end, for diagnosed and medicated White children's self-competence, to invalidate our findings. Estimates are most sensitive to the risk of unobserved confounding for diagnosed and medicated Black children, likely because the relatively small pool of

Figure 2. Predicted Future Teacher-Rated School Behaviors, Child Perceived Self-Competence, and Parent Educational Expectations of Undiagnosed, Diagnosed and Medicated, and Diagnosed and Unmedicated Children



Source: ECLS-K: 2010–2011 (Tourangeau et al. 2019).
Note: See table 1 for details. Displaying 95 percent confidence intervals around predicted scores. Panels A and B: Black children fare significantly worse on both teacher-rated school behaviors than Hispanic and White children, regardless of diagnosis and medication status. However, medication is associated with positive school behaviors among Black children: diagnosed and medicated Black children fare similarly to undiagnosed Black children on both school behaviors, while diagnosed and unmedicated Black children fare worse than undiagnosed Black children, on average. Panel C: Undiagnosed Hispanic and Black children report significantly lower perceived self-competence than undiagnosed White children, but this pattern does not hold among diagnosed children. White children report comparable levels of perceived self competence as their Black and Hispanic counterparts, regardless of medication treatment status. Panel D: Parents of diagnosed and medicated Hispanic and White (but not Black) children report significantly lower expectations for their children than do their same race-ethnicity undiagnosed counterparts, on average. Yet parents of diagnosed and unmedicated Hispanic and White children report statistically similar expectations as parents of undiagnosed Hispanic and White children, respectively.

($N = 820$) potential undiagnosed Black matches yields somewhat poorer quality matches even with these best available data. We discuss implications in the discussion.

Moreover, differential selection into diagnosis may partly reflect differential selection into evaluation based on unobservable factors within race-ethnicity. To help address this potential differential selection, supplemental matching analyses restricted the pool of potential undiagnosed matches to those children who were evaluated by a medical professional for a learning difficulty but who were not ultimately diagnosed with ADHD. These supplemental analyses contained only 20.3 percent of children ($N = 1{,}770$) in the full sample. With the exception that the lower perceived self-competence of diagnosed White children is no longer statistically significant, results lend confidence that unobserved selection into evaluation does not drive results (see the appendix and table A.4). Finally, to test the robustness of our results to alternate specifications of our outcomes, we examine—and find—that the same pattern of results when using binary outcomes (0 when the teacher or child reports 0 or 1 and 1 when they report 2 or 3), per table A.5.

DISCUSSION

This study advances our understanding of racial-ethnic heterogeneity in patterns of association between ADHD diagnosis, medication treatment, and future child well-being. We build on prior research on the benefits and drawbacks associated with ADHD diagnosis and potential medication use (Owens 2020b) by examining how positives and negatives can balance out differently for Black, Hispanic, and White children. Because the experimental gold standard is unfeasible in this context (for example, it is unethical to withhold diagnoses), we match children who are diagnosed (and subsequently medicated or unmedicated) with same race-ethnicity undiagnosed children who are otherwise comparable on observed characteristics, including social class. Although documenting correlations, matching helps us disentangle racial-ethnic differences in the role of ADHD diagnosis (with or without treatment) apart from underlying ADHD-related behaviors.

The study reveals three findings. First, an early elementary school ADHD diagnosis is associated with poorer future teacher-rated school behaviors among Black children; the magnitude is over twice as large among Black as among White children. This finding persists regardless of medication treatment status. Second, although a diagnosis is not consistently associated with poorer teacher-rated school behaviors among White children, White children uniquely report poorer child-perceived self-competence regardless of medication status. Third, even though diagnosed Hispanic children do not on average experience poorer teacher-rated behaviors or lower perceived self-competence than their undiagnosed matches, diagnosis is uniquely associated with lower educational expectations among Hispanic parents regardless of children's medication treatment status following diagnosis.

When it comes to teachers' behavioral ratings of Black children, teachers may perceive the diagnosis with or without medication as reinforcing expectations of poor behaviors or lack of academic commitment, themselves grounded in negative stereotypes (Okonofua and Eberhardt 2015; Owens 2022). By contrast, although diagnosed and unmedicated White children are also rated more poorly by teachers than their undiagnosed matches (whereas diagnosed and medicated White children are not), this relationship is half as large as among Black children. This may be because diagnosed and unmedicated White children are uniquely seen as having an unmet need for medication (Blanchett 2010; Ong-Dean 2006). These findings are consistent with the notion that diagnosis among Black children may function as a mechanism of social control within schools. But, for White children, diagnosis may be seen as a sign that additional support is needed for them to reach their full potential.

Hispanic parents may report lower educational expectations for their diagnosed versus undiagnosed children, regardless of medication status, for several reasons—even though neither teachers nor children themselves respectively report poorer ratings on school behaviors and self-competence. One possibility is that Hispanic parents have lesser knowledge of ADHD and lesser familiarity with how to help

overcome associated schooling barriers, for example, due to possible language barriers (Rothe 2005). Hispanic parents' lesser knowledge combined with mental health stigma (Pescosolido et al. 2008) may lead to larger negative associations between diagnosis and education expectations. Medication may reinforce the visibility of the mental health label among Hispanic parents, further lowering their expectations.

Our study also has a number of limitations and areas for future extension. First, race-based diagnostic reporting error among parents is possible. For example, White parents are more likely than other parents to seek out an ADHD diagnosis and medication treatment (Bussing et al. 2003; Morgan et al. 2013). Although research using the ECLS-K data considers parents to be valid and reliable reporters of ADHD diagnosis, symptoms, and medication receipt (Cumming et al. 2022; Morgan et al. 2013; Mulligan et al. 2019), research has not examined potential race-based diagnostic reporting error. Second, the associations we uncover may result from race-ethnicity-specific reference group effects, for example, if Black children have worse-behaved classmates than White children, leading teachers of Black children to be more agitated by minor deviations from desired behavior. However, these results appear even among teachers with comparable ratings of average classroom behavior.

Third, the associations we uncover should be treated as suggestive in nature and interpreted in light of potential unobserved racial-ethnic differences in selection into diagnosis and potential medication receipt. Differential unobserved selection may occur, for example, because our measures of ADHD-related behaviors (and internalizing and oppositional-defiant behaviors) do not align perfectly with those used by clinicians, and do not capture other clinical aspects beyond behavioral frequency, such as intensity or duration. Fourth, our results also extend only to the young children diagnosed between kindergarten and third grade. Fifth, these data also lack a direct measure of ADHD-related stigma or internalized shame. However, results are consistent with previous findings that ADHD diagnosis is associated with stigma and negative labeling among diagnosed children (Pescosolido et al. 2008). Future qualitative or experimental research should investigate this mechanism directly. In addition, future research should examine the relationships between an ADHD diagnosis and future test score outcomes by child race-ethnicity. Finally, for researchers, this study highlights the challenges of identifying diagnostic effects given the need to address differential selection into diagnosis despite the infeasibility of a randomized controlled trial in this context.

Taken together, our findings carry important implications for racial-ethnic disparities in children's future mental health and well-being. The differing associations between ADHD diagnosis (with versus without medication) and later well-being by child race-ethnicity may reflect different underlying social meanings of diagnosis, what we refer to as racialized patterns of stigma. When it comes to diagnosed White children's lower perceived self-competence, diagnosis with or without medication use may be seen as a sign that the child has failed to meet expectations for seemingly effortless academic excellence (Mueller and Abrutyn 2016). Although we cannot be sure of underlying mechanisms, that even diagnosed and medicated White children report poorer perceived self-competence is consistent with theories of negative diagnostic labeling: even when medication effectively controls ADHD-related behaviors, medication is not designed to address labeling. Diagnosed Black and Hispanic children do not report lowered perceived self-competence regardless of medication receipt, perhaps owing to their greater resilience given prior exposure to the realities of racial-ethnic discrimination and negative ability stereotyping.

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PART IV

Environmental Disruptions

Floods and Children's Education in Rural India

NAZAR KHALID, JERE BEHRMAN, EMILY HANNUM, AND AMRIT THAPA

Floods cause extensive damage in high-income countries, including the United States, but problems are more severe in low- and middle-income countries (LMICs) that lack preventative and mitigating infrastructure. Marginalized children's education in LMICs might be particularly vulnerable. Using the Indian Human Development Survey, we investigate flood exposure implications for the education of school-age rural children, paying particular attention to children from marginalized groups. Results show that lower-caste Hindu, Muslim, and poorer children with less-educated parents in agricultural households are more likely to experience flooding. Interactions between flooding and marginalization characteristics indicate that flood exposure is associated with disproportionately negative learning outcomes for girls and that economic resources may mitigate flood exposure effects on delayed school progress. While greater exposures for marginalized groups are concerning, the limited number and modest magnitudes of documented negative effect heterogeneities for marginalized children are somewhat better news.

Keywords: floods, rural education, socioeconomic stratification, caste, religious stratification, India

With climate change, flood frequency is increasing across the globe. Water-control systems are often inadequate for changing climatic conditions. Growing populations induce greater use of marginal lands with elevated flood vulnerability. The 2021 German floods demonstrate that effects can be catastrophic even in a high-income country known for

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strong infrastructure. Flooding is the most ubiquitous and costly natural hazard in the United States (Grimm 2020). The cost of flood damage in the United States was approximately $17 billion annually between 2010 and 2018, according to testimony from Federal Emergency Management Agency representative Michael Grimm (Grimm 2020; Duguid 2021). Although most of these costs as usually estimated are physical destruction, considerable foregone human-resource investments are possible in general and in terms of children's education, in particular. In recent times, Hurricane Sandy on the East Coast, Hurricane Maria in Puerto Rico, Hurricane Harvey in Texas, Hurricane Ida in Louisiana, and Hurricane Ian in Florida have had devastating implications for educational systems (Brusi and Godreau 2019; Chakrabarti and Livingston 2012), and vulnerability to flood exposure varies across subpopulations (Lieberman-Cribbin et al. 2021).

Marginalized groups tend to be relatively vulnerable to flooding and other climatic disasters across national settings, but wealthier countries are more likely to have the infrastructure and financial resources to limit disastrous effects and to support recovery, while poorer countries have fewer available avenues for prevention and recovery (Carty and Walsh 2022; see also Eckstein, Künzel, and Schäfer 2021). As climate change has escalated, problems in poorer countries have mounted. Oxfam estimates that funding requirements for UN humanitarian appeals linked to extreme weather are now eight times higher than they were twenty years ago, and that over the past five years, such appeals were only 54 percent funded on average, resulting in an estimated funding shortfall of $28 to $33 billion (Carty and Walsh 2022, 3).

In this context, high-income countries such as the United States are likely to face increasing pressure to divert foreign aid from development assistance to disaster protection and relief as climate-related damage grows (Harbeson and McCormick 2021). This shift is already happening: the Biden-Harris administration has committed to addressing the climate crisis abroad as a core element of national security and foreign policy, involving diplomatic engagement as well as foreign assistance (White House 2021a, 2021b). A recent White House Press Briefing states that the United States "has a compelling national interest in strengthening global protection for individuals and groups displaced by the impacts of climate" and that particular concern needs to be given to the disproportionate impact, globally, on marginalized communities (White House 2021b).

South Asia is a highly populated, geopolitically significant region that is also one of the most vulnerable to climatic shocks (World Bank 2022). The World Bank reports that more than half of all South Asians, approximately 750 million people, were affected by climate-related disasters in the last twenty years, and that climate change "could sharply diminish living conditions for up to 800 million people in a region that already has some of the world's poorest and most vulnerable populations" (2022). Floods that covered about a third of Pakistan in 2022 are a vivid illustration of these risks. An important mechanism through which diminishment in living conditions could occur, but one that is not yet well understood, is by disruptions in children's human-capital development (Benson and Clay 2004).

India is a particularly important case. It is ranked seventh in the 2021 global climate-risk index (Eckstein, Künzel, and Schäfer 2021, 7); has experienced secularly increasing floods and flood damage; is home to the world's largest number of school-age children; and is highly stratified along caste, religious, and socioeconomic lines. The majority of Indian children live in rural communities, where floods can hinder education by causing school closures, disrupting transportation systems, damaging school infrastructure, increasing child-labor demands to deal with fallout from floods and flood damage, and otherwise disrupting local activities. Consequences could include reduced enrollment and attendance, leading to slower grade progression and worse learning outcomes. The educational effects of flooding, moreover, might be heterogeneous, due to either disparate exposures or disparate buffering, with respect to child and family characteristics such as gender, age, religion, caste, and socioeconomic status.

This article considers flooding impacts on Indian children's education, with particular fo-

cus on heterogeneous impacts on the most marginalized school-age rural child populations. We use the Indian Human Development Survey (IHDS), a nationally representative panel survey that collected data on learning, in addition to more standard information on school enrollment and educational attainment. The IHDS permits investigation of the heterogeneous effects of floods on the educational progress and learning of rural children ages eight to eleven years.

We consider two questions: Are children from marginalized groups disproportionately exposed to floods? Do children from marginalized groups experience disproportionate negative educational effects, when exposed?

BACKGROUND

Natural disasters such as floods are expected to increase in frequency and intensity as a result of climate change over the next few decades and to affect a sizable portion of the global population (Hirabayashi et al. 2013; Scheuren et al. 2008). In studying the impact of disasters on people's lives, social scientists make a distinction between disasters as discrete environmental events that occur when a hazard is realized and disasters as social processes (Arcaya, Raker, and Waters 2020; Frankenberg, Laurito, and Thomas 2014). Extreme rainfall and floods affect millions of people by their adverse impacts on physical, financial, and human capital, and disruptions to economic activity, consumption, employment, and investment (Benson and Clay 2004). Interest among social scientists is strong in investigating the ways that different social groups experience climate risks and environmental exposures unequally (see Rauscher and Cao 2024, this issue). To gain a better understanding of the social roots of the impacts of such disasters, studies frequently use the concepts of vulnerability and resilience (Frankenberg et al. 2013). Existing inequalities along lines of gender, age, race, caste, religion, and socioeconomic status may all be important factors in determining who is most vulnerable to disasters and who is most resilient (Enarson 2012).

Given their high exposure, greater sensitivity to certain exposures, and reliance on caregivers, children are particularly vulnerable to negative environmental adversities (Ebi and Paulson 2007; Frankenberg and Thomas 2017; Walker et al. 2007). Research suggests that in low- and middle-income countries (LMICs), children are frequently the first and the most affected victims of environmental shocks (Martin 2010; Norris et al. 2005). Recurrent and extreme floods can affect children in multiple ways. Flooding can cause immediate physical harm. Flooding can also cause physical damage to the school and health-care infrastructure, disrupting education and limiting access to proper medical care. Similarly, floods increase the likelihood of households falling into poverty, which might be particularly significant for households that depend on natural resources for a living. In many LMICs, income loss, asset loss, and increased disaster-related expenditures can create pressure on families to remove their children from school to enable them to work instead. Financially strapped families may be unable to afford adequate medical care, food, or school supplies, all of which have negative impacts on children. Households may reduce food consumption due to income losses, which can raise risk of child malnutrition and stunted growth (Dimitrova and Muttarak 2020; WHO and de Onis 2006). Finally, trauma caused by such events can cause deterioration in mental health, which can affect physical health and academic achievement (Frankenberg and Thomas 2017).

Despite the realization that weather shocks have multiple effects on a wide range of indicators of children's well-being, research in LMICs continues to be almost exclusively focused on nutritional and health outcomes (Currie and Vogl 2013; Frankenberg et al. 2008; Rosales-Rueda 2018). Relatively few studies have investigated the schooling and educational attainment of children living in flood-prone areas, even though, according to EM-DAT (2021), floods are the most frequently reported natural disaster worldwide.

Emergency school closures and disruptions, which are common due to unpredictable, recurrent, and severe floods, can have significant adverse impacts on children's education. Studies of high-income countries have found that emergency school closures and other educational disruptions are associated with in-

creased dropout (Azevedo et al. 2021). Further, interrupted learning due to unscheduled school closures has been found to have negative impacts on test performance (Marcotte and Hemelt 2008).

Because destruction caused by disasters is a function of the events themselves, where and how societies build, and the resources available to recover and respond, children in LMICs feel adverse impacts to a far greater extent than adults (Kousky 2016). Uninsured extreme-weather shocks can have significant and long-lasting effects on children's human capital because low-income households are unable to protect their consumption of food, health, and education (Baez, de la Fuente, and Santos 2010). Xin Meng and Robert Gregory (2002) examined the impacts of school closures on children's educational attainment during China's Cultural Revolution. They find that interrupted learning because of frequent junior- and senior-high-school closures reduced children's chances of getting formal four-year university degrees by about 55 percent (Meng and Gregory 2002, 953). Kawin Thamtanajit (2020) finds that Thai children who were exposed to recurrent floods that resulted in months of school closures and destruction of basic school facilities performed worse on tests than children who were not exposed to such events. Floods in Madagascar reduced the likelihood of teenagers attending school, encouraging them to enter the labor market (Marchetta, Sahn, and Tiberti 2019). Girls had much higher chances of dropping out and entering labor markets than boys. In general, natural disasters are likely to exacerbate the learning crisis in LMICs, where roughly half of children are already failing to acquire required foundational skills (World Bank 2019).

The Indian Context

India's geophysical and climatic features make it one of the world's most disaster-prone countries (Patankar 2019). India's population has become more susceptible to flooding as a result of climate-change-induced increases in extreme precipitation events and ongoing population growth (Ali, Modi, and Mishra 2019). Floods have accounted for more than half of all natural and climate-related disasters in India since the 1990s (Patankar 2019). Floods have the potential to destroy crop and livestock production and thereby to jeopardize food security. Particularly vulnerable to this effect pathway are rural Indians, who account for nearly three-quarters of the population (Dimitrova and Muttarak 2020). Between 1980 and 2017, India experienced 278 floods, affecting more than 750 million people and causing an estimated $58.7 billion in damage (EM-DAT 2018). Strikingly, views are mixed on whether the past few decades of human development and economic growth have made India more resilient to the negative effects of floods (Bahinipati and Patnaik 2020; Parida 2020; Patri, Sharma, and Patra 2022).

Despite rapid recent economic growth, Indian children have some of the worst health and well-being indicators globally (Coffey et al. 2013). For example, in 2015, India had one of the highest rates of childhood malnutrition, and 38 percent of children under the age of five showed stunted growth patterns (Khan and Mohanty 2018). These conditions have implications for human-capital accumulation and capability development, and for resiliency in times of stress (Coffey et al. 2013). India also has the largest number of school-age children in the world, and many of these children live in rural areas of northern and eastern states prone to flooding. Anna Bertho and her colleagues (2012) find that flood-induced school closures varied between fifteen days to six months, with a median of three months, in highly flood-prone districts of Uttar Pradesh and Bihar, the two most populous states in India. Further, floods had a negative impact on education by making transportation to schools difficult or impossible, damaging school infrastructure, and otherwise disrupting local activities (Bertho et al. 2012). In a community-based study, Revathi Krishna, Kevin Ronan, and Eva Alisic (2018) find that many children whose studies were disrupted by severe floods explained that their return to school after the floods was inhibited because of illness or loss of books and uniforms. This article adds to limited existing research by providing a national-scale snapshot of the groups most vulnerable to flood exposure among rural children in India, and by investigating the implications of

flood exposures for rural children's educational outcomes, overall and across social groups.

Social Groups and Inequality

Along with gender and socioeconomic status, other important social group identities are critical to understanding social stratification in India. Caste, tribal status, and religion are key dimensions. Historically, the Hindu caste system was a division of individuals into hierarchical groups and subgroups based on occupation, which in turn was rigidly related to notions of ritual purity, privilege, and social status (Deshpande 2011; Vaid 2014). The lowest classification in this hierarchy referred to groups historically consigned to ritually polluting, dirty, and degrading occupations. Members of this group were previously referred to by terms now considered pejorative; they are referred to in the Indian Constitution and in current official documents as Scheduled Castes. Although the Indian caste system was abolished in 1950, caste continues to be a powerful marker of individual identity. Members of Scheduled Castes continue to face overt and covert forms of discrimination, abuse, humiliation, and violence (Coffey et al. 2018; Hathi et al. 2018). Most of the two hundred million people belonging to Scheduled Castes are very poor, with limited access to social and economic resources (Deshpande 2011).

Scheduled Tribes, also known as *adivasis,* are members of Indigenous or tribal groups whose identities are often considered outside the Hindu caste system. These groups number more than 104 million in population and often live in remote parts of the country; they continue to experience economic and educational deprivations (Kumar, Pathak, and Ruikar 2020; Maharatna 2000). Religious minorities also sit outside the traditional Hindu caste system. India is home to the world's third-largest Muslim population, at more than 176 million (World Population Review 2023). Muslims are the largest minority religious group in India. They rank close to Scheduled Castes in terms of human-development outcomes and face social, economic, and political discrimination (Asher, Novosad, and Rafkin 2018; Hathi et al. 2018; Jaffrelot and Gayer 2012; Sachar et al. 2006). Moreover, although Scheduled Castes have rights to certain preferential policies and programs, few such programs are open to Muslims (Sachar et al. 2006; on the vulnerability of the Muslim population, see Fazal 2020).

DATA AND METHODS

Our sample includes children in rural households in the India Human Development Survey. The IHDS is a nationally representative multitopic survey of more than forty-one thousand households in 971 urban blocks and 1,503 villages (Desai, Vanneman, and NCAER 2019). It is a panel survey with interviews conducted in 2004–2005 and in 2011–2012.

Dependent Variables

The IHDS collected information on current enrollment, highest grade completed, and other key information related to all members of the interviewed households. For children ages eight to eleven, the IHDS also administered learning, math, and writing assessment modules. Our analysis uses three measures of children's learning outcomes from 2011 to 2012. The first measure, grade-for-age, is defined as $grade/(age - 6)$, where grade is completed grades of education, age is a child's reported age, and six is the typical age children are when they complete the first grade.[1]

Our other two outcome measures come from IHDS's assessment of children's math and reading skills. The IHDS ranked children's performance on a math test from 1 to 4 in increasing order of math skills—cannot recognize numbers, able to recognize numbers, able to do subtraction, and able to do division. A similar ranking of 1 to 5 was used for performance on a reading test, with numbers referring, respectively, to children who could not recognize letters in the alphabet, could recognize letters in the alphabet, could read words, could read paragraphs, or could read stories. Both tests were based on standardized test modules de-

1. We use six to indicate that children complete their first grade by this age. However, studies on schooling in India tend to use both six and seven (Sahoo 2017; Desai and Kulkarni 2008).

veloped with the help of PRATHAM, an educational NGO, and are widely used in assessing learning among children in many contexts (Desai et al. 2010). Tests were translated into regional languages to facilitate easy administration and reduce anxiety levels among children. For the multivariate analysis of test score outcomes in tables 4 and 5, we standardized the test scores for each year of age to better facilitate interpretation of the estimates. In these tables, the outcome is defined as the number of standard deviations (SD) each child's test scores are above or below the mean of the test score distributions for children of the same age.

In the IHDS, the learning assessment tests were administered at home. For this reason, unlike analyses based on tests administered in schools, our analysis is not subject to selectivity bias due to school enrollment or attendance. Access to test score data means that our investigation goes beyond most studies to consider learning, rather than just time spent in school.

Independent Variables

The IHDS had a separate village module assessing various aspects of the local community, including information on village-level year-wise flooding histories for each year between 2006 and 2011. To minimize the problem of recall bias, the survey asked multiple informed citizens to report on the occurrence of floods for each year between 2006 and 2011. We defined a dichotomous measure of village flood exposure, with a value of 1 if the village was exposed to floods at least once during this period, and 0 if it was not. We also defined a state-level flood exposure measure as the fraction of villages in the state exposed to floods at least once during the period.

The IHDS includes rich characterizations of demographic and household characteristics: children's gender and age, caste, religious affiliation, household income, whether the main source of household income was agricultural, and parental educational attainments. These variables permit the investigation of differences in flood burdens on children's learning outcomes by potentially important stratifiers. Last, in a subset of our models for math and reading, we also include grade-for-age to explore whether falling behind in grade progression might be a mediating mechanism for flooding effects on learning.

Second-Wave Test-Taking Propensity Weighting

Estimated flood effects on educational outcomes could be biased by selective migration out of flood-prone areas. To reduce potential bias due to children not taking the second-wave survey tests, we adjust our estimates using a new set of weights constructed from each child's propensity to take the tests in the second wave. Despite its limitations, such propensity reweighting is a widely employed method for adjusting for survey nonresponse (Chen et al. 2015; Wun et al. 2007). We compare data from both waves to identify all children in the first wave who would have been between eight and eleven in the second wave and hence eligible for being administered the second-wave learning tests. This group included those who were administered the second-wave learning tests, those who were present in the second wave but did not take the tests, and those not present in the second wave. The propensity scores (or the predicted probability of taking the second-wave test) are estimated by a logistic regression of whether a child was tested in the second wave on village flood exposure, the fraction of villages exposed to the floods in the state between waves and first-wave values for gender, age, caste/religion group, income quintiles, main income source of the household, mother's and father's education, and total households in the village. We calculate final weights by multiplying the inverse of propensity to take the second-wave tests with the sample-design weights from the first wave of the IHDS.

Analytic Approach

First, we consider whether exposure to floods differs by groups defined by children's gender and ages, caste or religion, income quintile, whether agriculture is main income source, and parental education. Second, we estimate a series of ordinary least squares (OLS) regressions with each of three dependent variables—grade-for-age, math skills, and reading skills. For each outcome, we begin by estimating

equation (1)—a main-effects model denoted as model (1) in the tables:

$$Outcomes = \alpha_1 + \beta_1 vfe + \beta_2 sfe + \beta_3 g + \beta_4 age + \beta_5 sg + \beta_6 iq + \beta_7 msi + \beta_8 meduc + \beta_9 feduc + \varepsilon \quad (1)$$

The right-side variables in this model are village flood exposure (*vfe*), state flood exposure (*sfe*), children's gender (*g*) and age (*age*), social (caste or religion) group (*sg*), household-income quintile (*iq*), household main source of income (*msi*), mother's (*meduc*) and father's (*feduc*) grades of education, and a random term (ε).

For each outcome, a second specification, model (2) in the tables, adds interactions of each of the main-effects variables with the village flood-exposure variable. This specification allows us to investigate whether the impact of floods on education differs by social group, children's gender and age, income quintiles, whether agriculture is the main income source, and parental education. A third specification, model (3) in the tables, incorporates village fixed effects along with interactions. Adding the village fixed effects allows us to account for fixed factors at the village level between the two survey waves that were not included in the models but might also be associated with children's learning. For instance, using village fixed effects helps account for the fact that children with better resources are likely to live in villages that are less flood exposed or have access to better schools. This is our preferred specification. Finally, a fourth specification, model (4), is estimated in the tables for the math and reading tests. Model (4) adds grade-for-age and its interaction with village flood exposure to model (2), with main effects and the interactions of the main effects with the village flood exposure. This specification allows exploration of whether grade-for-age is a mediating mechanism through which floods affect learning in the interaction model.

RESULTS

Table 1 presents descriptive statistics of the raw data for children ages eight to eleven years old in the IHDS second wave. Indian children typically are in grades two through six during these ages. The mean score of 2.33 in math suggests that an average child did better than recognizing numbers but was unable to do basic arithmetic operations such as subtraction. A mean score of 3.33 in reading implies that an average child could read words but had difficulties reading an entire paragraph. The mean grade-for-age below 1.0 suggests that, on average, rural children have completed fewer grades relative to age than they would have were they to enter school on time and progress one grade each year.

One-third of the children lived in villages that were exposed to floods between 2006 and 2011. On average, 35 percent of villages in each state were exposed to floods during this period. The mean age in the sample is 9.5 years and 48 percent are girls. Hindu Scheduled Castes, Scheduled Tribes, and Muslims—groups that have been historically marginalized and discriminated against— are 46 percent of the sample. Hindu Other Backward Castes, an officially recognized collection of castes that have remained socioeconomically poor, are 38 percent of the sample. The most privileged caste and religious group, Hindu Upper Castes, are 14 percent of the sample. One percent of children belong to non-Hindu-and-Muslim identities—classified here as "Other." More than half of the children belong to households with incomes in the lowest two income quintiles. Agriculture is the main income source for 57 percent of our sample households. Fathers of children averaged 5.2 grades of education, two more grades than their mothers, who averaged 3.2 grades.

Vulnerability Across Background Characteristics

Table 2 presents sample distributions of flood exposure by background characteristics. No differences by gender or age are significant. Among social groups, Hindu Other Backward Castes, Muslim, and Hindu Scheduled Caste children are most likely to be exposed to floods. Scheduled Tribes and Indigenous children tend to live in forests or hilly regions with relatively low flood exposure. Children in higher household-income quintiles and with higher parental education are less exposed to floods. Children from agricultural households are more likely to be living in flood-prone villages.

Table 1. Summary Statistics of Rural Children, Ages Eight to Eleven, for Variables Used in Regression Analysis

	Mean/Proportions	Std.
Outcomes		
Math[a]	2.33	0.96
Reading[b]	3.32	1.42
Grade-for-age[c]	0.94	0.45
Flood exposure		
Village flood exposure[d]	0.33	0.47
State flooding index[e]	0.35	0.17
Demographic characteristics		
Female[f]	0.48	0.50
Age (years)	9.50	1.08
Caste or religion		
Hindu Upper Castes	0.14	0.35
Hindu Other Backward Castes	0.38	0.49
Hindu Scheduled Castes	0.24	0.43
Scheduled Tribes or Indigenous	0.09	0.29
Muslim	0.13	0.34
Other	0.01	0.09
Socioeconomic status[g]		
Income quintiles		
Poorest quintile	0.25	0.43
Second quintile	0.26	0.44
Third quintile	0.21	0.41
Fourth quintile	0.15	0.36
Richest quintile	0.12	0.32
Agriculture main income source	0.57	0.50
Mother's education (grades)	3.22	4.03
Father's education (grades)	5.15	4.51

Source: Authors' calculations based on Indian Human Development Survey (Desai, Vanneman, and NCAER 2019).

Note: N = 7,284. The sample includes only rural children. All statistics are using attrition weights constructed based on propensity score reweighting.

[a] Math skills based on children's performance on math assessment test: 1 = cannot recognize numbers, 2 = able to recognize numbers, 3 = do subtraction, 4 = do division.

[b] Reading skills based on children's performance on reading assessment test: 1 = cannot recognize letters in the alphabet, 2 = recognize letters in the alphabet, 3 = read words, 4 = read paragraphs, 5 = read stories.

[c] Grade-for-age grade / age six, where grade and age are current grade and age of the child.

[d] Village flood exposure: 0 = no flood, 1 = one or more episodes of floods between 2006 and 2011.

[e] State flood index refers to the fraction of total villages in a state exposed to one or more episodes of floods between 2006 and 2011.

[f] Female: 0 = male, 1 = female.

[g] Unequal distribution of income quintiles is because quintiles are generated at the household level based on household total income.

Table 2. Percentage Flood Exposed by Background Characteristics

	Percentage	Number in category	Flood-group independence test (χ^2)
Gender			n.s.
Male	32.6	3,873	
Female	34.0	3,411	
Child's age (years)			n.s.
Eight	34.9	1,714	
Nine	32.2	1,739	
Ten	33.4	2,233	
Eleven	32.3	1,598	
Caste-religion			***
Hindu Upper Castes	30.1	1,156	
Hindu Other Backward Castes	36.1	2,603	
Hindu Scheduled Castes	34.4	1,805	
Scheduled Tribes or Indigenous	22.1	725	
Muslim	35.3	905	
Other	11.7	90	
Income quintiles			***
Poorest quintile	38.8	1,733	
Second quintile	35.5	1,852	
Third quintile	32.9	1,524	
Fourth quintile	27.6	1,188	
Richest quintile	24.3	987	
Main income source			***
Nonagriculture	31.9	3,107	
Agriculture	34.3	4,177	
Mother's education			***
None	36.0	3,771	
Primary	31.3	1,380	
Middle or secondary	28.1	1,771	
High school or more	34.8	362	
Father's education			***
None	36.4	1,953	
Primary	35.9	1,875	
Middle or secondary	28.0	2,559	
High school or more	33.3	897	

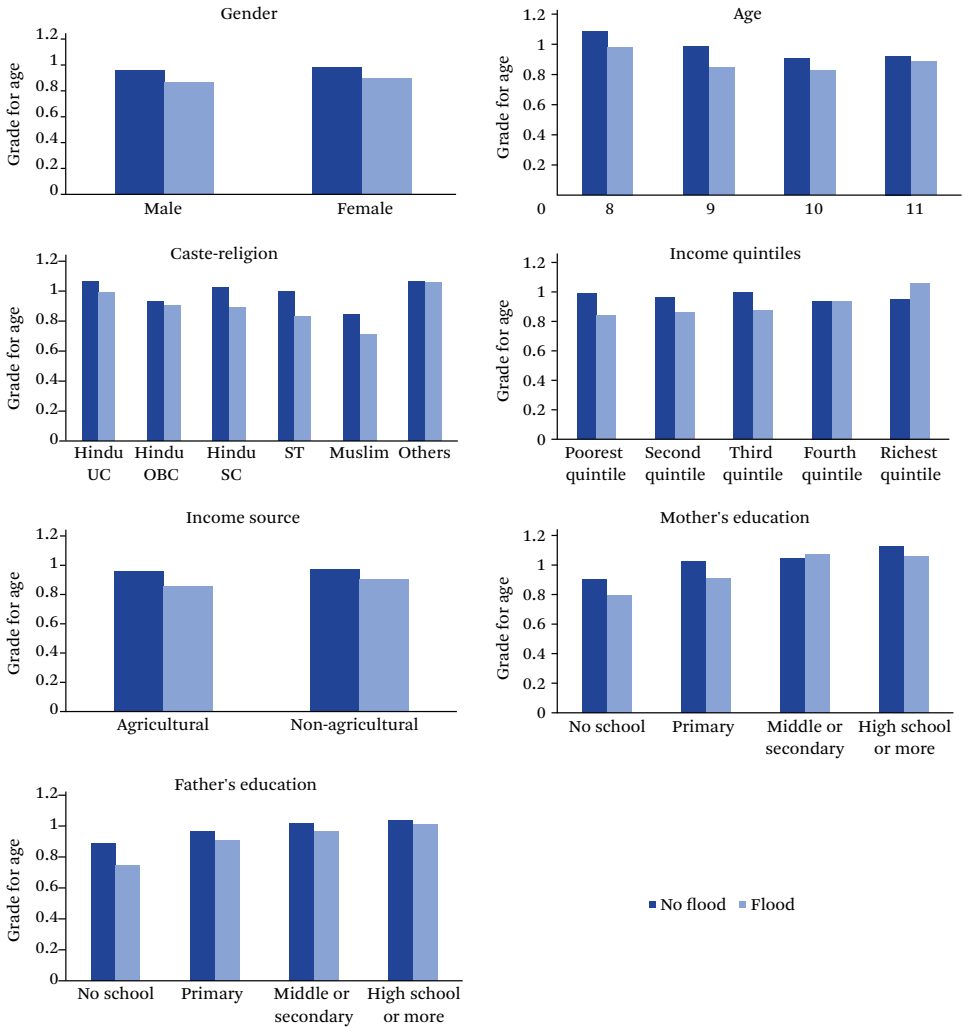
Source: Authors' calculations based on Indian Human Development Survey (Desai, Vanneman, and NCAER 2019).
+ $p < .1$; * $p < .05$; ** $p < .01$; *** $p < .001$

Educational Outcomes by Exposure and Group

Figures 1 through 3 show distributions of means of the outcome measures by background characteristics. For children's grade-for-age (figure 1), children from villages not exposed to floods tend to have positive and greater means relative to those from flood-exposed villages across various background characteristics. With the exception of girls, children from all marginalized groups, including those from agricultural households, are likely to have worse grade progression than privileged groups. Children from agricultural households are better off relative to nonagricultural households, perhaps in part because the latter group includes nonagricultural daily wage earners.

For children's math and reading skills (fig-

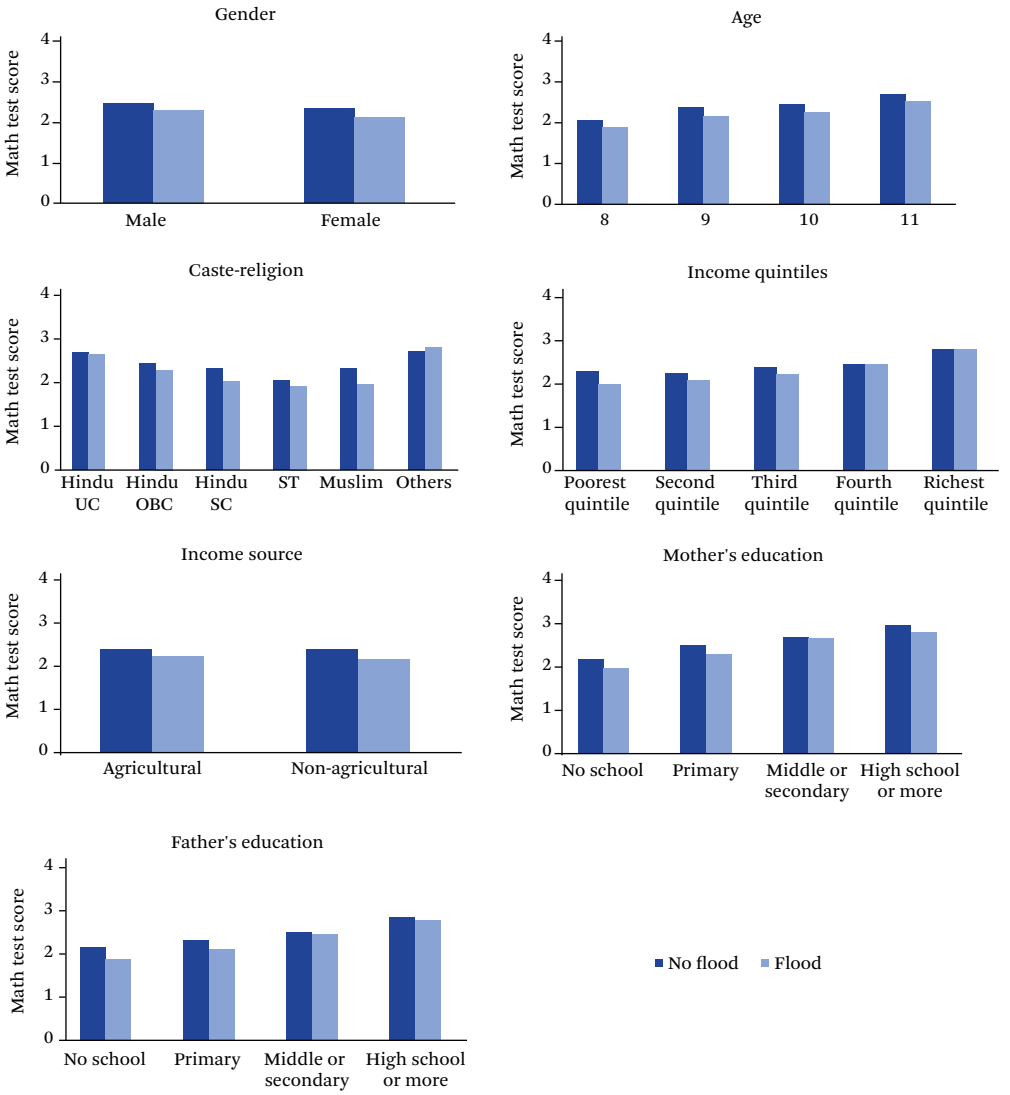
Figure 1. Distribution of Grade-for-Age by Variables Used in Regression Analysis



Source: Authors' calculations based on Indian Human Development Survey (Desai, Vanneman, and NCAER 2019).

Note: Two sample t-tests for equality of means between grade-for-age and categories of variables in the x-axis are statistically significant at 5 percent for all except Hindu OBC and Other in caste-religion; the fourth and richest quintiles; mothers with middle or secondary and high school or more; and fathers with high school or more.

Figure 2. Distribution of Math Skills by Variables Used in Regression Analysis

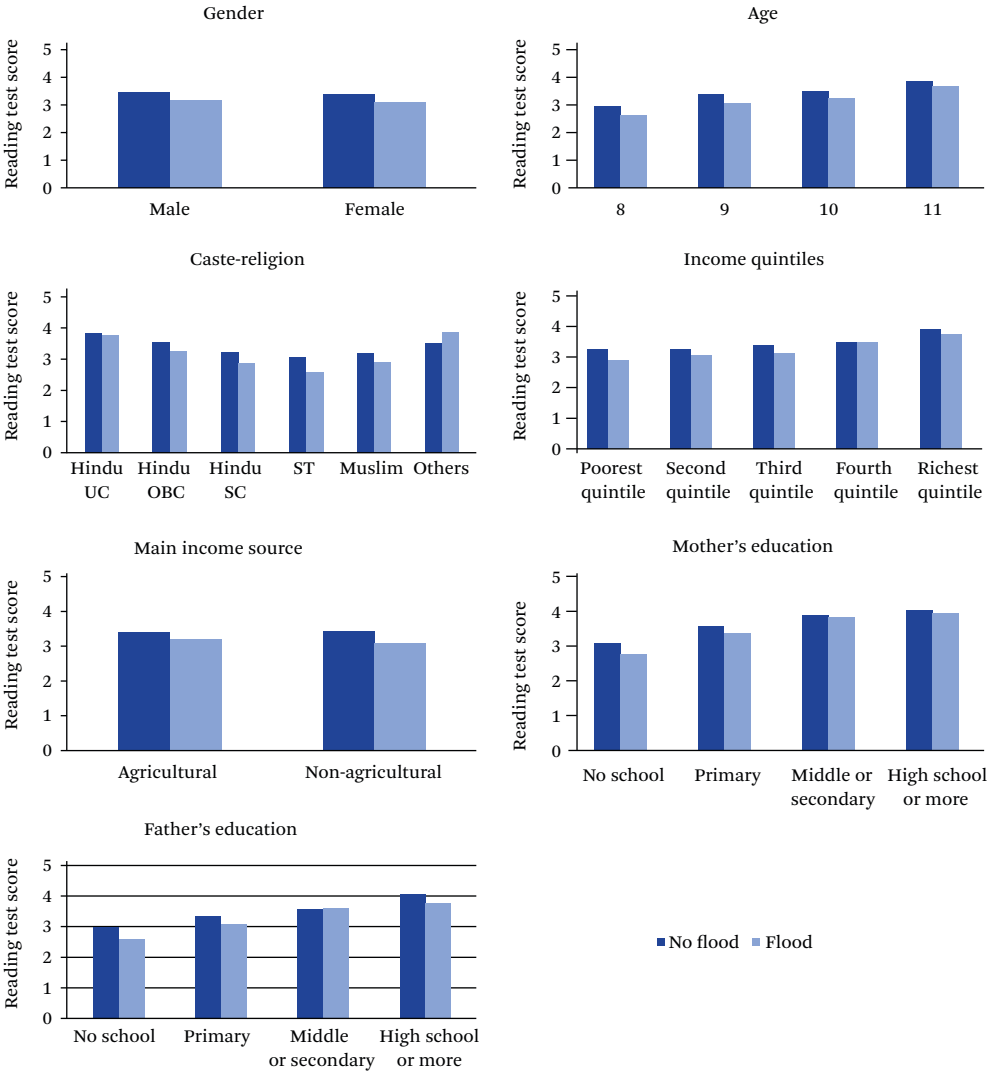


Source: Authors' calculations based on Indian Human Development Survey (Desai, Vanneman, and NCAER 2019).

Note: Two sample t-tests for equality of means between math skills and categories of variables in the x-axis are statistically significant at 5 percent for all except Other in caste-religion; the third, fourth, and richest quintiles; mothers with primary education; and fathers with high school or more.

ures 2 and 3), children from flood-exposed villages have lower mean skills than those in villages not exposed. Scores increase with age. Girls (in the case of math) and children belonging to marginalized caste or religious groups have worse skills relative to less-marginalized children in their respective groups. Higher income quintiles and higher parental education are associated with higher skills. Even within villages exposed to floods, higher parental education is associated with higher skills.

Figure 3. Distribution of Reading Skills by Variables Used in Regression Models



Source: Authors' calculations based on Indian Human Development Survey (Desai, Vanneman, and NCAER 2019).

Note: Two sample t-test for equality of means between reading skills and categories of variables in the x-axis are statistically significant at 5 percent for all except Other in caste-religion; the third, fourth, and richest quintiles; mothers with primary education; fathers with middle or secondary schooling.

OLS Analyses of Grade-for-Age

The first model in table 3 shows the main effects. The coefficient estimates for village flood exposure and state flood index are both negative (though the former is significant only at the 0.10 level), suggesting that children in flood-exposed areas fall behind. Girls perform better than boys, and older children are further behind than younger children. Muslim, Hindu Other Backward Caste, and Scheduled Tribe or Indigenous children are significantly behind relative to Hindu Upper Caste children. However, it is puzzling that children from the two highest income quintiles households are be-

hind relative to those from the poorest quintile. A possible explanation for this could be that such children start later by their parents' choice, or that they attend higher-quality and more-demanding schools in which grade promotion is less automatic. Higher parental education, about twice as much for mothers as for fathers, is associated with higher grade attainment for age. The second and third columns present estimates with, in addition to the main effects, interactions between village flood exposure and other main-effects-model variables. In addition, the third column has village fixed effects and is our preferred model. We focus here on the significant estimates of the coefficients of the interactions, which indicate how the associations with village floods differ from the overall average effects for the background characteristics interacted with the village flood variable.[2] The patterns of the estimates of interactions are similar between columns 2 and 3 with the exceptions that agricultural households have a significantly positive coefficient and Hindu Other Backward Castes have a negative coefficient in column 2, which are no longer significant in column 3 with the control for village fixed effects. After accounting for the fixed village-level characteristics in column 3, a positive coefficient estimate of household income suggests that richer children are better able to moderate the negative association between flood exposure and grade-for-age in comparison with children from lowest income quintile. Our model also finds that mothers with more education can significantly moderate probabilities of children falling behind with flood exposure relative to those with less education.

OLS Analysis of Academic Skills

Table 4 presents estimates for age-standardized math skills as the dependent variable to facilitate interpretation. The main-effects model (column 1) shows a statistically significant negative association of −0.141 SD between village flood exposure and math, holding constant all other sociodemographic variables in the model. Although negative, the coefficient estimate for the state-flooding index is not significantly associated with math performance. Girls (−0.138 SD) and children from Hindu Scheduled Castes (−0.141 SD), Scheduled Tribes and Indigenous (ST) (−0.329 SD), and Muslims (−0.177 SD) perform significantly worse in math relative to the reference groups (that is, boys and children from Hindu Upper Castes). Children from richer households perform better than those from the poorest. Children whose parents have more education rank higher in math. The coefficient estimate for households where agriculture is the main source of household income, although negative, is not statistically significant. Among the significant effects, the largest in absolute values are for Scheduled Tribe and Indigenous children, highest income quintile children, Muslim children, and Hindu Scheduled Caste children, indicating that these characteristics are more important predictors than gender, parental education, and differences in the lower income quintiles.

Column 2 shows coefficient estimates with, in addition to the main effects, interactions between village flood exposure and each of the main-effects-model variables. The significant coefficient estimates for the interaction terms suggest that Muslim children are more vulnerable to the negative influence of flood exposure on math than children from Hindu Upper Caste households, and that richer households may also be more able to protect learning among their children in the event of flood exposure.

In the village-fixed-effect regression estimates (column 3), the coefficient estimates for the interactions with the highest two income quintiles continue to be positive (implying a protective effect of approximately a third of a standard deviation for being in the fourth rather than the first quintile, with the fifth quintile estimate not significantly different from the fourth).[3] The coefficient estimate for

2. Once the interactions are included, the coefficient estimates of the main-effect variables refer to the overall reference category (that is, boys, Hindu Upper Caste, poorest income quintile, main income source nonagriculture, and so on), which is not of particular interest for this article, so we do not discuss these estimates extensively given space constraints.

3. The *p*-value for a t-test of difference in coefficients is .148.

Table 3. Coefficient Estimates from OLS Regression of Grade-for-Age

	(1) Main Effects	(2) Flood Interactions	(3) Village Fixed Effects (Preferred)
Main effects			
Flood exposure			
Village flood exposure (ref.: no floods)	−0.022+	−0.423***	
	(0.011)	(0.110)	
State flooding index	−0.455***	−0.469***	
	(0.032)	(0.038)	
Demographic characteristics			
Female (ref.: male)	0.029**	0.025*	0.028*
	(0.010)	(0.012)	(0.012)
Age	−0.055***	−0.062***	−0.062***
	(0.005)	(0.006)	(0.006)
Caste-religion (ref.: Hindu Upper Castes)			
Hindu Other Backward Castes	−0.066***	−0.099***	−0.039
	(0.016)	(0.019)	(0.024)
Hindu Scheduled Castes	−0.004	−0.011	−0.059*
	(0.018)	(0.021)	(0.025)
Scheduled Tribes or Indigenous	−0.052*	−0.052*	−0.095**
	(0.022)	(0.025)	(0.036)
Muslim	−0.179***	−0.185***	−0.130***
	(0.02)	(0.024)	(0.035)
Other	−0.049	−0.051	−0.181*
	(0.059)	(0.063)	(0.089)
Socioeconomic status			
Income quintiles (ref.: poorest quintile)			
Second quintile	−0.015	−0.030+	−0.056**
	(0.014)	(0.018)	(0.018)
Third quintile	−0.018	−0.026	−0.032+
	(0.015)	(0.018)	(0.020)
Fourth quintile	−0.057***	−0.089***	−0.058**
	(0.017)	(0.020)	(0.022)
Richest quintile	−0.080***	−0.138***	−0.086***
	(0.019)	(0.023)	(0.026)
Agricultural household (ref.: non-agricultural household)	0.013	0.001	−0.013
	(0.01)	(0.013)	(0.015)
Mother's education (grades)	0.016***	0.014***	0.005*
	(0.002)	(0.002)	(0.002)
Father's education (grades)	0.008***	0.008***	0.008***
	(0.001)	(0.002)	(0.002)
Village flood interactions			
Flood exposure			
State flooding index		0.071	
		(0.071)	
Demographic characteristics			
Female		0.009	−0.018
		(0.021)	(0.021)
Age		0.024*	0.014
		(0.010)	(0.010)

(*continued*)

Table 3. (*continued*)

	(1) Main Effects	(2) Flood Interactions	(3) Village Fixed Effects (Preferred)
Caste-religion			
Hindu Other Backward Castes		0.103**	0.061
		(0.034)	(0.041)
Hindu Scheduled Castes		0.032	0.073
		(0.038)	(0.045)
Scheduled Tribes or Indigenous		−0.024	0.091
		(0.051)	(0.071)
Muslim		0.029	−0.015
		(0.043)	(0.058)
Other		0.024	0.094
		(0.181)	(0.220)
Socioeconomic status			
Income quintiles			
Second quintile		0.037	0.089**
		(0.029)	(0.03)
Third quintile		0.018	−0.002
		(0.031)	(0.033)
Fourth quintile		0.110**	0.074+
		(0.036)	(0.039)
Richest quintile		0.221***	0.180***
		(0.042)	(0.047)
Agricultural household		0.044*	0.031
		(0.022)	(0.025)
Mother's education (grades)		0.006+	0.008*
		(0.003)	(0.004)
Father's education (grades)		−0.001	0.002
		(0.003)	(0.003)
Constant	1.595***	1.719***	1.475***
	(0.051)	(0.061)	(0.049)
N	7,284	7,284	7,284
R^2	0.107	0.116	0.418
Akaike information criterion	8,227.780	8,185.581	5,126.425
Bayesian information criterion	8,344.968	8,406.171	5,326.334

Source: Authors' calculations based on Indian Human Development Survey (Desai, Vanneman, and NCAER 2019).

Note: Standard errors in the second row. Coefficients are weighted using attrition weights calculated based on response propensities.

+ $p < .1$; * $p < .05$; ** $p < .01$; *** $p < .001$

Muslim, however, is no longer statistically significant, even though the magnitude of the estimate is not changed substantially from that in column 2, because the precision of this estimate declines with the village fixed effects. The interaction coefficient on flood exposure and gender is significantly negative for girls with controls for village fixed effects (protective effect for boys of about a tenth of a standard deviation). In regard to interactions with the flood

Table 4. Coefficient Estimates from OLS Regression of Age-Standardized Math Skills

	(1) Main Effects	(2) Flood Interactions	(3) Village Fixed Effects (Preferred)	(4) Flood Interactions + Grade-for-Age
Main Effects				
Flood exposure				
Village flood exposure (ref.: no floods)	−0.141***	−0.197		0.105
	(0.025)	(0.239)		(0.242)
State flooding index	−0.086	0.001	0.000	0.274***
	(0.070)	(0.083)	(.)	(0.081)
Demographic characteristics				
Female (ref.: male)	−0.138***	−0.119***	−0.115***	−0.134***
	(0.022)	(0.026)	(0.027)	(0.026)
Age	−0.004	−0.007	−0.006	0.030*
	(0.010)	(0.012)	(0.012)	(0.012)
Caste-religion (ref.: Hindu Upper Castes)				
Hindu Other Backward Castes	−0.024	−0.022	−0.054	0.036
	(0.035)	(0.042)	(0.053)	(0.040)
Hindu Scheduled Castes	−0.141***	−0.103*	−0.246***	−0.097*
	(0.038)	(0.046)	(0.056)	(0.044)
Scheduled tribes or Indigenous	−0.329***	−0.333***	−0.331***	−0.303***
	(0.048)	(0.055)	(0.080)	(0.053)
Muslim	−0.177***	−0.105*	−0.017	0.003
	(0.043)	(0.052)	(0.078)	(0.051)
Other	0.029	0.045	−0.320	0.074
	(0.127)	(0.136)	(0.196)	(0.132)
Socioeconomic status				
Income quintiles (ref.: poorest quintile)				
Second quintile	0.011	−0.052	−0.093*	−0.034
	(0.030)	(0.038)	(0.041)	(0.037)
Third quintile	0.084**	0.037	−0.014	0.052
	(0.032)	(0.040)	(0.043)	(0.038)
Fourth quintile	0.117**	0.020	−0.093+	0.071+
	(0.036)	(0.043)	(0.050)	(0.042)
Richest quintile	0.290***	0.224***	0.043	0.305***
	(0.041)	(0.049)	(0.057)	(0.047)
Agricultural household (ref.: non-agricultural household)	−0.032	−0.012	0.056+	−0.013
	(0.022)	(0.027)	(0.033)	(0.026)
Mother's education (grades)	0.044***	0.042***	0.042***	0.034***
	(0.003)	(0.004)	(0.005)	(0.004)
Father's education (grades)	0.027***	0.025***	0.023***	0.020***
	(0.003)	(0.004)	(0.004)	(0.003)
Educational progress				
Grade-for-age				0.583***
				(0.030)
Village flood interactions				
Flood exposure				
State flood index		−0.215		−0.274+
		(0.155)		(0.151)

(*continued*)

Table 4. (*continued*)

	(1) Main Effects	(2) Flood Interactions	(3) Village Fixed Effects (Preferred)	(4) Flood Interactions + Grade-for-Age
Demographic characteristics				
Female		−0.056	−0.111*	−0.060
		(0.046)	(0.046)	(0.044)
Age		0.010	−0.011	−0.006
		(0.021)	(0.021)	(0.021)
Caste-religion				
Hindu Other Backward Castes		−0.014	0.072	−0.074
		(0.074)	(0.089)	(0.072)
Hindu Scheduled Castes		−0.108	0.034	−0.126
		(0.082)	(0.099)	(0.079)
Scheduled Tribes or Indigenous		0.036	0.033	0.046
		(0.111)	(0.157)	(0.107)
Muslim		−0.190*	−0.201	−0.214*
		(0.093)	(0.127)	(0.090)
Other		−0.007	0.242	−0.022
		(0.391)	(0.485)	(0.377)
Socioeconomic status				
Income quintiles				
Second quintile		0.149*	0.106	0.128*
		(0.063)	(0.066)	(0.060)
Third quintile		0.107	0.043	0.096
		(0.067)	(0.073)	(0.065)
Fourth quintile		0.296***	0.343***	0.233**
		(0.077)	(0.086)	(0.075)
Richest quintile		0.196*	0.187+	0.071
		(0.092)	(0.103)	(0.089)
Agricultural household		−0.055	−0.093+	−0.078+
		(0.048)	(0.056)	(0.046)
Mother's education (grades)		0.004	−0.004	0.001
		(0.007)	(0.008)	(0.007)
Father's education (grades)		0.006	0.007	0.007
		(0.006)	(0.007)	(0.006)
Educational progress				
Grade-for-age				−0.044
				(0.052)
Constant	−0.117	−0.088	−0.052	−1.090***
	(0.109)	(0.132)	(0.108)	(0.138)
N	7,284	7,284	7,284	7,284
R^2	0.136	0.141	0.414	0.200
Akaike information criterion	19,459.460	19,448.510	16,651.847	18,933.109
Bayesian information criterion	19,576.648	19,669.100	16,851.757	19,167.486

Source: Authors' calculations based on Indian Human Development Survey (Desai, Vanneman, and NCAER 2019).
Note: Standard errors in parentheses. Coefficients are weighted using attrition weights calculated based on test response propensities.
+ $p < .1$, * $p < .05$, ** $p < .01$, *** $p < .001$

exposure variable, the other Hindu categories are not significantly disadvantaged relative to Hindu Upper Castes and parental education does not have significant coefficient estimates in any of the three sets of interaction estimates. Overall, our results indicate that even though children face marginalization of various forms, the economic resources of their households are likely to help them overcome loss in mathematical achievement in villages when floods occur. Furthermore, boys' math achievement is affected less than girls.

Finally, column 4 includes main effects, interactions, and grade-for-age (and its interaction with village flood exposure) to control for a possible mechanism through which floods might affect learning. The coefficient estimate on grade-for-age is not significantly nonzero, suggesting that this is not an important mechanism for math, so we do not discuss the other coefficient estimates here.

Table 5 presents estimates for age-standardized reading skills as the dependent variable. The estimates generally follow similar patterns to those for math skills in table 4. The only difference for the basic main-effects model (column 1) is the significantly negative coefficient estimate (–0.255 SD) for the state flood index for reading, in addition to the significantly negative estimate for village flood exposure (–0.118 SD). When interactions are added (column 2), for reading but not for math, the significant negative interaction between the village and the state flood variables indicates greater negative effects of village floods in states in which floods are more prevalent. For reading, the coefficient estimate for interactions of village floods is negative and marginally significant for Scheduled Tribes but not for Muslims. This contrasts with the coefficient estimate for math, which is negative and significant only for Muslims. Column 3 presents village fixed effects coefficient estimates. Unlike in math skills, the economic resources of children's households and child's gender do not seem to have significant protective effects against loss in reading achievement in villages when floods occur. When the grade-for-age variable is added (column 4), one difference for reading versus math is that for reading the grade-for-age variable is marginally significantly negative, consistent with grade-for-age possibly being one mechanism though which floods affect learning. Most of the other estimates are similar to those for the interactions model (column 2) except that interactions with Other Backward Castes and the richest quintile have marginally significant negative coefficient estimates, the latter of which is puzzling.

DISCUSSION AND CONCLUSIONS

Climate change is a growing global concern. One manifestation is increased flooding, particularly in LMICs in which protective measures for flooding are often limited, but also in high-income countries such as the United States. Relatively little is known, however, about the relations between flooding in LMICs and children's education, though a priori it would seem that important negative effects due to flood impacts on school infrastructures, access to schools, and time used for children's learning are possible. Moreover, such effects may be relatively large for marginalized children as identified by gender, caste, religion, and socioeconomic status.

This article contributes to the limited literature by characterizing differential exposure to floods for different marginalized groups and estimating empirical relations between flood exposure and educational outcomes for children in rural areas in India, a country that has substantial and increasing flood exposure and has the world's largest population of school-age children. Our emphasis is not on school enrollments and educational attainment, as in much of the literature on education in LMICs. Instead, we focus on timely progress and what children actually know about basic math and reading—whether or not they were in school at the time of the surveys. This approach is an improvement on studies that are limited to children in school, which is likely to be a selected subpopulation.

This article highlights the importance of distinguishing differential exposures and differential impacts in analyzing social stratification in the experience of disruption in childhood. The characterization of differential exposure to floods for different marginalized groups shows that differences are significant—by caste or religious group, with marginalized

Table 5. Coefficient Estimates from OLS Regression of Age-Standardized Reading Skills

	(1) Main Effects	(2) Flood Interactions	(3) Village Fixed Effects (Preferred)	(4) Flood Interactions + Grade-for-Age
Main effects				
Flood exposure				
Village flood exposure (ref.: no floods)	−0.118***	−0.133		−0.023
	(0.025)	(0.244)		(0.248)
State flood index	−0.255***	−0.110	0.000	0.143+
	(0.071)	(0.085)	(.)	(0.083)
Demographic characteristics				
Female (ref.: male)	−0.031	−0.028	−0.028	−0.042
	(0.022)	(0.027)	(0.028)	(0.026)
Age	−0.005	−0.012	0.003	0.022+
	(0.010)	(0.013)	(0.013)	(0.012)
Caste-religion (ref.: Hindu Upper Castes)				
Hindu Other Backward Castes	−0.006	0.019	−0.060	0.072+
	(0.035)	(0.043)	(0.054)	(0.041)
Hindu Scheduled Castes	−0.212***	−0.185***	−0.283***	−0.179***
	(0.039)	(0.047)	(0.057)	(0.045)
Scheduled tribe or Indigenous	−0.307***	−0.257***	−0.287***	−0.229***
	(0.049)	(0.056)	(0.082)	(0.055)
Muslim	−0.219***	−0.208***	−0.098	−0.108*
	(0.044)	(0.054)	(0.080)	(0.052)
Other	−0.221+	−0.224	−0.551**	−0.197
	(0.130)	(0.139)	(0.201)	(0.135)
Socioeconomic status				
Income quintiles (ref.: poorest quintile)				
Second quintile	0.051	0.007	0.003	0.023
	(0.031)	(0.039)	(0.042)	(0.037)
Third quintile	0.045	0.028	0.033	0.042
	(0.033)	(0.041)	(0.044)	(0.039)
Fourth quintile	0.066+	0.002	−0.033	0.050
	(0.036)	(0.044)	(0.051)	(0.043)
Richest quintile	0.162***	0.162**	0.101+	0.237***
	(0.042)	(0.050)	(0.058)	(0.048)
Agricultural household (ref.: non-agricultural household)	−0.034	−0.019	0.060+	−0.020
	(0.023)	(0.028)	(0.034)	(0.027)
Mother's education (grades)	0.043***	0.040***	0.035***	0.032***
	(0.003)	(0.004)	(0.005)	(0.004)
Father's education (grades)	0.029***	0.028***	0.024***	0.024***
	(0.003)	(0.004)	(0.004)	(0.004)
Educational progress				
Grade-for-age				0.540***
				(0.031)
Village flood interactions				
Flood exposure				
State flood index		−0.509**		−0.511***
		(0.158)		(0.155)

Table 5. (*continued*)

	(1) Main Effects	(2) Flood Interactions	(3) Village Fixed Effects (Preferred)	(4) Flood Interactions + Grade-for-Age
Demographic characteristics				
Female		−0.002	−0.082+	−0.010
		(0.047)	(0.047)	(0.045)
Age		0.022	−0.027	0.013
		(0.022)	(0.022)	(0.021)
Caste-religion				
Hindu Other Backward Castes		−0.074	0.042	−0.130+
		(0.076)	(0.092)	(0.074)
Hindu Scheduled Castes		−0.075	0.052	−0.094
		(0.084)	(0.101)	(0.081)
Scheduled Tribe or Indigenous		−0.211+	−0.185	−0.192+
		(0.114)	(0.161)	(0.110)
Muslim		−0.018	−0.069	−0.020
		(0.095)	(0.130)	(0.092)
Other		0.169	0.355	0.159
		(0.400)	(0.498)	(0.386)
Socioeconomic status				
Income quintiles				
Second quintile		0.105	0.063	0.084
		(0.064)	(0.068)	(0.062)
Third quintile		0.029	−0.096	0.020
		(0.069)	(0.075)	(0.066)
Fourth quintile		0.193*	0.147+	0.132+
		(0.079)	(0.088)	(0.076)
Richest quintile		−0.035	0.019	−0.162+
		(0.094)	(0.106)	(0.091)
Agricultural household		−0.048	−0.080	−0.076
		(0.049)	(0.057)	(0.047)
Mother's education (grades)		0.010	0.008	0.005
		(0.007)	(0.008)	(0.007)
Father's education (grades)		0.002	0.008	0.003
		(0.007)	(0.007)	(0.006)
Educational progress				
Grade-for-age				0.090+
				(0.053)
Constant	−0.083	−0.053	−0.148	−0.981***
	(0.112)	(0.135)	(0.111)	(0.141)
N	7,284	7,284	7,284	7,284
R^2	0.121	0.125	0.398	0.184
Akaike information criterion	19,772.461	19,769.331	17,039.803	19,270.257
Bayesian information criterion	19,889.649	19,989.921	17,239.713	19,504.634

Source: Authors' calculations based on Indian Human Development Survey (Desai, Vanneman, and NCAER 2019).

Note: Standard errors in parentheses. Coefficients are weighted using attrition weights calculated based on test response propensities.

+ $p < .1$; * $p < .05$; ** $p < .01$; *** $p < .001$

Hindu castes and Muslims more exposed; by socioeconomic status, with children from poorer households with parents with less education more exposed; and by major income source, with agricultural households somewhat more exposed. In short, we show substantial evidence of differential exposures across many of the key stratifiers in Indian society. Findings demonstrate a lack of significant differences in exposure by gender or age.

In contrast, the estimation of effect heterogeneity of flood exposure tells a slightly different story. Our preferred village fixed-effects specifications finds the following three significant (in some cases marginally significant) flood-social group interactions: flood effects on increasing grade-for-age are greater for poorer income quintiles; flood effects reduce math skills more for girls and poorer households; and flood effects reduce reading skills more for girls but the fourth income quintile is protective. In these estimates for the three educational outcomes, age, caste-religion, agricultural main income source, and parental education do not significantly interact with flood exposure. Overall, the number of interactions is limited and many of the significant ones are not very large in magnitude. In short, although marginalized children are disproportionately likely to experience floods, relative to other rural children, systematic evidence is less of disproportionate educational penalties relative to the penalties other children face when floods do occur. In other estimates, we investigate the possibility that grade-for-age is a mechanism for the impacts of floods on learning, but only find marginally significant coefficient estimates for reading and not for math.

This study has limitations. The data used permit estimates of associations, not of causal effects.[4] Flood exposure may be operating as a proxy, in part for a constellation of other associated factors that make some children more vulnerable, though we control for a number of observed variables and, in our preferred estimates, for unobserved village characteristics. Moreover, the outcome variables pertain only to grade-for-age and to fairly limited categorical indicators of basic mathematics and reading, not to more nuanced learning or to more advanced learning. Finally, it is important to acknowledge that these findings likely underrepresent the scale of disparities across all children in India, because urban children as a group enjoy educational and economic advantages and our sample focuses on disparities within the rural population.

Nevertheless, this study contributes to a very limited literature about flood exposure and education by analyzing the case of India—a LMIC with the largest population of school-age children in the world. Findings suggest the need to better understand the impacts of flooding on educational outcomes among marginalized populations in other LMICs as well as in high-income countries (Azevedo et al. 2021; EPA 2021; Lieberman-Cribbin et al. 2021). Findings also highlight the need for further efforts to identify causal relations and mitigating factors. One policy implication is that effective strategies need to be designed, piloted, and implemented to minimize disproportionate exposure and its adverse educational outcomes for marginalized children—both in LMICs such as India and in high-income countries (EPA 2021; Kousky 2016; World Bank 2019). The effectiveness of such strategies in LMICs could have important implications for the composition—that is, development versus disaster relief—and the amount of aid flows from high-income countries and international organizations to LMICs.

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Unequal Effects of Wildfire Exposure on Infant Health by Maternal Education, 1995–2020

EMILY RAUSCHER AND XINYAN CAO

Using National Vital Statistics Birth and Fetal Death Data from 1995 to 2020 linked to county-level information on wildfires, we use variation in wildfire timing to examine how effects of wildfire exposure on infant health vary by maternal education. Results indicate that wildfire exposure increases the likelihood of low birth weight and fetal death, but effects vary by both trimester and maternal education. Mediation analyses suggest the variation by maternal education reflects selective survival and unequal sensitivity, rather than differential parental response to wildfires. In addition, mediation analyses suggest that maternal behaviors explain a greater share of the relationship between wildfire exposure and infant health than air quality. Wildfires may therefore reduce infant health through stress.

Keywords: wildfires, infant health, fetal death, inequality

Prenatal wildfire exposure is associated with poorer infant health (see Amjad et al. 2021 for a review; Jayachandran 2009; Requia et al. 2022), but less is known about why. The association could reflect air quality, stress, or selective exposure to wildfires. Mixed evidence in existing research could reflect a number of limitations, including bias due to sample exclusions and confounding (Amjad et al. 2021), as well as potential heterogeneous effects by maternal socioeconomic status (SES) (Cozzani, Triventi, and Bernardi 2022).

Wildfires are increasing in frequency and intensity in the United States (Dennison et al. 2014; Halofsky, Peterson, and Harvey 2020). The increasing prevalence of wildfires in more areas of the United States makes understanding their health and inequality implications urgent and relevant for a growing swathe of the country. We contribute to existing research by, first, examining wildfires throughout the United States from 1995 to 2020 to include a more representative sample than studies that limit analysis to one location or time period; second, including births from the full distribution of health outcomes to avoid potential exclusion

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bias (Amjad et al. 2021); third, examining heterogeneous effects by maternal SES and conducting mediation analyses to understand mechanisms; and, fourth, examining effects on fetal death to explicitly examine selective survival.

We use National Vital Statistic Birth Data for 1995 through 2020 linked to county-level wildfire and air quality data to examine how the relationship between wildfire exposure and infant health varies by maternal education—a key SES indicator that is consistently associated with infant health. We examine several potential mediators, including prenatal care and health behaviors, to help understand that variation. We address two research questions: Does the relationship between prenatal wildfire exposure and infant health vary by maternal education? Do prenatal care or health behaviors explain variation by maternal education?

Baseline infant health and access to care could vary by local risk of wildfires, which would bias naïve estimates of the relationship between wildfire exposure and infant health. We use two strategies to address this concern. First, we use fixed-effects models to adjust for stable differences in infant health between counties and national changes in infant health over time. Second, we use geocoded wildfire data and take advantage of variation in their timing to estimate causal effects of wildfire exposure on infant health.

To preview our results and consistent with existing work, wildfire exposure during pregnancy is related to poorer infant health. Using variation in wildfire timing within counties, we find that effects of wildfire exposure vary by both trimester and maternal education, with more negative effects among low-SES mothers exposed during the second trimester. These results hold under a series of sensitivity analyses, including controlling for air quality and seasonality of births and assuming all pregnancies last nine months. Estimated effects on fetal death and mediation analyses suggest that the variation by maternal education could partly reflect selective survival and unequal sensitivity, rather than differential parental response to wildfires.

BACKGROUND

Exposure to environmental toxins, including air pollution and wildfires, has negative implications for health at every life stage through multiple and compounding effects on the immune, neurological, and endocrine systems (Torche, Fletcher, and Brand 2024, this issue; Crinnion 2000; Sexton et al. 1992). Exposure to environmental toxins or insults are particularly harmful during early life and even during pregnancy (Conley and Bennett 2000; Goosby 2013; Haas 2008; Palloni 2006; Pizzorno and Murray 2020). For example, lead exposure during childhood has been linked to cognitive impairment and lower test scores in adolescence and adulthood (Aizer et al. 2018; Bellinger et al. 1991; Mazumdar et al. 2011). Flood exposure among rural, school-age children in India is related to lower math and reading skills (Khalid et al. 2024, this issue). Similarly, exposure to famine in utero has been linked to chronic health problems, including obesity, cardiovascular problems, and cognitive functioning later in life (de Rooji et al. 2010; Roseboom, de Rooji, and Painter 2006; Schulz 2010).

Exposure to environmental shocks has negative implications for infant health through multiple pathways and the effects can vary depending on the timing of exposure during pregnancy. For example, exposure to an earthquake during gestation reduced infant health through maternal stress, but only among those exposed during the first trimester of pregnancy (Torche 2011). Exposure to iron mining residues due to a collapsed dam during the third trimester reduced infant birth weight and increased infant mortality (Carrillo et al. 2020).

Air pollution is one potential mechanism (Currie, Neidell, and Schmieder 2009; Ritz et al. 2007, 2000; Liu et al. 2003; Maisonet et al. 2001; Rogers et al. 2000; Ritz and Yu 1999; Lee et al. 2003). In addition to air pollution, wildfires could also influence infant health through other mechanisms, such as maternal stress, pregnancy complications, and disrupted prenatal care, family, and work routines. Wildfires increase the risk of maternal PTSD-like symptoms and maternal stress over family separation, childcare, and strained spousal relationships (Verstraeten et al. 2021; Bremault-Phillips et al. 2020). Maternal

stress is also related to pregnancy complications, such as hypertensive disorders, and may cause premature delivery (Currie and Rossin-Slater 2013; Oni et al. 2015). Finally, wildfires can limit pregnant women's physical mobility and disrupt their routines, roles, and occupational schedules (Pike et al. 2022).

Poor infant health has long-term consequences, resulting in higher risk of disability, mortality, and poor health later in life as well as lower educational and labor-market outcomes (de Jong et al. 2012; Swamy, Ostbye, and Skjaerven 2008; Aizer et al. 2018; Bellinger et al. 1991; Mazumdar et al. 2011; Baranowska-Rataj et al. 2022). Poor infant health, including low weight births, are also expensive, with one underweight hospital birth costing approximately $24,000 more than a normal weight birth (America's Health Rankings 2021). Exposure to wildfires and other air pollution is increasing, making it important to understand how to mitigate their effects on infant health.

Variation in Environmental Effects on Infant Health

The effects of environmental insults on infant health can vary depending on factors other than timing of exposure, particularly parental socioeconomic status. Socioeconomic status could alter the effects of environmental insults through variation in exposure, sensitivity, survival, or parental responses (Cozzani, Triventi, and Bernardi 2022).

Effects could be larger among low-SES infants if mothers are exposed to more wildfires or poorer air quality because of the proximity, duration, or intensity of wildfires. People with fewer resources are exposed to more air pollution than higher-SES populations at home and at work (Tessum et al. 2021, 2019; Ferguson et al. 2020; Hajat, Hsia, and O'Neill 2015). However, exposure to wildfires may be more equal because wildfires occur in areas where those across the SES distribution are likely to live, including suburban and rural areas. We assess exposure rates by SES in our sample and find relatively similar exposure rates (see tables A.3 and A.4 in the online appendix).[1]

When exposure is equal, negative effects of wildfire exposure may still be stronger among low-SES infants because of higher sensitivity or lower resilience among low-SES mothers. For example, low-SES mothers may have more severe pre-existing conditions and risk factors, including exposure to chronic stress, that increase the likelihood of negative health outcomes from stress or poor air quality (Torche 2018; Martins et al. 2004; Turner and Avison 2003; Prescott et al. 2003; Chen, Krewski, and Dales 2001; Jerrett et al. 2004; Phelan and Link 2005). Alternatively, exposure to higher air pollution or stress could have more detrimental effects among higher-SES mothers because of lower resilience or higher sensitivity from limited earlier exposure (Genereux et al. 2008; Feder, Nestler, and Charney 2009; Cagney et al. 2016).

Low-SES mothers have fewer resources available to avoid wildfires, avoid poor air quality days, access health care to prevent and address health concerns, and reduce stress through healthy coping mechanisms (Link and Phelan 1995; Phelan and Link 2005; Torche 2018; Elo 2009). This perspective suggests that those with higher SES have a flexible set of resources—money, knowledge, time—that they leverage to maintain better health as the policy and environmental context change (Torche, Fletcher, and Brand 2024, this issue; Link and Phelan 1995). In the case of wildfires, effects could be larger among low-SES mothers if they are less able to access prenatal care or stay indoors on unhealthy days (House et al. 1990; House 2002; Lieberson 1985; Link and Phelan 1995; Preston and Taubman 1994; Zeng, Gu, and Land 2007).

Exposure to environmental insults, including wildfires, could increase the chances of fetal death, resulting in the survival of healthier and more robust infants. If wildfires increase fetal death, then their negative effects on infant health would be underestimated when examining only live births because the resulting births are healthier (Bharadwaj et al. 2013). Selective survival could help explain varying effects by SES if wildfires have different effects by both

1. Online appendix material can be found at https://www.rsfjournal.org/content/10/1/255/tab-supplemental.

maternal SES and the timing of exposure. For example, environmental insults could increase the likelihood of fetal death early in pregnancy for low-SES births, leaving healthier low-SES fetuses relative to high-SES fetuses. This form of selective survival would predict negative health effects of early exposure for low-SES pregnancies, followed by weaker effects of later exposure among low-SES pregnancies. Because high-SES pregnancies are less selected, selective survival would predict more negative health effects of late-pregnancy exposure among high-SES births. Because most studies examine live births, little research has directly examined selective survival as a potential explanation for varying effects of environmental insults (Cozzani, Triventi, and Bernardi 2022).

Wildfires vary in their timing and location. The increasing prevalence of wildfires in more areas of the United States makes understanding their health implications urgent and relevant for a growing swathe of the country (Dennison et al. 2014; Halofsky, Peterson, and Harvey 2020). As wildfires occur in more areas throughout the country, it is becoming difficult for women across the SES distribution to avoid them entirely. We use variation in wildfire timing to estimate effects of wildfire exposure on infant health. We build on work by Marco Cozzani, Moris Triventi, and Fabrizio Bernardi (2022) and Florencia Torche and Andres Villarreal (2014) by explicitly examining mechanisms, including selective survival, to understand variation in effects of environmental insults by maternal SES. Based on this review, we pose two hypotheses:

> Hypothesis 1: Wildfire exposure has negative effects on infant health outcomes.
>
> Hypothesis 2: The negative health effects of wildfire exposure are larger for less-educated mothers.

METHODS

Mothers with more resources, including education and health knowledge, are more likely to live in counties with higher-quality air and less pollution (House et al. 1990; House 2002; Lieberson 1985). Rates of prenatal exposure to wildfires are relatively similar by SES (see tables A.3 and A.4), but baseline differences in local air quality, health-care access, or other resources could bias naïve estimates of the relationship between wildfire exposure and infant health. To address such differences, we limit the main analyses to counties with a Class G wildfire (those that burned at least five thousand acres), taking advantage of variation in the timing of wildfires and the timing of exposure relative to conception. We use fixed-effects models to adjust for stable differences in infant health between counties and geocoded wildfire data to test whether infant health changes with wildfire exposure within the same county.

Data

National Vital Statistics System (NVSS) birth data provide administrative infant health and prenatal care information for each live birth in the United States and include information on maternal education and county of residence. We use restricted NVSS data, which include maternal county of residence. We take a 10 percent random sample of singleton births, with information about infant health and maternal characteristics, born each year from 1995 to 2020. We limit analyses to singleton births because multiple births (such as twins or triplets) are not randomly distributed by maternal education and have lower measures of infant health.

NVSS fetal death data provide information about fetal deaths (pregnancies that did not result in a live birth, also called stillbirths or miscarriages) in the United States, which we use to examine potential selective survival. Fetal death data include information about maternal education and county of residence in the restricted data, but do not include induced terminations of pregnancy (abortions) and in most states do not include deaths early in pregnancy (before twenty weeks of gestation or less than 350 grams). We use all singleton fetal deaths and, because we take a 10 percent random sample of live births but not of deaths, we assign a weight of ten to each sampled birth observation and a weight of one to each death observation for analyses examining fetal death. Maternal education is not available between 2007 and 2013, so analyses examining fetal death include those from 1995 to 2006 and from 2014 to 2020.

We link individual NVSS birth and fetal death data to county-level data on air quality and wildfire timing and severity using county Federal Information Processing System (FIPS) codes for maternal county of residence. Air Quality Index (AQI) data provide annual county-level data on air quality from the U.S. Environmental Protection Agency (EPA) for 1995 through 2020 (EPA 2021). AQI values are based on daily information recorded from monitors throughout the United States. In the time period we examine, EPA provides AQI data for approximately half (47 percent) of U.S. counties. These monitors record particulates and toxic gases or matter in the air. The EPA reports annual county-level air quality statistics, including 90th percentile and maximum AQI and the number of unhealthy days in a county during the year. Higher AQI values indicate higher pollution and lower quality air. According to the EPA, AQI values between 0 and 50 are good and those above 50 are unhealthy to varying degrees.

Wildfire data are from Monitoring Trends in Burn Severity (MTBS 2022), which is conducted by the U.S. Geological Survey Center for Earth Resources Observation and Science and the USDA Forest Service Geospatial Technology and Applications Center. MTBS data provide information about the location, timing, and burn severity of large fires throughout the United States, including fires that burn at least five hundred or one thousand acres in the eastern and western United States, respectively. Wildfire locations are geocoded using ArcGIS Pro, spatially joined to the county in which they began, and linked to NVSS and EPA data using county FIP codes. To focus on the most severe wildfire in each county-year, we include wildfires that burned the largest number of acres in each county-year from 1995 to 2020. We further focus our analyses on Class G fires that burn at least five thousand acres. This results in a sample of 2,890 large wildfires across county-years from thirty-seven states, with multiple wildfires in counties over time (only 237 counties had one wildfire over the period examined). To allow event study analyses, we link wildfire data to the 10 percent random sample of singleton births in the same county in the year before, the year of, and the year after the wildfire, yielding a sample of 1,389,357 births. Figure A.1 shows the distribution of wildfire severity by month and by year. These figures show increasing severity over years as measured by the number of acres burned and percent of county acres burned. Wildfires that started in September are the most severe, potentially because they occur in the dry period following summer.

Measures

Primary dependent variables are based on NVSS birth and fetal death data and measured as low birth weight (less than 2,500 grams) and fetal death. The low birth weight threshold identifies infants at high risk for poor health in childhood and later life (Conley et al. 2003; Johnson and Schoeni 2011; Institute of Medicine 2003). Fetal death (also called stillbirth or miscarriage) allows explicit examination of selective survival and is an indicator for whether the observation is a live birth (in the NVSS birth data) or did not result in a live birth (in the fetal death data). Fetal death and low birth weight are not mutually exclusive and approximately 81 percent of fetal deaths are also low birth weight. Sensitivity analyses examine preterm birth (less than thirty-seven weeks), birth weight (grams), gestational length (weeks), and intrauterine growth restriction (under the 10th percentile of birth weight for gestational age) to examine continuous outcome measures and to allow for downward trends in birth weight over time (Oken et al. 2003). Gestational length is based on last missed period before 2014 and obstetric estimate since 2014.

The primary independent variables are indicators for wildfire exposure during the first, second, or third trimester. Exposure timing is measured based on wildfire start date and county, maternal county of residence, and estimated conception date, calculated as birth date minus gestational length. First trimester exposure is coded 1 if a wildfire started in the mother's county of residence during the first three months of gestation and 0 otherwise. Second trimester exposure indicates whether a wildfire started during months four through six of gestation, and third trimester exposure indicates whether a wildfire started after six months of gestation and before birth. Date of conception is measured with error, but measur-

ing wildfire exposure by counting backward from birth date is biased due to variation in gestational length (Currie and Rossin-Slater 2013). Premature births could be inaccurately coded as exposed when calculating wildfire exposure based on birth date. We calculate conception month since wildfire ignition date to compare infant health over time relative to the wildfire.

Wildfire severity is measured as the number of acres burned and the percent of acres burned in the county. Main analyses are limited to Class G wildfires that burn at least five thousand acres. Sensitivity analyses examine effects of more severe wildfires that burn more than the median percent of county acres (2 percent) or at least ten thousand acres. The data do not include duration or containment date, but duration would be measured with error even with this information because wildfires can continue burning after they are fully contained (Thompson et al. 2017; Reimer, Thompson, and Povak 2019). The average wildfire duration in western U.S. forest areas is fifty-two days (Westerling 2016, 7), but average duration is likely longer for the fires in our study, because we examine the most severe Class G fire in each county and year.

We measure *socioeconomic status* using maternal education. NVSS birth data do not include a measure of family income. Maternal education provides a measure of socioeconomic status that strongly predicts health (Elo 2009; Harding, Morris, and Hughes 2015; Montez et al. 2019). We stratify the sample and examine birth outcomes separately by maternal education level: less than a high school degree, high school degree, some college, and at least a four-year college degree. Controls include maternal race-ethnicity (mutually exclusive categories for Black, American Indian, Asian, Latina, or White), maternal age, marital status, and whether the infant is male.

Potential mechanisms for the relationship between infant health and wildfires include prenatal care, maternal health behaviors, and air quality. We measure prenatal care using indicators for receipt of any prenatal care, receipt of care in the first trimester, and number of prenatal visits. Measures of maternal health behavior include indicators for smoking during pregnancy, number of daily cigarettes during pregnancy, and weight gain during pregnancy. These measures are not available in all years; we examine multiple measures to check for consistency across potential mechanisms and to allow for potential variation in health-care needs and behaviors. AQI is the air quality measure used by the Environmental Protection Agency and ranges from 0 to 500, with higher values indicating higher air pollution (EPA 2021). We use county-year maximum AQI, 90th percentile AQI, and the number of unhealthy days to measure exposure to poor air quality in each year for each county. These measures are logged to reduce skewness.

Analyses

We follow previous research and use an event study design to compare birth outcomes for those exposed to a wildfire during gestation with those born shortly before or conceived shortly after the wildfire in the same area (Holstius et al. 2012). We improve on existing work in three ways. First, we examine wildfires throughout the United States between 1995 and 2020 to include a more representative sample than studies that limit analysis to one location or time period. Second, we include births from the full distribution of health outcomes rather than exclude births below a certain weight or gestational length (a common limitation identified in a review by Amjad et al. 2021). Third, we examine effects on fetal death to explicitly examine selective survival. Including fetal deaths provides a more complete distribution of infant health outcomes by including pregnancies that did not result in a live birth and allows us to examine whether varying effects by maternal education reflect unequal chances of survival.

We limit analyses to counties with a wildfire because mothers and infants in those counties could differ from those in other counties on baseline health conditions and ability to respond to environmental insults. In each county-year with a wildfire, we limit analyses to births conceived twenty-one months before to twelve months after the wildfire start date. This sample includes births likely exposed during gestation (conceived approximately zero to nine months before the wildfire start date), as

well as those conceived another twelve months before and twelve months after the wildfire start date. Equation 1 predicts individual infant health (i) in each birth year (t) and birth month (m), in each county of maternal residence (j), with wildfire exposure, fixed effects for birth month, year, and county, and controls (X_{ijtm}) for individual characteristics (sex of the infant, parental marital status, maternal age and race/ethnicity, and estimated conception date). County fixed effects account for stable county differences in infant health, and month and year fixed effects address nationwide changes in infant health over time. Robust standard errors adjust for county clustering in all models.

$$LBW_{ijtm} = a + \beta_1 Tri1_{ijtm} + \beta_2 Tri2_{ijtm} + \beta_3 Tri3_{ijtm} + County_j + Year_t + Month_m + X_{ijtm} + \varepsilon_{ijtm} \quad (1)$$

The coefficients of interest (β_1, β_2, and β_3) estimate the relationship between wildfire exposure and timing and the likelihood of low birth weight (LBW). We stratify the sample to fit models separately for each level of maternal education and then compare coefficients by maternal education.

Estimates rely on within-county variation in exposure across birth cohorts and within-cohort variation in exposure across counties. We fit models with and without controls and add controls for time-varying county-level characteristics (unemployment rate, poverty rate, median income) to account for local economic changes that could influence infant health.

When predicting indicators for low birth weight and fetal death, positive coefficients for wildfire exposure would be consistent with hypothesis 1, suggesting more negative health outcomes from wildfire exposure. We test for significant differences between wildfire exposure coefficients by maternal education using z tests (Clogg et al. 1995). For example, to test for different effects of first trimester exposure by education, we calculate z statistics ($z = \beta_{<HS} - \beta_{BA} / \sqrt{SE^2_{<HS} + SE^2_{BA}}$), where $\beta_{<HS}$ indicates the estimated effect of first trimester exposure among births to mothers with less than high school and β_{BA} indicates the estimated effect of first trimester exposure among births to mothers with at least a bachelor's degree. If these z statistics are positive and statistically significant, they would support hypothesis 2, that negative health effects of wildfire exposure are larger for less-educated mothers.

We repeat analyses controlling for air quality, wildfire severity (acres burned), and county economic characteristics to address potential unequal exposure and varying contexts. Because higher SES women are more likely to plan births at certain times of the year (Buckles and Hungerman 2013; Torche and Corvalan 2010), we calculate six- and twelve-month periodicity measures (following Torche and Corvalan 2010) and repeat analyses when controlling for these seasonality measures. Finally, as women with longer pregnancies have a higher chance to be exposed to wildfires (Currie and Rossin-Slater 2013), we repeat the analyses when assuming a nine-month gestation period for all births.

RESULTS

Table A.1 provides descriptive statistics for the 10 percent random sample of singleton births from 1995 to 2020. According to the CDC, rates of low birth weight and preterm birth in 2020 were 7 percent and 8 percent for singleton births (Osterman et al. 2022, 7). In our random sample including earlier years, low birth weight and preterm birth rates were comparable, at 6 percent and 10 percent, respectively. Consistent with previous studies (Rauscher 2020; Rauscher and Rangel 2020; Aizer and Currie 2014), mothers with higher levels of education give birth to healthier infants, on average. For example, rates of low birth weight are 6 percent among mothers with less than a high school degree, but 4 percent among mothers with at least a bachelor's degree.

Table 1 presents estimates of the effects of wildfire exposure on infant health among all births in the sample, specifically, births in counties with Class G wildfires that burned at least five thousand acres, conceived twenty-one months before to twelve months after the wildfire start date. Estimates indicate that infants who are exposed to a wildfire in their second or third trimester are about 0.2 percent more likely to be low birth weight than those born to mothers in the same county but conceived earlier or later relative to the wildfire. With approx-

Table 1. Estimated Relationship Between Wildfire Exposure and Infant Health

	Low Birth Weight	Preterm	Fetal Death
Limited to Live Births			
Trimester 1	0.0007 (0.0006)	−0.0016* (0.0008)	
Trimester 2	0.0021* (0.0009)	0.0007 (0.0017)	
Trimester 3	0.0016* (0.0007)	0.0018* (0.0007)	
N	681,015	681,015	
Including Fetal Deaths			
Trimester 1	0.0008 (0.0006)	−0.0016* (0.0008)	0.0002 (0.0002)
Trimester 2	0.0021* (0.0009)	0.0008 (0.0017)	−0.0000 (0.0001)
Trimester 3	0.0017* (0.0007)	0.0016* (0.0007)	0.0004** (0.0001)
N	691,309	692,293	692,293
Controlling for Seasonality			
Trimester 1	0.0008 (0.0006)	−0.0016* (0.0008)	0.0002 (0.0002)
Trimester 2	0.0021* (0.0009)	0.0008 (0.0017)	−0.0000 (0.0001)
Trimester 3	0.0017* (0.0007)	0.0016* (0.0007)	0.0004** (0.0001)
N	691,309	692,293	692,293
Controlling for Air Quality			
Trimester 1	0.0009 (0.0006)	−0.0016 (0.0008)	0.0003 (0.0002)
Trimester 2	0.0021* (0.0009)	0.0011 (0.0017)	−0.0000 (0.0001)
Trimester 3	0.0018* (0.0007)	0.0020** (0.0007)	0.0004* (0.0002)
N	652,441	653,304	653,304

Source: Authors' tabulation using CDC (1995–2020); EPA (2021); MTBS (2022).
Note: Sample includes births and fetal deaths conceived 21 months before to 12 months after the largest county Class G wildfire within one year, with AQI data in models controlling for air quality, and excluding years without maternal education in fetal death data (2007–2013). All models control for maternal age, parental marital status, infant sex, estimated conception date (month, year), and fixed effects for month of birth, year of birth, and county of maternal residence. Robust standard errors adjusted for county clustering in parentheses.
+ $p < .1$; * $p < .05$; ** $p < .01$

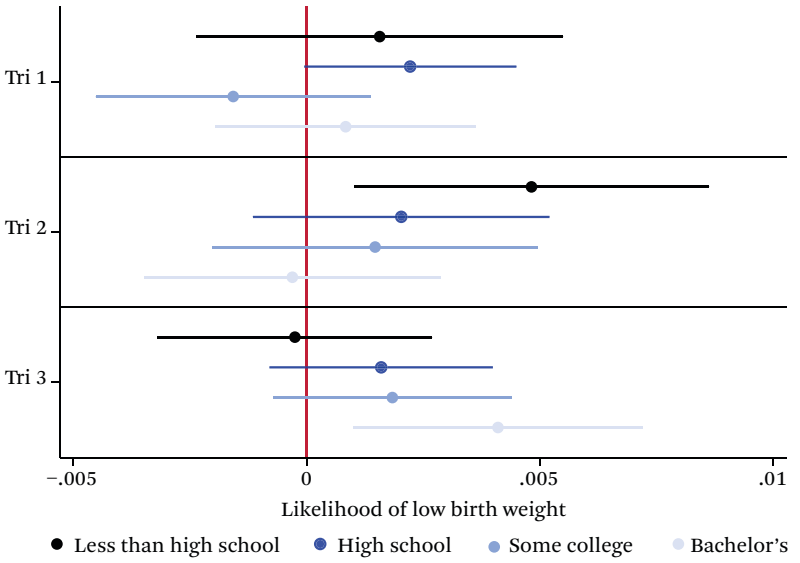
imately 3.6 million births per year in the United States and about 4 percent exposed to a wildfire in their second or third trimester, this slight increase in the rate would amount to about 288 additional LBW infants. Each underweight hospital birth costs approximately $24,000 more than a normal weight birth, resulting in an estimated annual cost of nearly $7 million (America's Health Rankings 2021).

Exposure in the third trimester increases the likelihood of preterm birth by 0.2 percent and fetal death by 0.04 percent. Results in table 1 are thus consistent with hypothesis 1 and suggest negative infant health effects of wildfire exposure, especially exposure late in pregnancy. These estimates hold when controlling for seasonality and air quality, suggesting that effects are not driven by air quality or selective birth timing alone. Effects on fetal death suggest selective survival could underestimate effects in naïve analyses examining only live births.

Variation by Maternal Education

Table 2, panel A presents estimates predicting the likelihood of low birth weight separately by maternal education. Among births to mothers with less than a high school degree, wildfire exposure during the second trimester consistently increases the chances of low birth weight by about 0.5 percent. However, exposure during the third trimester has no effect for mother

Figure 1. Predicted Effect of Wildfire Exposure on Likelihood of Low Birth Weight



Source: Authors' tabulation.

Note: Figures are coefficients from table 2, panel A. Error bars indicate 95 percent confidence intervals.

with less than high school. In contrast, exposure during the third trimester consistently increases the likelihood of low birth weight by 0.4 percent among mothers with a bachelor's degree. Coefficients among mothers with less than high school and a bachelor's degree are significantly different for both second and third trimester exposure. The unequal impact of wildfire severity on likelihood of low birth weight by maternal education is shown in figure 1. These results hold when controlling for seasonality or air quality and when including fetal deaths (pregnancies that did not result in a live birth). Estimates predicting the likelihood of preterm birth are shown in table A.5.

These estimates are small and births to mothers with less than high school account for only about 10 percent of annual births in the United States. Based on estimated effects of exposure in the first and second trimesters (0.16 percent + 0.48 percent = 0.64 percent), and average exposure in our sample (5 percent among those with less than high school in first and second trimesters), wildfires are estimated to increase the number of underweight births just to mothers with less than high school by about 117 (3,664,292 births in 2021 × 0.10 proportion less than high school × 0.05 × 0.0064 = 117). If each underweight birth costs an additional $24,000 (America's Health Rankings 2021), even this relatively small increase would represent nearly $3 million in annual hospital costs. Births to mothers with a bachelor's degree make up nearly a quarter of births and based on estimates of third trimester exposure (0.4 percent), wildfires are estimated to increase the number of underweight births to mothers with a bachelor's degree by about 110 (3,664,292 births in 2021 × 0.25 proportion bachelor's degree x 0.03 × 0.004 = 110), resulting in about $2.5 million in annual hospital costs.

Table 2, panel B presents estimates predicting the likelihood of fetal death separately by maternal education. Estimates (shown in figure 2) suggest that wildfire exposure in the third trimester increases the likelihood of fetal death by about 0.03 percent to 0.04 percent at all levels of maternal education. Exposure during the second trimester increases the likelihood of fetal death, but only among mothers with less than high school and these estimates are not significant. Estimates are consistent when controlling for seasonality and air quality.

Table 2. Relationship Between Wildfire Exposure and Infant Health by Maternal Education

Panel A. Likelihood of Low Birth Weight

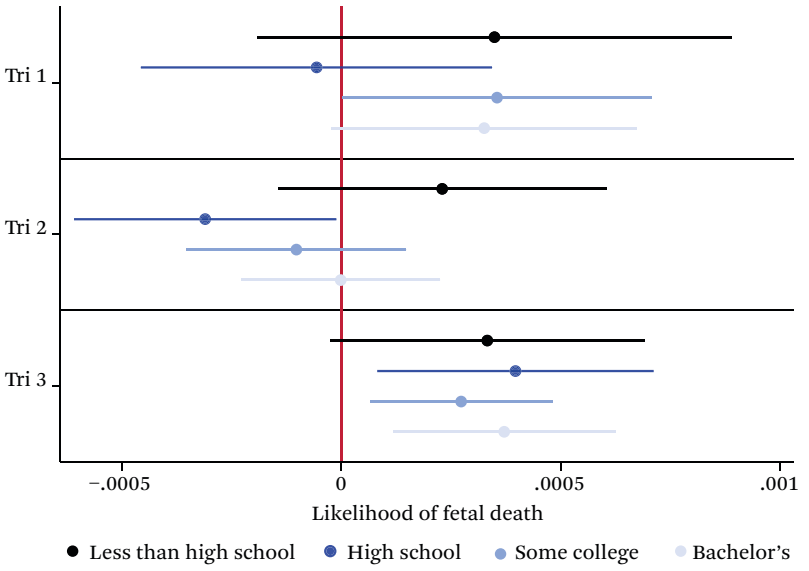
	< High School		High School		Some College		Bachelor's +	
Limited to live births								
Trimester 1	0.0014	(0.0020)	0.0022	(0.0012)	−0.0017	(0.0015)	0.0007	(0.0014)
Trimester 2	0.0047*	(0.0019)	0.0021	(0.0016)	0.0014	(0.0018)	−0.0003	(0.0016)
Trimester 3	−0.0004	(0.0015)	0.0015	(0.0012)	0.0018	(0.0013)	0.0040*	(0.0016)
N	170,716		197,373		163,812		149,114	
Including fetal deaths								
Trimester 1	0.0016	(0.0020)	0.0022	(0.0012)	−0.0016	(0.0015)	0.0008	(0.0014)
Trimester 2	0.0048*	(0.0019)	0.0020	(0.0016)	0.0015	(0.0018)	−0.0003	(0.0016)
Trimester 3	−0.0003	(0.0015)	0.0016	(0.0012)	0.0018	(0.0013)	0.0041**	(0.0016)
N	173,209		200,737		165,938		150,693	
Controlling for seasonality								
Trimester 1	0.0016	(0.0020)	0.0022	(0.0012)	−0.0016	(0.0015)	0.0008	(0.0014)
Trimester 2	0.0048*	(0.0019)	0.0020	(0.0016)	0.0015	(0.0018)	−0.0003	(0.0016)
Trimester 3	−0.0002	(0.0015)	0.0016	(0.0012)	0.0018	(0.0013)	0.0041**	(0.0016)
N	173,209		200,737		165,938		150,693	
Controlling for air quality								
Trimester 1	0.0017	(0.0021)	0.0020	(0.0012)	−0.0018	(0.0015)	0.0010	(0.0015)
Trimester 2	0.0051*	(0.0020)	0.0021	(0.0017)	0.0005	(0.0018)	−0.0003	(0.0017)
Trimester 3	−0.0008	(0.0016)	0.0022	(0.0013)	0.0017	(0.0013)	0.0043**	(0.0016)
N	165,289		187,215		155,255		144,044	

Panel B. Likelihood of Fetal Death

	< High School		High School		Some College		Bachelor's +	
Including fetal deaths								
Trimester 1	0.0003	(0.0003)	−0.0001	(0.0002)	0.0004*	(0.0002)	0.0003	(0.0002)
Trimester 2	0.0002	(0.0002)	−0.0003*	(0.0002)	−0.0001	(0.0001)	−0.0000	(0.0001)
Trimester 3	0.0003	(0.0002)	0.0004*	(0.0002)	0.0003*	(0.0001)	0.0004**	(0.0001)
N	173,388		201,030		166,154		150,835	
Controlling for seasonality								
Trimester 1	0.0003	(0.0003)	−0.0000	(0.0002)	0.0004*	(0.0002)	0.0003	(0.0002)
Trimester 2	0.0002	(0.0002)	−0.0003	(0.0002)	−0.0001	(0.0001)	0.0000	(0.0001)
Trimester 3	0.0004*	(0.0002)	0.0004**	(0.0002)	0.0003**	(0.0001)	0.0004**	(0.0001)
N	173,388		201,030		166,154		150,835	
Controlling for air quality								
Trimester 1	0.0004	(0.0003)	0.0001	(0.0002)	0.0004*	(0.0002)	0.0004	(0.0002)
Trimester 2	0.0002	(0.0002)	−0.0003	(0.0002)	−0.0001	(0.0001)	0.0000	(0.0001)
Trimester 3	0.0004	(0.0002)	0.0005*	(0.0002)	0.0002*	(0.0001)	0.0004**	(0.0001)
N	165,436		187,467		155,447		144,179	
Assuming 9-month gestation								
Trimester 1	0.0003	(0.0003)	−0.0001	(0.0002)	0.0003	(0.0002)	0.0003	(0.0002)
Trimester 2	0.0003	(0.0002)	−0.0003	(0.0002)	−0.0001	(0.0001)	−0.0000	(0.0001)
Trimester 3	0.0001	(0.0001)	0.0002	(0.0001)	0.0001	(0.0001)	0.0001	(0.0001)
N	173,388		201,030		166,154		150,835	

Source: Authors' tabulation using CDC (1995–2020); EPA (2021); MTBS (2022).
Note: Sample includes births and fetal deaths conceived twenty-one months before to twelve months after the largest county Class G wildfire within one year, with AQI data in models controlling for air quality, and excluding years without maternal education in fetal death data (2007–2013). Models are fit separately by maternal education level and all models control for maternal age, parental marital status, infant sex, estimated conception date (month, year), and fixed effects for month of birth, year of birth, and county of maternal residence. Robust standard errors adjusted for county clustering in parentheses. Shaded cells indicate significant difference from models limited to mothers with less than high school, $p < .05$ (Clogg et al. 1995).
* $p < .05$; ** $p < .01$

Figure 2. Predicted Effect of Wildfire Exposure on Likelihood of Fetal Death



Source: Authors' tabulation.
Note: Figures show coefficients from table 2, panel B. Error bars indicate 95 percent confidence intervals.

Longer pregnancies have a higher chance wildfire exposure (Currie and Rossin-Slater 2013), so analyses assuming nine-month gestation for all births are analytically valuable when predicting fetal death. When assuming nine-month gestation, second trimester wildfire exposure increases the likelihood of fetal death significantly more among mothers with less than high school than those with a high school degree.

Overall, results examining variation in effects of wildfire exposure are generally consistent with hypothesis 2 for second trimester exposure and suggest wildfires reduce infant health more among mothers with low levels of education. However, third trimester exposure has more negative infant health effects among mothers with higher levels of education. Varying effects of wildfire exposure by timing and maternal education are consistent with the selective survival explanation for unequal effects of environmental insults by SES.

Sensitivity Analyses

Results are consistent when conducting multiple sensitivity analyses. We repeat analyses with and without controlling for time-varying county characteristics (unemployment rate, poverty rate, median income) and with and without including controls for parental characteristics (maternal race, age, marital status). We repeat analyses when excluding births in counties with only one wildfire and results are consistent. Results are also consistent when limiting analyses to counties with a severe wildfire (above the median percent of county acres burned). Estimates controlling for seasonality measures and when assuming a nine-month gestation period for all births yield consistent results.

We include the full range of infant health outcomes to avoid selective exclusion concerns in existing research identified by Sana Amjad and her colleagues (2021). However, because some states do not report fetal death data for births below 350 grams or twenty weeks of gestation, we repeat analyses excluding births below these values and find consistent results.

After a wildfire, the same forest can burn again even in the following year, depending on climate conditions and plant adaptation to fires (Harvey, Donato, and Turner 2016; Coop et

al. 2020). However, wildfires in an area that recently burned may be less severe or disruptive. To account for repeat fires in the same area, we conduct two additional sets of analyses examining only the largest wildfire in each county within three years or within five years. Results in some models are smaller but in the same direction when examining births around these more severe wildfires. We also estimate the relationship between wildfire exposure and infant health when including all counties, even those without a wildfire, and find consistent results.

Mediation Analyses

Heterogeneous effects of wildfires by maternal education raise questions about mechanisms that could explain the varying results. Table 3, panel A presents the coefficients from models predicting the effect of wildfire exposure on multiple potential mechanisms. Estimates suggest that wildfires increase tobacco use and reduce prenatal care and weight gain among mothers at each level of education. For example, estimates predicting receipt of any prenatal care suggest that women are about 9 to 12 percent less likely to receive prenatal care when exposed to a wildfire. Similar estimates by SES are not consistent with unequal parental response to wildfire exposure. Based on measures of prenatal care, tobacco use, and weight gain, maternal response to wildfire exposure is similar by maternal education.

Table 3, panel B presents estimates of the percentage of the total effect of wildfire exposure on low birth weight that is mediated by the potential mechanisms examined, using medeff in Stata (Hicks and Tingley 2011). Estimates are shown separately by maternal education as an exploratory step to understand varying effects of wildfires. The largest mediation estimates are for the number of prenatal visits and tobacco use, and variation offers suggestive evidence that their mediating role differed by maternal education. Specifically, estimates suggest wildfire exposure in the second and third trimesters may have reduced infant health among less-educated mothers in part by reducing prenatal visits and increasing tobacco use. In contrast, these maternal behaviors mediated smaller fractions of the effect of wildfire exposure for more-educated mothers.

Mediation estimates suggest county air quality may also mediate a small part of the ef-

Table 3. Mediation Analyses

Panel A. Coefficients Predicting the Effect of Wildfire Exposure

Variable	< High School	High School	Some College	Bachelor's +
Any prenatal care	−0.102***	−0.093***	−0.118***	−0.087***
	(0.009)	(0.011)	(0.015)	(0.022)
First trimester care	−0.010**	−0.009**	−0.011***	−0.004
	(0.003)	(0.003)	(0.003)	(0.004)
Prenatal visits	−0.006***	−0.006***	−0.005***	−0.004***
	(0.000)	(0.000)	(0.000)	(0.000)
Tobacco use	0.057***	0.047***	0.039***	0.056***
	(0.007)	(0.006)	(0.007)	(0.015)
Daily cigarettes	0.002***	0.002***	0.002***	0.001*
	(0.000)	(0.000)	(0.000)	(0.001)
Weight gain	−0.002***	−0.002***	−0.001***	−0.002***
	(0.000)	(0.000)	(0.000)	(0.000)
Maximum AQI (log)	−0.001	−0.004	−0.005	−0.002
	(0.004)	(0.003)	(0.003)	(0.003)

Source: Authors' tabulation using CDC (1995–2020); EPA (2021); MTBS (2022).
Note: Sample and models are the same as those in table 2. Estimates are coefficients from equation (1) predicting potential mediators. Robust standard errors adjusted for county clustering in parentheses.
* $p < .05$; ** $p < .01$; *** $p < .001$

Table 3. (*continued*)

Panel B. Estimated Percentage of Total Effect on Low Birth Weight Mediated

	< High School	High School	Some College	Bachelor's +
Trimester 1				
Any prenatal care	7.4	−4.2	0.4	−0.3
First trimester care	2.0	1.9	2.4	0.9
Prenatal visits	−12.3	−1.0	8.6	4.3
Tobacco use	6.3	−2.6	2.2	−0.1
Daily cigarettes	−0.7	0.1	1.2	−0.2
Weight gain	−2.6	2.2	3.9	5.2
Maximum AQI (log)	0.0	1.9	2.3	1.4
Trimester 2				
Any prenatal care	1.1	−2.0	2.7	0.4
First trimester care	0.5	0.1	−1.5	−0.2
Prenatal visits	5.2	−0.1	6.9	3.8
Tobacco use	4.9	−5.2	−2.7	0.5
Daily cigarettes	0.3	−1.1	−2.0	0.1
Weight gain	0.8	−13.3	−6.7	−5.2
Maximum AQI (log)	0.3	−1.1	−1.0	−0.8
Trimester 3				
Any prenatal care	0.8	0.8	1.7	0.0
First trimester care	0.9	0.1	1.0	0.3
Prenatal visits	9.2	2.6	8.1	−0.4
Tobacco use	1.5	1.0	1.7	−0.8
Daily cigarettes	2.8	0.7	0.9	0.2
Weight gain	−2.5	2.0	4.8	2.6
Maximum AQI (log)	−0.1	0.0	−0.3	0.0

Note: Sample and controls are the same as table 2. Estimates of the percent of the total effect of wildfire exposure on low birth weight mediated by each variable (using medeff in Stata; Hicks and Tingley 2011).

Panel C. Sensitivity of Low Birth Weight Mediation Estimates

Variable	< High School	High School	Some College	Bachelor's +
Any prenatal care	−0.048	−0.059	−0.057	−0.041
First trimester care	−0.002	−0.010	−0.019	0.001
Prenatal visits	−0.138	−0.160	−0.148	−0.120
Tobacco use	0.041	0.043	0.041	0.020
Daily cigarettes	−0.160	−0.135	−0.125	−0.151
Weight gain	0.036	0.034	0.041	0.014
Maximum AQI (log)	−0.025	−0.020	−0.025	−0.031

Note: Sample and controls are the same as table 2. Estimates of the error correlation required for the mediation estimates in panel B to be zero (using medsens in Stata; Hicks and Tingley 2011; Imai et al. 2011).

fect of prenatal wildfire exposure on infant health. Air quality is measured using the annual county maximum AQI score, which is not ideal because it does not vary by individual birth within each county-year. Using county-year measures, mediation estimates suggest air quality could explain up to 2 percent of the effects of wildfire exposure on infant health.

At the same time, our mediation estimates suggest that wildfires affect infant health through mechanisms other than air quality. Wildfires are disruptive events, influencing multiple aspects of life, including transportation to work and prenatal care, destruction of capital, and stress (Wang et al. 2021; Davis et al. 2014; Kuligowski 2017). Individual-level air quality measures could yield higher mediation estimates, but relatively large estimates for prenatal visits, tobacco use, and weight gain suggest that other mechanisms are involved. For example, wildfires may influence infant health by disrupting transportation to prenatal care, destroying family homes, and increasing stress (Wang et al. 2021; Davis et al. 2014; Kuligowski 2017).

These mediation estimates should be interpreted with caution because they rely on the strong assumption of sequential ignorability (Imai et al. 2011), which is often violated. Table 3, panel C shows the correlation between error terms from the models predicting each mediator and the outcome measure required to make each mediation estimate zero. Mediation estimates are predicted to become zero at relatively low levels of correlation between error terms in models predicting the outcome and the mediator, suggesting estimates are sensitive to potential violation of the sequential ignorability assumption. Mediation estimates for prenatal visits and daily cigarettes are the least sensitive to potential violation, consistent with the evidence that prenatal care and tobacco use are key mechanisms for the relationship between wildfire exposure and infant health.

CONCLUSION

Based on more than 1.3 million birth records between 1995 and 2020, estimates suggest that exposure to a wildfire in the county where the mother resides during pregnancy reduces infant health. The relationship between wildfire exposure and infant health, however, varies by maternal education and by the timing of exposure. Wildfire exposure during the second trimester reduces infant health more among mothers with low levels of education, but exposure during the third trimester reduces infant health more among mothers with at least a bachelor's degree. For example, among births exposed during the second trimester, wildfire exposure increased the likelihood of low birth weight by 0.5 percent for mothers with less than high school, but had no effect on those with a bachelor's degree. In contrast, among births exposed during the third trimester, wildfire exposure increased the likelihood of low birth weight by 0.4 percent for mothers with a bachelor's degree, but had no effect for mothers with less than high school. These results hold in multiple sensitivity analyses.

The effects of wildfire exposure on infant health are small. However, even small effects on the likelihood of low birth weight have substantial long-term consequences for life chances, resulting in higher risk of disability, mortality, and poor health later in life, as well as lower educational and labor-market outcomes (de Jong et al. 2012; Swamy, Ostbye, and Skjaerven 2008; Aizer et al. 2018; Bellinger et al. 1991; Mazumdar et al. 2011; Baranowska-Rataj et al. 2022). In addition, even small effects on infant health are costly for society. Wildfire exposure is estimated to increase the number of underweight births by about 288 births per year, amounting to nearly $7 million in added annual hospital costs. As wildfire frequency and severity increase (Dennison et al. 2014; Halofsky, Peterson, and Harvey 2020), these estimates suggest the importance of mitigating their effects.

In a novel step, we examine fetal death data to understand variation by maternal education and to explicitly examine selective survival. We find that wildfire exposure slightly increases the likelihood of fetal death, particularly in the third trimester. In some models, second trimester wildfire exposure increases the likelihood of fetal death significantly more among mothers with less than high school than among those with a high school degree. The variation in likelihood of fetal death is consistent with selective survival and suggests that wildfire exposure earlier in pregnancy reduces the chances of fetal survival more among mothers with fewer resources. By the third trimester, fetuses carried by less-educated mothers are more highly selected and less sensitive to further environmental insults. In contrast, fetuses carried by more-educated mothers are more likely to survive wildfire exposure earlier in

pregnancy, suggesting they are less selected and may be more sensitive to later environmental insults.

In addition to selective survival, mediation analyses suggest the variation by maternal education could partly reflect varying importance of prenatal care and tobacco use. Wildfire exposure reduces prenatal care and increases tobacco use at all levels of maternal education. But those maternal behaviors explain a higher fraction of the relationship between wildfire exposure and infant health outcomes for mothers with less than high school than those with a bachelor's degree. These results are not consistent with unequal parental response and are consistent with differential sensitivity to wildfires. Despite similar exposure and similar changes in prenatal care and tobacco use, wildfire exposure can still have more negative effects on low-SES infants due to higher baseline risk factors, such as exposure to chronic stress, that can increase the likelihood of negative health outcomes from additional stress or poor air quality during a wildfire (Torche 2018; Martins et al. 2004).

Mediation analyses suggest prenatal care, tobacco use, and weight gain account for a larger fraction of the relationship between wildfire exposure and infant health than county air quality. Mediation analyses are sensitive to potential violation of the sequential ignorability assumption, but estimates predicting infant health are also similar with or without controlling for county air quality. Taken together, these findings suggest that wildfires may harm infant health more through stress and maternal behaviors than air quality. Stress could help explain the negative health implications for mothers with both low and high education levels, consistent with evidence of the substantial economic and disruptive effects of wildfires (Wang et al. 2021; Currie and Rossin-Slater 2013). The NVSS birth data do not include economic or stress measures and the fetal death data do not include all pregnancies that do not result in a live birth. Future research examining those measures or more complete pregnancy data would provide additional evidence about mechanisms and help explain variation by maternal education.

Overall, results provide additional evidence of the negative effects of wildfires when including a more complete sample of births and when explicitly examining selective survival. Detrimental effects of wildfires on infant health indicate their long-term implications for health and well-being in the next generation. Poor infant health has economic and health costs for individuals and society (de Jong et al. 2012; Swamy, Ostbye, and Skjaerven 2008; Aizer et al. 2018; Bellinger et al. 1991; Mazumdar et al. 2011; America's Health Rankings 2021) and growing wildfire exposure is likely to increase those costs. Furthermore, our results suggest that the negative health implications of wildfires are stronger among infants born to mothers with low levels of education, increasing the likelihood of fetal death and low birth weight early in pregnancy. Mediation analyses suggest the variation by maternal education reflects selective survival and unequal sensitivity, rather than differential parental response to wildfires. In addition to reducing wildfire exposure, mitigation and response efforts should work to reduce the burdens wildfires pose for pregnant women with low levels of education.

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