

Estimating the Effects of Residential Mobility: A Methodological Note

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ABSTRACT

This article reviews the methodological challenges of estimating a causal association between mobility and children's cognitive, social, emotional, and physical development. Utilizing a comprehensive set of empirical articles published in the past 25 years that employ quantitative methods, it describes the limitations of previous studies and the innovative ways that researchers have attempted to deal with them. The concept of mobility is inconsistently operationalized along four dimensions: school versus residential, distance, timing, and frequency. Imprecise operationalization conflates different forms of mobility, which have differential effects on development. Attempts to estimate a causal association between mobility and development suffer from three sources of bias: selection, contextual shifts, and contemporaneous instigating events. (a) Methods that account for unobserved differences between mobile and nonmobile children have consistently shown smaller or even positive effects of mobility. (b) Moving can have a positive or negative effect on children's ecological contexts in ways that are systematically correlated with child development. (c) Moves are frequently catalyzed by changes in family structure and employment. The article concludes with recommendations for future research. Researchers should continue to engage fixed- and random-effect, matching, and instrumental variable techniques, each of which makes the question of causality explicit.

KEYWORDS

Mobility; child development; methodology; causality

Introduction

Despite reaching a 50-year low, the United States remains a nation with high rates of residential mobility; between 2014 and 2015, 12% of the general population moved, including 13% of children (U.S. Census Bureau Public Information Office, 2009; U.S. Census Bureau, 2015). The poor move nearly twice as often as the general population, at a rate of 20% in 2015, sometimes moving multiple times in the same year (Schachter, 2001; U.S. Census Bureau, 2015; Ziolo-Guest & McKenna, 2014). Given these statistics, it is critical to understand the consequences of mobility for children, particularly those from disadvantaged backgrounds.

Researchers propose a variety of links between residential mobility and children's cognitive, social, emotional, and physical development (Anderson, Leventhal, Newman, & Dupéré, 2014). In the short term, a move may pose a financial burden, induce family stress, sever social ties, and limit institutional supports (Hanushek, Kain, & Rivkin, 2004; Pribesh & Downey, 1999). Moving may alter children's

developmental contexts, notably their families, schools, neighborhoods, and peers, in ways that have long-term ramifications (Anderson, Leventhal, Newman, & Dupéré, 2014; Bronfenbrenner & Morris, 2006; Chetty & Hendren, 2015). These contextual shifts can theoretically have favorable or unfavorable consequences for children's development. For example, more-advantaged families who move to gain access to better school systems might change children's contexts in a manner supportive of their development (Hanushek et al., 2004; Tiebout, 1956). By contrast, the types of involuntary moves experienced by more-disadvantaged families might result in exposure to inferior housing and neighborhood conditions that compromise children's development (Alexander, Entwisle, Blyth, & McAdoo, 1988; Schachter, 2001; Ziolo-Guest & McKenna, 2014).

Despite this complex picture, there is near consensus in the literature that high rates of residential mobility have deleterious consequences for a wide range of child outcomes, including academic

achievement and attainment, social and emotional functioning, delinquency, and health (e.g., Adam & Chase-Lansdale, 2002; Astone & McLanahan, 1994; Government Accountability Office, 1994; Hagan, MacMillan, & Wheaton, 1996; Haveman, Wolfe, & Spaulding, 1991; Hendershott, 1989; Jelleyman & Spencer, 2008; Rumberger & Larson, 1998; Simpson & Fowler, 1994; South, Haynie, & Bose, 2005; Swanson & Schneider, 1999). However, nearly all of these studies relied on analytic techniques that are vulnerable to selection bias, and unmeasured factors may explain child outcome–mobility links. As described in the following, recent empirical work using more-advanced analytic strategies designed to account for these biases raises questions about earlier findings, often showing insignificant or even beneficial associations between mobility and children’s outcomes in some contexts (Coley, Leventhal, Lynch, & Kull, 2013; Gasper, DeLuca, & Estacion, 2010, 2012; Hanushek et al., 2004; Schwartz, Stiefel, & Cordes, 2016; Voight, Shinn, & Nation, 2012; Wright, 1999).

In addition to the selection problem, researchers have grappled with the question of how to define or operationalize residential mobility, how to incorporate contextual shifts into their analyses, and finally, how to account for concurrent events that can instigate mobility and may themselves be associated with children’s outcomes. This review takes up each of these dilemmas in turn, highlighting not only the methodological challenges, but also the innovative ways researchers attempt to resolve them. Given the relative scarcity of studies using statistical methods with purchase on causal inference, there is little value in attempting to summarize the results of the literature in any systematic way. This article is designed to provide a road map for future research on the outcomes of child mobility. Updating the research on residential mobility is imperative not only for the field’s understanding of its connection to children’s development, but to estimate the costs and benefits of a host of federal, state, and local policies directly and indirectly related to residential mobility.

Methods

The objective of this review is to rigorously examine the methodological challenges of estimating the causal links between residential mobility and children’s outcomes. Unlike a meta-analysis or review paper, this article does not attempt to synthesize the findings of

previous studies to present a summary of what is known about mobility and children’s development. The outcomes, measures, methods, and data sources are too heterogeneous for such a synthesis to be of value. Instead, it highlights only those studies that provide key methodological insights.

Studies included in this review were identified using a large number of search engines, including PsychINFO; PsycARTICLES; Psychological Index; ERIC; Academic Search Premier (which contains EconLit and International political science abstracts); Wilson Web (which contains Social Sciences Full Text); CSA Illumina (which contains CSA Sociological abstracts; CSA Worldwide political science abstracts; Sociology: A SAGE full-text collection); and Medline. Because the goal is to provide recommendations for future quantitative research on this topic, the review is comprehensive, but not exhaustive. For example, studies that did not meet basic standards of scientific rigor, were derived from nongeneralizable samples, provided no empirical data, or employed qualitative or ethnographic methodologies are excluded. The review is limited to research published in the past 25 years, though it references earlier landmark studies. A great deal of methodological innovation has occurred over that time span, and the ability to contrast recent studies with studies from the 1990s provides key insights into the field’s methodological innovations. These criteria resulted in a sample of 47 peer-reviewed studies used as a basis for this analysis. These studies are summarized in Table 1.

Results

Defining and Operationalizing Mobility

The apparently singular concept of mobility incorporates a wide range of events in children’s lives, from long-distance, highly strategic moves occurring one or two times during childhood to extreme housing instability resulting in a series of short-distance, unplanned relocations (Rossi, 1980; Ziol-Guest & McKenna, 2014). Because different operationalizations of mobility tend to capture different aspects of this spectrum, definitional precision is critical in the interpretation of results. In the literature, *mobility* is defined in dozens of different ways, too often without explicit comment on the ramifications of that decision. Examining the mobility measures used in the literature, four major dimensions of difference exist: (a) a change of



Table 1. Papers reviewed.

Author(s)	Outcome variable(s)	Mobility variable(s)	Sample	Estimation technique	Finding
Alexander Entwisle, & Blyth (1996)	CAT-R, CAT-M scores, grades, risk of retention	low/high frequency mover (childhood and adolescence)	Beginning School Study (BSS)	lagged dependent variable	negatively associated with reading, ns for other outcomes
Anderson and Leventhal (in press)	achievement and behavior problems	number of moves since 5th grade moves between waves	NICHD SECCYD	propensity score modeling	positively associated with internalizing behavior, ns with achievement or externalizing
Astone and McLanahan (1994)	High school dropout	sex timing and frequency	High School and Beyond National Survey of Children	multinomial logit	mobility is negatively associated with dropout
Baumer and South (2001)	adolescent substance abuse	moved during last 12 months	Icelandic adolescents	Poisson, logistic regression	positively associated with premarital sex, number of partners
Bernburg, Thorlindsson, & Sigfusdottir, (2009a)	suicide attempts, ideation	moved during last 12 months	Icelandic adolescents	HLM (cross-sectional)	positively associated with cigarette and drug use
Bernburg, Thorlindsson, & Sigfusdottir, (2009b)	health and mental health	moved > 2 times as child	Midlife in the United States (MIDUS)	HLM (cross-sectional)	positively associated with suicide and ideation
Coley et al. (2013)	behavior (CBCL), cognitive ability (WJ)	moving in last 2 years, years at residence	Three-City Study	logistic regression	negatively associated with global health, not mental
Cordes et al. (2016)	state standardized test score, time to graduation	school and residential move, upward and downward	NYC Administrative Data	hierarchical linear models (HLM)	negatively associated with health between students, ns within students
Crowder and Teachman (2004)	premarital pregnancy and dropout	number of moves during adolescence	Panel Study of Income Dynamics	OLS regression	school not neighborhood associated short term, both long term, depends on context change
Dewit (1998)	drug use	moves before age 16	Onatrio Mental Health Supplement	discrete time event history	positively associated with pregnancy and dropout
Elickson and McGuigan (2000)	adolescent violence	number of elementary schools attended	High school seniors in CA an OR	accelerated failure time models	positively associated with drug but not alcohol use
Fantuzzo et al. (2012)	measures of educational well-being	binary change schools btw K and 3rd	rep. sample Philadelphia public schools	logistic and OLS regression	positively associated with relational but not predatory violence
Fomby and Sennott (2013)	problem behavior	school and residential moves (short and long)	National Longitudinal Survey of Youth 1997	lagged dependent variable	negatively associated with achievement, positively with behavior problems
Fowler et al. (2015)	rates of depression, criminal activity, and smoking	count of residential addresses	National Longitudinal Study of Adolescent Health	lagged dependent variable	no significant effects
Gasper, DeLuca, & Estacion (2010)	delinquency and substance abuse	moved in last year	National Longitudinal Survey of Youth 97	latent class analysis and OLS	negatively associated with outcomes
Gasper DeLuca, & Estacion (2012)	high school dropout	attended more than one high school	National Longitudinal Survey of Youth 1997	hybrid random effects	no within-person associations
Gruaman, Harachi, Abbott, Catalano, & Fleming (2008)	academic performance, classroom participation, attitude	total school changes, binary school change last year	Raising Healthy Children (RHC) project	propensity score modeling	positively associated with dropout
Hango (2006)	educational attainment	number neighborhoods prior to age 15	1986 Canadian General Social Survey	HLM	ns for attitude
Hanushek et al. (2004)	standardized math tests (Texas)	move between years	UTD Texas Schools Project	logistic and multinomial regression	mobility is beneficial to educational attainment
Haverman et al. (1991)	high school completion	number of location moves	Panel Study of Income Dynamics	fixed-effects models	small negative correlations with achievement net of school quality
Haynie and South (2005)	violent behaviors	moved within last two years	National Longitudinal Study of Adolescent Health	probit model	negatively associated with high school completion
Haynie, South, & Bose (2006)	suicide attempts	moved within last two years	National Longitudinal Study of Adolescent Health	negative binomial regression	positively associated with violent behavior
Heinlein and Shinn (2000)	standardized reading and math tests	moved throughout childhood	New York City Administrative Data	logistic regression	positively associated with suicide
Hoffman and Johnson (1998)	drug use	moved in previous five years	National Household Survey on Drug Abuse	multiple regression	not associated with achievement when 3rd grade baseline included in model
Hutchings et al. (2013)	Key 1 Stage exam (age 7)			logistic regression	positively associated with drug use in adolescence
					negatively associated with exam performance

Joon, Ensminger, & Feehan (2003)	mortality	psychological well-being, mortality	number of residential and school moves	Welsh Electronic Cohort for Children (WECC)	no association with mortality
Oishi and Schimmack (2010)	psychological well-being, mortality	frequency of moves before age 7	moves to new neighborhood in childhood	Woodlawn Project (Black 1st graders 1966)	negatively associated with well-being
Ou and Reynolds (2008)	educational attainment	moves to new neighborhood in childhood	number of school moves	Midlife in the United States (MIDUS)	negatively associated with high school completion
Pittman and Bowen (1994)	Hill's ABC-X	educational attainment	number of months since last move, distance	Chicago Longitudinal Student data	various relationships with stressors
Porter and Vogel (2014)	self-reported delinquency	self-reported delinquency	residential moves between census tracts	Air Force adolescents	no association
Pribesh and Downey (1999)	NCEs academic performance measures	self-regulation	binary school, residential, both move	National Longitudinal Study of Adolescent Health	small negative correlation, mostly reduce when lagged control included
Roy et al. (2014)	high school completion	self-regulation	binary residential move	National Education Longitudinal Study 88	associated with behavioral and cognitive deregulation
Rumberger and Larson (1998)	high school completion	high school completion	categorical school change, binary mobility	Chicago School Readiness Project	negatively associated with high school completion
Shwartz et al. (2016)	standardized test scores	standardized test scores	school moves, structural and nonstructural	National Education Longitudinal Study 88	sometimes positive, sometimes negative
Simpson and Fowler (1994)	behavioral problem index, emotional problems	behavioral problem index, emotional problems	never, one, two, three-plus moves	New York City Department of Education admin	positively associated with emotional and behavior problems
South and Baumer (2000)	age at premarital birth	age at premarital birth	moves between waves	1988 National Health Interview Survey	positively associated with earlier first birth
South and Haynie (2004)	friend networks	friend networks	moved residence and/or school, last two years	National Longitudinal Study of Adolescent Health	movers have smaller and denser networks, less popular
South et al. (2005)	timing first premarital sex	timing first premarital sex	moved within last two years	National Longitudinal Study of Adolescent Health	positively associated with sex earlier in life
South, Haynie, and Bost (2007)	school dropout	school dropout	change in residence and/or school in last year	National Longitudinal Study of Adolescent Health	positively associated with dropout
Sun (1999)	test scores math, reading, science, social studies	test scores math, reading, science, social studies	count of school changes	National Education Longitudinal Study 88	negatively associated with test scores
Swanson and Scheider (1999)	various achievement and behavioral	various achievement and behavioral	residential and school mobility, early and late	National Education Longitudinal Study 99-94	short-term negative effects, long-term benefits of early mobility
Tucker et al. (1998)	grade repeat, behavior, academic achievement	grade repeat, behavior, academic achievement	number of moves, distance, timing	1988 National Health Interview Survey	negatively associated if non-two-parent households
Voight et al. (2012)	math and reading grade	math and reading scores 3rd to 8th grade	moved btw K and 2nd grade	sample of urban elementary school students	early moves negatively associated with reading, with math only if move was recent
Wood et al. (1993)	child dysfunction	child dysfunction	binary > 90th percentile number of moves	1988 National Health Interview Survey	positively associated with child dysfunction
Wright (1999)	Kansas reading and math assessments	Kansas reading and math assessments	move within district, pre/post achievement test	administrative data, Midwestern school district	effect largely confounded by individual and family factors
Ziol-Guest and McKenna (2014)	children's language, literacy, and behavior	children's language, literacy, and behavior	moved residences at least three times	Fragile Families and Child Wellbeing Study	negatively associated with behavior for poor children

Note. Includes empirical articles 1999–2016 designed to test associations between residential and school mobility and child outcomes. Not all articles discussed in text. ns = not significant

residence, school, or both; (b) short- or long-distance moves; (c) the timing of mobility; and (d) the number of moves. Each of these dimensions may meaningfully affect a study's estimated association between mobility and children's development, the interpretation of its findings, and its subsequent implications.

Residential Versus School Mobility

Residential and school mobility are clearly linked, but they do not always co-occur (Cordes, Schwartz, Stiefel, & Zabel, 2016). Short-distance moves may not require a school change, and parents sometimes elect to keep their children in the school zoned for their previous residence if a move occurs in the middle of a school year (Hansen, 1995; Swanson & Schneider, 1999). Similarly, school choice programs may facilitate non-promotional school transitions outside of the context of residential mobility or the reverse—children may not need to change schools if they move within the same jurisdiction (Swanson and Schneider, 1999; U.S. Department of Education, 2009).

Residential moves and school moves are distinct in their theoretical association with children's development. Changing residence without an accompanying school change, for example, may affect family, neighborhood, and housing dynamics, while allowing children to retain their peer networks and avoid disruption in their academic progress (Swanson & Schneider, 1999). This dual nature of mobility is crudely reflected in much of the literature. Most studies limit their mobility measure to either residential mobility exclusively (Astone & McLanahan, 1994; Hango, 2006; Haveman et al., 1991; Long, 1975; Ou & Reynolds, 2008; Simpson & Fowler, 1994; Tucker, Marx, & Long, 1998; Wood, Halfon, Scarlata, Newacheck, & Nessim, 1993) or school mobility exclusively (Ellickson & McGuigan, 2000; Fantuzzo, LeBoeuf, Chen, Rouse, & Culhane, 2012; Hanushek et al., 2004; Simpson & Fowler, 1994), but do not generally account for whether both transitions occurred simultaneously.

Three studies directly address this issue (Cordes et al., 2016; Pribesh & Downey, 1999; Swanson & Schneider, 1999). The earlier two used data from the National Education Longitudinal Study (1988 and 1992 waves), a nationally representative longitudinal survey of American high school students, and examined the association between mobility and students' math test scores. However, the two studies came to very different conclusions

regarding the relative association between residential and school mobility and children's test scores. Pribesh and Downey (1999) used a lagged dependent variable regression to predict 12th-grade math scores by controlling for 9th-grade scores and a host of demographic controls (e.g., child gender, race and ethnicity, parent education, and family income and composition). Neither residential nor school mobility during high school was significantly associated with children's math scores on its own, but the combination was adversely associated with children's math ability. Swanson and Schneider (1999), by contrast, used a differencing technique that regressed mobility on the change in children's test scores (between 8th and 10th grades and between 10th and 12th grades). Like Pribesh and Downey (1999), they controlled for earlier math ability, but they included a more thorough set of controls for educational attainment such as earlier behavior problems and GPA. They also differentiated between early moves in grades 8 through 10 and later moves in grades 11 and 12. Swanson and Schneider (1999) found that changing residences *or* schools in early high school was associated with children's improving math trajectories, whereas changing schools but *not* residences in late high school was associated with lower math scores relative to non-mobile peers. The authors suggested that school changes late in high school are often to help a struggling student but can backfire if the disruption associated with moving undermines the potential benefits of shifting to a more supportive school environment.

There are enough differences between the two studies that it is impossible to state with complete confidence that the discrepancy in findings is due to the analytic techniques employed. Yet it seems likely that the cumulative consequences of residential and school mobility reported by Pribesh and Downey (1999) are at least partially the result of preexisting differences between mobile and nonmobile children and their families. In other words, despite controlling for earlier (or baseline) test scores, mobile children were gaining math ability at a slower rate than their nonmobile counterparts. The more robust set of controls helped Swanson and Schneider (1999) reduce this bias, resulting in nonsignificant and even beneficial "effects" of mobility.

A third, more recent, study by Cordes et al. (2016) used linked administrative data from 81,502 public school students in New York City. The article used regression analysis to compare the standardized test scores and time to graduation of children on the basis

of their short- and long-term mobility patterns. Their models distinguished between neighborhood and school moves and included indicators of whether they entered higher- or lower-quality contexts (defined by neighborhood poverty and mean standardized test scores, respectively). Their study found that school and neighborhood mobility, while highly correlated, have independent associations with achievement and graduation on a number of dimensions. For example, short-term neighborhood moves were not statistically associated with achievement, while school mobility was highly correlated. For long-term achievement, both school and neighborhood mobility were associated with achievement and graduation, in complex ways. The article made no attempt to address selection bias, but the differential associations of school and residential mobility across a variety of outcomes present strong evidence that such a distinction is fundamental to mobility research.

For all three articles, it appears that residential and school mobility act independently. As Swanson and Schneider (1999) pointed out, children who change schools but not residences may be doing so for strategic reasons, sometimes proactively but often because of the perception that the child's current school situation is inadequate, such as when parents seek a better learning environment for a struggling student. This situation may be a very different phenomenon from a school change resulting from a residential move. If residential and school mobility operate independently, including one but not the other runs the risk of masking a more complex dynamic with a single coefficient.

Distance Moved

The consequences of mobility for children's development may vary depending on the distance a family moves. As noted earlier, long-distance moves are more likely to accompany a school change than are shorter moves (Swanson & Schneider, 1999) and may be more disruptive to social and peer networks (Coleman, 1988; Pribesh & Downey, 1999). Conversely, long-distance moves are more common among more-advantaged families than among disadvantaged families, suggesting that such moves may be more likely to be strategic on the part of parents, less correlated with financial distress, and more planned (Long, 1975, 1992; Schachter, 2004; Tiebout, 1956). Some studies limit themselves to only long-distance moves (Hango, 2006; Long, 1975), differentiate among

moves of various distances (Pittman & Bowen, 1994; Tucker et al., 1998), or in several cases include some combination of the two (e.g., Astone & McLanahan, 1994; Haveman et al., 1991). Most studies ignore this issue altogether.

Unfortunately, many of the studies that directly addressed whether distance matters had relatively weak correlational designs. For example, using data from the 1988 Child Health Supplement of the National Health Interview Survey, Tucker et al. (1998) employed logistic regression to examine the association between mobility and elementary school children's academic and behavior problems. Greater mobility was negatively associated with children's outcomes in general, yet this case did not hold for children who moved more than 50 miles. Although these findings lend some support to the claim that long-distance moves are qualitatively different from short-distance moves, the question remains largely unexplored. As Long (1975) claimed decades ago, higher-performing children may simply come from families who make longer moves, not that these moves are beneficial. Thus, the role of distance in mobility requires further study.

Timing of a Move Relative to Outcome

The timing of a move may influence children's development in two important ways. First, some researchers suggest that the disruptive nature of moving may be relatively short term, whereas others argue that shifts in family, school, and neighborhood may have more lasting consequences (Hanushek et al., 2004; Voight et al., 2012). Second, moving may have different consequences for children's development depending on when in the life course it occurs (Hango, 2006; Haveman et al., 1991; Swanson & Schneider, 1999; see Anderson, Leventhal, & Dupéré, 2014, for review).

Only one study addressed both of these timing issues simultaneously; (however, a few studies considered them independently). Anderson, Leventhal, and Dupéré (2014) used the National Institute of Child Health and Human Development Study of Early Child Care and Youth Development (NICHD SECCYD) to investigate durability. They examined concurrent and longitudinal associations between residential mobility and two child outcomes (achievement and behavior problems) across three developmental periods (early childhood [birth–54 months], middle childhood

[K–6th grade], and adolescence [7th grade–age 15]) and whether any observed associations operated through the family context; analyses included an extensive battery of covariates. Moving during adolescence was adversely associated with youth's internalizing problems at that time compared with their stable peers. However, residential mobility in early childhood had a long-term but indirect association with children's compromised achievement in adolescence via the family context. These findings suggest that the short- or long-term consequences of moving for children's development may be specific to the developmental period and outcome being studied.

Two other studies with the same data explicitly took on the second issue of developmental timing (Anderson & Leventhal, *in press*; Anderson, Leventhal, & Dupéré, 2014). The first study explored the link between residential mobility and four social contexts—family, neighborhood, peers, and schools—across the same three developmental periods, each of which is a potential explanatory pathway (or mediator) of the association between mobility and children's development (Anderson, Leventhal, & Dupéré, 2014). They found substantial differences in the association between mobility and these contexts during different developmental periods. Mobility had the strongest association with children's contexts in middle childhood, being associated with family, neighborhood, and peer-group quality (but not school). In early childhood, mobility was associated only with neighborhood quality and one aspect of the family context—the percentage of time the father was in the home. Finally, mobility was only associated with the family context in adolescence. The second study employed propensity score matching, discussed in the following, to determine whether residential mobility was differentially associated with children's outcomes depending on whether the move occurred in childhood, adolescence, or both periods (Anderson & Leventhal, *in press*). Their analysis was limited by the small number of children that experienced adolescent but not childhood mobility (in the NICHD SECCYD). Nevertheless, they found no association between childhood moves alone and adolescent behavior, but movers in both childhood and adolescence had more internalizing behavioral problems than their stable peers. Together, their findings suggest that researchers estimating the

effects of mobility on children's development need to consider how timing affects results.

Number of Moves

Finally, it is possible that mobility has a nonlinear relationship with children's development. Researchers operationalize mobility in different ways: as a binary event of whether a family moved over some period of time (Fantuzzo et al., 2012; Pribesh & Downey, 1999); as a categorical variable such as no moves, one to two moves, and three or more moves (Astone & McLanahan, 1994; Dewitt, 1998; Ou & Reynolds, 2008; Simpson & Fowler, 1994; Tucker et al., 1998); as a count of the number of moves (Ellickson & McGuigan, 2000; Fowler, Henry, & Marcal, 2015; Simpson & Fowler, 1994); or as the number of months since the last move (Pittman & Bowen, 1994).

Despite suspicions that the operationalization of mobility measures matters, there is no consistent empirical evidence on the topic and there are no study tests for nonlinearity explicitly, although it can be inferred from studies using categorical approaches. For example, a study based on High School and Beyond and employing logistic regression found that residential mobility was significantly associated with adolescents' odds of dropping out in this representative sample of high school students (Astone & McLanahan, 1994). Youth who moved once since fifth grade were more likely to drop out of school than their peers who never moved; however, the log odds coefficient for one move (−.49) was nearly indistinguishable from the coefficient for two moves (−.46), but was almost half that for youth moving three or more times (−1.16). This pattern suggests a potential nonlinear association. Similarly, Ou and Reynolds (2008) used logistic regression to explore the link between school mobility and the odds of high school completion within the Chicago Longitudinal Study's sample of 1,539 children from high-poverty neighborhoods. No evidence of nonlinearity was found among the same four categories as Astone and McLanahan (1994; never moved, moved once, twice, three or more times), but significant differences emerged between youth who made two and three school relocations (compared with no relocations) and their odds of completing high school. These two odds ratios were relatively comparable (.58 vs. .42, respectively). Because no study explicitly tests for thresholds, and because few rigorous comparisons can be made

between studies, it is only possible to recommend more work be done in this area to explore whether there are thresholds beyond which mobility starts to have greater effects and at what point there are diminishing returns.

Identification Issues

Imprecisely specified mobility measures reduce external validity and muddy interpretations of findings. More pernicious, however, are the methodological issues that produce inaccurate estimates and have for decades lead researchers to overestimate the deleterious effects of moving by confounding it with three factors: (a) the unmeasured characteristics of highly mobile families that may be correlated with child outcomes; (b) contextual changes in family, neighborhood, peers, and school that may be differentially affected by mobility; and (c) contemporaneous events such as divorce, marriage, and job transitions that may both prompt mobility and affect children's outcomes (and possibly be related to contextual changes).

Selection

To date, there are no randomized control trials to estimate the causal effects of residential mobility on children's development. Housing mobility experiments that randomized moves, such as the Moving to Opportunity for Fair Housing Demonstration (MTO), cannot be used to examine mobility directly because the treatment is confounded by a shift in housing subsidy type and a mandated change in neighborhood poverty rate (Sanbonmatsu et al., 2011). Researchers interested in the effects of mobility net of these changes need to rely on statistical techniques to reduce selection bias (Leventhal & Newman, 2010). This section discusses the limitations of these techniques and the ways recent studies attempt to overcome these issues using propensity score, fixed effect, and instrumental variable methods.

The problem of selection bias is endemic to correlational designs. Simply put, an apparent causal relationship between a treatment (i.e., a move in this case) and an outcome may be an artifact of a third unmeasured variable that simultaneously predicts both selection into the treatment and the outcome. In this context, certain types of families may be more likely to move, and children in those families may have more academic and behavioral problems than their peers in

less mobile families. For example, because socioeconomic status predicts both children's outcomes and mobility, the apparent correlation between mobility and children's achievement, and any causal claims made about this association, may be specious unless the analysis controls for family income and parental education.

Addressing these issues with observational data is not easy, and issues of selection in OLS and logistic regression analysis are well documented (Morgan & Winship, 2015). Controlling for the typical slate of socioeconomic factors such as family income, parental education, and employment reduces this bias, but unobserved and unobservable characteristics can have a substantial effect on both mobility and children's outcomes. Nevertheless, the majority of mobility research uses these approaches (see Table 1). In a handful of cases, however, researchers have employed more advanced statistical techniques that approximate a random experiment, and the trend is clear: the more a study accounts for selection, the more complex the effects of mobility appear to be.¹

When child outcomes are collected at least twice, researchers can control for baseline performance with a lagged dependent variable, which accounts for differences in prior (or baseline) performance that precede mobility. Alexander, Entwisle, and Dauber (1996) used this approach in perhaps the first study to seriously question the deleterious effects of mobility. In their sample of 500 Baltimore public school children in early elementary school, they reproduced previous estimates of the adverse association between mobility and children's fifth-grade achievement, grade retention, and special education receipt. However, when they added controls for first-grade performance, the majority of these coefficients became insignificant. Insignificant coefficients are not a true test of null effects, especially with Alexander et al.'s (1996) relatively small and nonrepresentative sample. Pribesh and Downey (1999) used a similar technique with a sample of 10,000 students in the National Education Longitudinal Survey, a nationally representative school-based study of 8th graders, estimating the association between mobility and children's test scores. In this case, the negative association between mobile children's test scores remained significant after the inclusion of baseline scores, but the coefficients dropped by nearly 80%. The researchers concluded that a substantial portion of the mobility effect in the

estimate excluding baseline scores was due to endogenous characteristics of mobile children that existed before relocation.

Although these findings are suggestive of the larger trend, the use of lagged dependent variables addresses only differences in premobility outcomes at a fixed point in time and not endogenous differences in children's developmental trajectories thereafter. In other words, just because two children are similar on an outcome prior to mobility does not mean their development would continue in parallel in the absence of mobility. Even subtle differences in these counterfactual trajectories can bias studies using a lagged dependent variable as well as differencing approaches (Morgan & Winship, 2015).

Taking a counterfactual approach to causal inference, some researchers employ propensity score matching (PSM) to identify groups of children who are identical to each other on all observable characteristics except for the presence or absence of mobility. The goal of this process is to approximate randomization, where treatment and control cases have no systematic differences. First, researchers estimate a child's propensity to experience mobility and then use those predicted scores to reweight the overall sample, allowing for a more accurate estimation of the counterfactual condition of what would have happened if the mobile youth had not relocated (Morgan & Winship, 2015; Stuart, 2010). Although PSM remains vulnerable to omitted variable bias, its application to child mobility has been fruitful. For example, as reviewed, the majority of studies using basic regression analysis find a positive link between moving and delinquency (Rumberger & Larson, 1998; South et al., 2005; Swanson & Schneider, 1999). By contrast, Porter and Vogel (2014) matched mobile and nonmobile adolescents in the National Longitudinal Study of Adolescent to Adult Health, a representative school-based sample, and found that differences in delinquency were largely attributable to background characteristics associated with moving rather than to moving per se. Similarly, Anderson and Leventhal (*in press*) used propensity score matching to examine how moving in childhood, adolescence, or both was related to a range of adolescent outcomes. Using data from the NICHD SECCYD, they found that multiple moves over the course of childhood and adolescence was associated with greater internalizing behavioral problems (vs. no moves) but was not related to externalizing behaviors

or reading and math achievement. There were no significant associations for moves in childhood alone.

Both studies used racially, ethnically, and socioeconomically diverse samples and found substantial declines in effect size estimates after matching. By contrast, Roy, McCoy, and Raver (2014) used PSM on data from the Chicago School Readiness Project (a high-poverty sample) and found that residential mobility's association with behavioral and cognitive dysregulation was robust, suggesting that the outcomes of child moves may be heterogeneous across populations.

When longitudinal data on both mobility and child outcomes are available, it is possible to more fully address selection issues by looking at changes within each individual over time. In these models, known broadly as individual fixed effects, each case serves as its own control, and time-invariant differences between individuals cannot be a source of bias (Allison, 2009). These methods also have the benefit of permitting researchers to use administrative data that lack the rich set of time-invariant covariates required for analysis of data collected at a single point in time. For example, Hanushek et al. (2004) used a large database of Texas students' achievement test scores (187,998 moves in total) and found that once fixed effects were controlled, moving was associated with a drop of less than .10 standard deviations on children's standardized tests, a significant but small short-term effect. Another study by Gasper et al. (2010) applied a similar analytic technique to examine the link between mobility and adolescent delinquency in the National Longitudinal Survey of Youth (NLSY79). Mobility had no association with trajectories of delinquency, suggesting mobile adolescents may have a preexisting propensity toward delinquency. Finally, Coley et al. (2013) used hierarchical linear models to assess simultaneously the association between mobility and children's behavioral problems both within particular children (similar to fixed effects) and between children (similar to regression analysis) for a representative sample of low-income families in the Three City Study. Their between-person estimates showed an unfavorable relationship between mobility and children's behavior problems; however, the within-person estimates revealed the opposite—a favorable relationship between mobility and children's behavior (with a similar association for achievement). The authors explain this inconsistency in two ways. First, it is possible that the negative

effects of moving are the cumulative result of a lifetime of instability rather than a particular move, but it is at least equally likely that the between-person estimates are simply vulnerable to selection bias and are picking up endogenous characteristics of the families not captured in the authors' robust set of control variables.

Finally, only two published studies employed instrumental variable (IV) analysis to address the selection issue in mobility research (Pettit & McLanahan, 2003; Schwartz et al., 2016). IV analysis depends on the researcher's ability to identify a variable that is correlated with the treatment variable (mobility in this case) but uncorrelated with the outcome variable except through its correlation with the treatment variable. This IV typically is identified theoretically rather than empirically and assumes that the correlation between the IV and the outcome represents an exogenous portion of the treatment effect that can be considered unbiased.

The first study used data from MTO to examine the relationship between mobility and families' social capital, defined as parents talking to other parents, and by children's participation in after-school activities (Pettit & McLanahan, 2003). It is important to keep in mind the caveats noted earlier about using this study and other such housing mobility programs to investigate the relationship between mobility and child outcomes. The researchers used random assignment status to the treatment, comparison, or control group as the exogenous instrument. Both the treatment and comparison groups were offered a housing voucher to move from public housing to private housing using a voucher—the former to low-poverty neighborhoods and the latter to neighborhoods chosen by the families without the low-poverty constraint. Some families in the control group, who did not receive vouchers, moved anyway, and not all families assigned to the experimental and comparison groups moved. The researchers compared results of OLS and IV models. The OLS models suggested that families who moved had less social capital than families who were stable, but the IV results indicated no such differences. The authors interpreted these findings as negative selection: Families who moved may have had less social capital prior to moving than their counterparts who were stable.

The second study, by Schwartz et al. (2016), may have the greatest purchase on causal estimates of any reviewed here. The researchers used administrative data from the New York City Department of Education for 185,000 students in five cohorts. To produce

“causal” estimates, they employed two IVs (grade span of the elementary school and whether renter households lived in properties that were foreclosed or sold) combined with student fixed effects. The results are highly suggestive. Regardless of the IV used, structural school moves—dictated by the school's grade span—were adversely associated with children's achievement. However, the estimated effect of non-structural moves depended on the choice of IV. The researchers suggested this discrepancy was a result of their two IVs having different sets of *compliers*. In other words, families who are more likely to move because of foreclosure are very different from those families strategically responding to the grade span of their children's schools. They argue that grade-span compliers may be more likely to make proactive moves that benefit children and that have positive or null effects on their long-term achievement. By contrast, children forced to change schools because their families lost rental housing made reactive moves, which had negative or null effects on children's long-term achievement. These findings not only confirm suspicions of the selection effects endemic to previous mobility work, but reinforce the importance of considering move context and timing as important dimensions of mobility.

Contextual Shifts

One of the most durable consequences of moving is the potential to change the developmental contexts in which children live. These contexts include their family, housing, neighborhood, peers, and school, each of which is linked to children's outcomes in the literature. Taking just the first as an example, mobility may be associated with a change in family economic circumstances inducing stress, poor parenting, and material deprivation, which may in turn compromise children's development (Adam, 2004; Bradley & Corwyn, 2002; Coley et al., 2013; Conger & Donnellan, 2007; Costello, Compton, Keeler, & Angold, 2003; Gershoff, Aber, Raver, & Lennon, 2007). Similarly, mobility is often contemporaneous with changes in family structure and accompanying family instability, which may be deleterious to children's development (Fowler et al., 2015; Cavanagh & Huston, 2006; Evans, 2006; Hoffmann, 2006; Jolleyman & Spencer, 2008; Michielin & Mulder, 2008; Schachter, 2001; Tucker et al., 1998).

It is important to disentangle the portion of the mobility effect that is the result of the move itself from changes in contexts. For example, mobility in middle childhood is associated with both family and neighborhood context (Anderson, Leventhal, & Dupéré, 2014), which may be associated with children's outcomes (Cavanaugh & Huston, 2006; Chetty & Hendren, 2015; Coleman, 1988; Roy et al., 2014). In this case, it is the neighborhoods into which highly mobile child move rather than mobility per se that is detrimental to children's development. This distinction is in many ways a purely theoretical one. If moving systematically affects children's contexts, it is perhaps overly pedantic to claim that it is not somehow the effect of mobility. Nonetheless, it is important to understand how contextual changes explain or mediate any potential mobility effects, if for no other reason than the fact that contexts can be changed in the absence of mobility and that mobility may not necessarily alter any particular context.

The degree to which these contextual shifts explain the link between mobility and children's development has not been explored rigorously. Cordes et al. (2016) were able to differentiate between school and residential moves into higher or lower quality contexts (measured by neighborhood poverty rate and mean standardized test scores). They found that moves that improved school or neighborhood quality were associated with higher test scores and graduation, although this association does not suggest a causal link.

While neighborhood and school contexts are directly affected by mobility, family and social context may be differentially affected as well. Anderson, Leventhal, and Dupéré (2014), in a study previously described, investigated whether the family context served as a pathway between residential mobility and children's achievement and behavior across different developmental periods. Mobility in early childhood was not associated with children's achievement at that time but was indirectly associated with their subsequent achievement in adolescence through the family context, specifically a combination of quality parenting, the home environment, and maternal depression. Pribesh and Downey (1999), in a study also described earlier, examined to what degree social contexts, particularly children's social ties to peers, school, and community, played a role in the association between children's mobility and their math and reading achievement. Prior to controlling for social ties,

mobility was negatively associated with both outcomes. After accounting for children's social ties, the estimated coefficient for mobility was no longer significant for reading achievement and dropped by approximately 20% for math. Finally, Hanushek et al. (2004) examined the extent to which changes in school quality mediated the association between mobility and children's performance on Texas state-wide math exams, using the fixed-effects modeling strategy described earlier. Consistent with Schwartz et al. (2016), long-distance moves generally improved school quality, which in turn had long-term benefits for children's math achievement. By contrast, moves that did not improve school quality, such as short intradistrict moves,² were associated with short-term dips in mobile students' performance.

Contemporaneous Instigating Events

As Rossi (1980) pointed out decades ago, moves are rarely independent of other life-course events. Families move when there is a change in their composition or configuration (e.g., childbirth, divorce), employment status, or housing circumstance (e.g., eviction; Anderson, Leventhal, & Dupéré, 2014; Schachter, 2004). Although most of these events may have long-term ramifications for children's developmental contexts (Bornstein & Leventhal, 2015), they are distinct from the contextual shifts described in the prior section because they represent events that instigate mobility rather than are caused by it. In other words, contextual shifts *mediate* the association between mobility and children's development, but unmeasured contemporaneous events that cause mobility *confound* the association, resulting in biased estimates. Because these factors are time variant, they are not controlled for in fixed effects models and require either an IV approach or some other way of addressing selection. In other words, it is difficult for researchers to isolate the disruptive costs of mobility from other life events (Hanushek, 2004; Schachter, 2004).

Researchers rarely can control for all the contemporaneous family and income dynamics that would theoretically prompt mobility and alter children's outcomes. However, a few studies offer some insights into the roles of these events. Pribesh and Downey (1999) and Swanson and Schneider (1999) included dummy variables for whether parents divorced, married, died, or lost their job during the study period. The inclusion of these covariates reduced the mobility coefficients substantially, particularly for short-

distance moves. The coefficients for parental divorce, marriage, and death were statistically significant. Fomby and Sennott (2013) considered whether mobility and family structure change were independently related to children's behavior problems using a lagged dependent variable in their analysis of a nationally representative sample of adolescents in the NLSY79. Once robust controls were included, mobility and family structure change often co-occurred but had independent effects on children's behavior. Their analysis indicated that mobility had no direct association with adolescents' behavior problems, suggesting that much of the negative association reported in previous studies may be the result of unmeasured family dynamics.

Finally, another study used two different data sets, the NICHD Study of Early Child Care and Youth Development and the Quebec Longitudinal Study of Child Development (a representative birth cohort study) to explore school mobility and children's social adjustment (Dupéré et al., 2015). These researchers looked at the independent and interactive effects of school mobility and family transitions on children's outcomes. They applied propensity score matching to address selection. Across the two data sets, school mobility was only related to children's social maladjustment in the context of a family transition.

Taken together, these three studies reveal that the connection between mobility and contemporaneous family events is complex and may play out as confounders, mediators, or moderators. This research also highlights the observation that cumulative transitions take a toll on children's development, but how these effects unfold is unclear.

Conclusion

Because residential and school mobility is a common experience for U.S. children, it is a topic that merits both research and policy attention. The goal of this article was not to provide an exhaustive review of mobility research and its effect on children's development, but rather to address the methodological and conceptual dilemmas endemic to the topic and highlight how some researchers have tackled them. This section provides several recommendations for future research.

Starting with definitional issues, it is clear that a single operationalization of mobility misses the mark.

Moves can involve changes of residences, schools, or both; they are of varying distances and result in heterogeneous shifts in school, neighborhood, and housing quality; they also occur at different times in children's life course. The literature reviewed suggests that each of these differences may matter in terms of the consequences of mobility for children's development. However, only a few studies examine these differential effects directly, and further work is needed in these areas. Such research would provide insights into the key policy questions of the mechanisms by which mobility matters for children's development, for whom, and at what period during childhood.

For data sets containing only a single operationalization of mobility, researchers should be explicit about the type of mobility being evaluated. When multiple measures are available, the findings reviewed here suggest future research should explicitly examine different types of mobility and their relation to children's development. For example, when multiple waves of a study are available, researchers can explore how mobility is differentially associated with outcomes across early childhood, middle childhood, and adolescence. Because connections to place, school, and peers differ according to age, such comparison may provide insights about why and when mobility matters (Anderson, Leventhal, and Dupéré, 2014; Anderson & Leventhal, *in press*).

Many of the choices made by researchers in the studies described are driven by data limitations. For example, the use of statewide administrative data from school systems has the advantage of multiple repeated measures of achievement for a large number of children, which are required for more robust longitudinal modeling approaches (Hanushek et al., 2004; Schwartz, Stiefel, & Cordes, 2016). However, they typically contain incomplete information on residential mobility and limited information on child and family characteristics. This situation requires being circumspect in interpretations and avoiding the temptation to make blanket statements about mobility when analyzing only one form of mobility at one particular time for one specific outcome.

Like all nonexperimental research, estimates of mobility effects are vulnerable to selection bias. It is inappropriate to fault earlier studies for the limitations of correlational analysis, given the relatively recent development of many causal techniques in the social sciences (Morgan & Winship 2015). However, the

legacy of this bias is the general perception that mobility has only negative effects on child development. Methodological improvements designed to limit bias typically reduce or even eliminate the negative association between mobility and children's developmental outcomes, and some studies report benefits of mobility.

Therefore, it is important to draw a hard line between correlational and causal estimates and to account for selection. Aside from randomization, there is no magic bullet for causal estimation, but strategies such as fixed and random effects, propensity score matching, and instrumental variables at least force researchers to engage the problem explicitly and, in most cases, improve estimates. Careful application of these approaches promises to strengthen the quality of research on mobility and children's development. As with any technique, a causal model is only as good as its theory, and future research should make the assumptions of causal inference explicit, notably by articulating potential confounders, mediators, moderators, and omitted variables.

No modeling technique can account for contemporaneous instigating events or contextual shifts when data are not available. Several studies come close (e.g., Fragile Families; the NICHD's Study of Early Child Care and Youth Development), but because they were not designed to examine mobility per se, they often lack important variables necessary for sophisticated analyses. An ideal mobility module would collect full residential and school trajectories of children, including any instigating events and cotemporaneous changes in family structure. Sufficient information should be collected about each ecological context (home, family, school, and neighborhood) to allow researchers to examine how mobility is correlated with positive or negative changes in children's environments. In addition, because any single data set represents a select population at a particular time, replication of findings across data sets is a high priority for future mobility research.

In summary, this article's recommendations for future research are threefold. First, researchers should test for the differential effects of mobility across multiple operationalizations and not assume estimated effects are invariant to context, timing, distance, and so forth. Second, researchers should refrain from studying the outcomes of mobility in childhood with techniques that do not address the unobserved and

unobservable differences between mobile and nonmobile youth. Even when sophisticated techniques are used, however, this work should rigorously describe causal assumptions. Finally, future data collection efforts should incorporate modules designed to test the effects of residential and school mobility across heterogeneous populations.

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Notes

1. Given statistical power limitations, an increasingly insignificant and/or smaller coefficient does not necessarily suggest that an effect is zero, only that the estimates found in earlier studies may have been biased by selection.
2. For Black students, no association between mobility and school quality was found regardless of the distance moved.

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