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Housing Mobility and Cognitive Development: Change in Verbal and Nonverbal Abilities

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Abstract

This study investigates the influence of housing instability on verbal and nonverbal cognitive development among at-risk children and adolescents involved in the child welfare system. Frequent residential changes threaten child mental health, especially among low-income families. Little is known regarding disruptions to cognitive growth, specifically the impact on verbal and nonverbal abilities. The study tests whether developmental timing of housing mobility affects cognitive development beyond individual and family risks. A nationally representative study of families (n = 2,442) susceptible to housing and family instability tracked children and adolescents aged four to 14 years (M = 8.95 years) over 36 months following investigation by the child welfare system. Youth completed standardized cognitive assessments while caregivers reported on behavior problems and family risk at three time points. Latent growth models examined change in cognitive abilities over time. Housing mobility in the 12 months prior to baseline predicts lower verbal cognitive abilities that improve marginally. Similar effects emerge for all age groups; however, frequent moves in infancy diminish the influence of subsequent housing mobility on verbal tasks. Housing instability threatened cognitive development beyond child maltreatment, family changes, poverty, and other risks. Findings inform emerging research on environmental

influences on neurocognitive development, as well as identify targets for early intervention. Systematic assessment of family housing problems, including through the child welfare system, provides opportunities for coordinated responses to prevent instability and cognitive threats.

Keywords

housing mobility; cognitive development; child welfare; family stability; developmental timing

Inadequate housing represents a significant barrier to healthy child development for many at-risk families in the United States (Adam, 2004; Leventhal & Newman, 2010). Low-income families struggle to secure safe and stable housing in tight affordable housing markets that remain difficult to navigate after a slow recovery from economic recession (Joint Center for Housing Studies of Harvard University, 2012; Institute for Children, Poverty, and Homelessness, 2013). A growing body of evidence demonstrates associations between housing problems and poorer child mental health and school outcomes (Adam, 2004; Jelleyman & Spencer, 2008; Leventhal & Newman, 2010). However, less research examines the effects of housing mobility on cognitive development, especially in the context of other family and economic stressors. The present study proposes and tests a developmentally informed model of housing instability and child development. Using data from a nationally representative sample of at-risk families, the study hypothesizes that timing and chronicity of moves influence growth of verbal and nonverbal abilities beyond co-occurring family instability.

Housing and Child Development

Safe and stable homes facilitate healthy families and child development (Leventhal & Newman, 2010); however, a substantial portion of children experience precarious housing situations marked by unsustainable accommodations and frequent moves. The Current Population Survey estimates 10 million children aged 1 to 19 years (12.8%) moved at least once in a 12-month period in 2013 and 2014, while female-headed and low-income households move at more than two times that rate (United States Census Bureau, 2015). Although moves reflect voluntary and involuntary decisions, frequent mobility indicates economic strains that range from seeking affordability to chronic housing changes characteristic of homeless families (Buckner, 2008).

A growing body of evidence links housing mobility with poor behavioral adjustment and worse school outcomes among children and adolescents. Youth exposed to multiple residential moves exhibit greater emotional, behavioral, and social maladjustment both immediately following housing transitions, and over time (Adam, 2004; Jelleyman & Spencer, 2008). Moves also relate with poorer educational attainment and greater likelihood of dropout (Cutuli et al., 2013; Metzger, Fowler, Anderson, & Lindsay, in press; Voight, Shinn, & Nation, 2012). Maladaptation seems especially pervasive for at-risk youth (Coley, Leventhal, Lynch, & Kull, 2013; Fowler et al., 2014; Hagan, Macmillan, Wheaton, 1996). A recent study of children born to single mothers in 20 United States cities suggests excessive mobility in the first five years of life relates to elevated externalizing problems, particularly among youth in lower income families (Ziol-Guest & McKenna, 2014). This evidence

points to specific conditions (i.e., low income) and time periods (i.e., early childhood) in which housing mobility disrupts behavioral adjustment among children.

Less is known about the role of housing instability on cognitive development – a fundamental domain of child development with life course implications (Heckman, 2006). Cognitive abilities broadly refer to the effective application of novel solutions to ambiguous tasks and situations (Sternberg, 1985). Contrary to previous conceptualizations of intelligence as a static individual characteristic, recent evidence shows malleability of cognitive functioning associated with environmental adversities across childhood and into young adulthood (Beckett, Castle, Rutter, & Sonuga-Barke, 2010; Jaffee, 2007). Only one study explicitly examines developmental delays associated with housing mobility among low-income children across the United States (Coley, Doyle, & Kull, 2015); the authors did not find significant relationships between timing of moves among low-income infants and toddlers and delays in cognitive domains measured a year later. However, the short follow-up period and focus on younger children limits the implications of the study for theory. Although a larger body of research demonstrates inverse relations between housing instability and academic achievement (Coley et al., 2013; Cutuli et al., 2013; Voight, Shinn, & Nation, 2012), underlying developmental processes remain understudied.

Ecobiodevelopmental Model of Housing Stability

An ecobiodevelopmental model of housing illustrated in Figure 1 emphasizes the multilevel and dynamic nature of family instability (Coley, Lynch, & Kull, 2015; Shonkoff & Garner, 2012). Based on the ecological systems theory (Bronfenbrenner, 1979; Bronfenbrenner & Evans, 2000), this model proposes child development occurs within concentric zones of influence that interact over time. Housing stability represents an exosystem process that facilitates relationships within and between environmental contexts. Safe and stable accommodations support positive microsystem connections between parents and children, including establishment of consistency and routines that facilitate active learning and behavioral adaptation (Mayberry, Shinn, Benton, & Wise, 2014). Housing also nurtures important links with peer networks, teachers, and neighbors in the community who contribute to and invest in healthy child development (Coleman, 1988). Macrosystem processes contribute to housing stability through employment opportunities, quality affordable housing, and policies that support integrated communities (Sampson, 2012). Consistency in relations with family and community readies children for developmental challenges such as the transition into school, formation of peer networks, and onset of puberty. The accumulation of strong social ties facilitated by stable housing promotes protective factors that support healthy child development.

Housing instability and exposure to environmental adversities

Housing mobility disrupts protective relationships and increases risk for exposure to adverse environments. Relocation to more affordable accommodations often requires moving away from extended family, peers, teachers, and neighbors. Frequent moves limit families' abilities to accumulate and use age-appropriate enrichment materials (e.g., books, games, and computers), and impoverished housing conditions limit dedicated space for parents to engage children in learning (Leventhal & Newman, 2010). Moreover, communities

accessible to low-income families often host fewer educational and enrichment opportunities; children attend more impoverished and less desirable schools, and a lack of safe spaces in the community limits opportunities for children to play and families to connect with neighbors. To avoid more precarious situations and homelessness, caregivers double-up with relatives and friends in temporary accommodations, such as staying on couches (Buckner, 2008). Overcrowded and impermanent conditions strain connections with social supports, and families often cycle in and out of places to stay, including homeless shelters. Dynamics across multilevel environments perpetuate frequent mobility among vulnerable families that further threatens child development.

An ecobiodevelopmental model of housing emphasizes risks in the family microsystem. Families preoccupied by navigating tight affordable housing markets with limited emotional and instrumental supports experience greater distress that disrupts positive parenting (Kull & Coley, 2014; Samuels, Fowler, Ault, Tang, & Marcal, in press). Precarious housing that results from and exacerbates parental mental health problems interferes with the ability to provide emotional support for children. The strain increases the probability of emotional and physical abuse, while caregivers may also neglect basic child needs (food and clothing); inadequately housed families are disproportionately in contact with the child welfare system (Fowler, Taylor, & Rufa, 2011; Park, Metraux, Brodbar, & Culhane, 2004).

Poverty research alludes to specific neurodevelopmental deficits associated with housing instability and environmental chaos (Blair, Raver, Granger, Mills-Koonce, & Hibel, 2011; Evans & Kim, 2012). Compared to higher-income households, children in low-income families demonstrate greater lags in language development, while deficits are less pronounced in spatial processing and nonverbal skills (Farah et al., 2008; Noble, Farah, & McCandliss 2006; Noble, Norman, & Farah, 2005). Theory attributes the pattern of delays to impoverished communication between low-income parents and children; financial and emotional stress makes caregivers less available to talk and engage in reciprocal interactions necessary for development of language brain circuitry (Shonkoff & Garner, 2012). In contrast, nonverbal tasks develop more consistently because low-income children continue to engage spatially despite environmental chaos. Verbal deficits accumulate over time and help explain subsequent socioeconomic educational gaps that endure into adulthood (Duncan, Yeung, Brooks-Gunn, & Smith, 1998). Poverty might be expected to explain academic deficits and behavior problems associated with housing mobility; however, research consistently shows effects of mobility beyond other risks, including socioeconomic status (Hagan et al., 1996; Metzger et al., in press; Ziol-Guest & McKenna, 2014).

Housing instability in context of child development

Developmental timing of housing instability provides a further probe of the ecobiodevelopmental model on cognitive development. The framework emphasizes child age at exposure as well as the chronicity of environmental adversities as timing processes, meaning that children are more vulnerable to environmental threats during developmental transitions or in sensitive periods for acquisition of competencies (Bronfenbrenner, 1979; Cicchetti & Lynch, 1995; Huston & Bentley, 2010). Poverty research indicates earlier and more persistent exposure to impoverished conditions delay cognitive development (Blair et

al., 2011; Duncan, et al., 1998; Evans & Kim, 2012). Theory suggests adversities disrupt neural circuitry, especially in the development of early language abilities, and deficits accumulate with time spent in poverty (Farah et al., 2008; Noble et al., 2006; Noble et al., 2005). However, research on childhood exposure to chronic child maltreatment and deprivation in orphanages suggests initial cognitive delays rebound in later childhood after children receive more stable and enriched environments (Beckett et al., 2010; Jaffee, 2007; Straus & Paschall, 2009). Despite these bodies of work, there is very little information on the effects of housing stabilization across cognitive processes as well as at different ages.

Very little research has examined differences between verbal and nonverbal cognitive processes associated with housing mobility. Studies of homeless children have provided limited evidence of developmental timing differences that vary by outcome. A prospective study matched children entering New York City homeless shelters with a random sample of youth whose families received public assistance (Shinn et al., 2008). Five years later, homelessness related to lower verbal scores among preschoolers aged 4 to 6 years at baseline, while no differences emerged among children aged seven to 17 at shelter entry. Homeless and housed children performed similarly on nonverbal abilities. Another study comparing children in homeless shelters to matched low-income children found differences in verbal but not nonverbal tasks among school-aged children; however, children aged 3 to 5 years in shelters performed more poorly on both verbal and nonverbal tasks (Rescorla, Parker, & Stolley, 1991). A similar pattern was found in a comparison of homeless children with youth from the same neighborhoods (Yu et al., 2008). Although not explicitly tested, the pattern of effects across child ages suggests potential timing influences for particular cognitive domains.

The limited evidence suggests early childhood represents a particularly vulnerable window - especially for verbal development, and potential exists for a rebound effect of cognitive processes following housing stabilization. Nevertheless, these hypotheses are derived primarily from studies of poverty and extreme housing instability, so further investigation of the impact of housing mobility remains needed.

Present Study

The present study leverages longitudinal data from a nationally representative sample of at-risk families to examine individual variation in cognitive abilities over time associated with mobility. Repeated assessments of children and adolescents (n = 2,442) examine within- and between-individual change in verbal and nonverbal cognitive processes over a three-year follow-up. To test an ecobiodevelopmental framework, analyses account for risks on cognitive development at multiple levels and over time. Models emphasize family microsystem processes as potential alternative explanations for housing effects, especially in the high-risk population; type and frequency of child maltreatment, as well as caregiver mental health, are explicitly modeled. Response from the child welfare system represents an exosystem factor that might promote child development; socioeconomic characteristics such as caregiver highest educational achievement and household income address macrosystem influences. Importantly, models also account for individual development of co-occurring behavioral regulation shown to be related with housing instability (Fowler et al., 2014).

Analyses investigate specific hypotheses regarding whether a) increased residential moves relate to hampered growth of cognitive abilities beyond the effects of other socioeconomic and family risks; b) deficits associated with housing mobility emerge for both verbal and nonverbal processes; c) preschoolers experience the greatest impact of housing mobility on cognitive development compared to school-aged children and adolescents; and d) early and repeated exposure to mobility relates to suppressed cognitive development.

Method

Participants

Data were drawn from the first cohort of the National Survey of Child and Adolescent Well-Being (NSCAW), a nationally representative sample of families under investigation for child abuse and neglect from October, 1999 to December, 2000. Face-to-face interviews with caregivers, children, and child welfare caseworkers occurred within six months of child protective services investigation; follow-up occurred 12, 18, 36, and 59 to 97 months after baseline assessment. With 5,501 total families investigated, the current study included those with children aged 4 to 16 years who remained together after CPS investigation (n = 2,442). Families placed out of home (n = 1,467) did not provide information on housing mobility, while children aged zero to three (n = 1,592) were not administered cognitive assessments. This study included caregiver and child reports at baseline, 18-, and 36-month follow-ups.

Child mean age was 8.95 years (SD = 3.26 years) at baseline. Caregivers, aged 34.47 years on average (SD = 8.32), were predominantly female (89%) and unmarried (66%). The majority of families were ethnic minorities, including 27% African Americans, 18% Hispanics, and 8% other ethnicities; the remainder (47%) were white. Over half of families (56%) earned below $20,000 per year, and one-third of households reported incomes below the federal poverty level. More than half of families (57%) received in-home child welfare services to support family functioning after maltreatment investigation.

Measures

Mobility—Three measures of housing instability were employed in this study:

1. *Housing mobility*. Housing mobility was assessed at the baseline interview through caregiver-reported number of moves with children in the last 12 months. As in other studies of family housing and homelessness, total number of moves was used and has demonstrated adequate validity in capturing risk associated with instability above and beyond other indicators of family disruption (Coleman, 1988; Cutuli et al., 2013; Wood et al., 1993). A similar distribution of recent moves was found in this sample as in prior research; most families reported no moves (70%), 20% reported one move, while 10% reported two or more moves within 12 months. Caregiver-reported number of moves was not collected at follow-up waves.
2. *Address changes*. To assess housing mobility after baseline, dichotomous variables indicated whether parent interviews occurred at the same physical address as the prior interview. Address locations were tracked in an electronic database as part of study protocol. A fuzzy matching algorithm identified matches, accounting for

minor spelling and data entry errors. Many families changed addresses between baseline and the 18-month follow-up (49.1%), as well as between 18- and 36-months (42.4%).

3. *Early mobility*. Caregivers were asked at baseline to report the number of moves made with children in the first 12 months of the child's life. This item served as a proxy of exposure to early mobility (Osborne & McLanahan, 2007). The count variable was dichotomized such that zero represented none or one move (83%) within the child's first 12 months, while one represented two or more moves (17%). This bifurcation was based on the variable distribution, which showed a binary pattern with very few families (4%) reported moving three or more times.

Cognitive development—The vocabulary and matrices subscales of the Kaufman Brief Intelligence Test (K-BIT) measured cognitive ability (Kaufman & Kaufman, 1990). Individually administered to youth, the vocabulary subscale assessed word knowledge and verbal concept formation; the matrices subscale measured nonverbal ability to recognize relationships and patterns. Normed on a nationally representative sample, the subscales demonstrated adequate reliability and validity. Internal consistency for the vocabulary subscale among children aged 4 to 19 years was high (ranging from .89 to .98) and moderate to high for the matrices subscale (ranging from .74 to .95). Internal consistency for this sample was also adequate for the vocabulary (α = .76) and matrices (α = .79) subscale scores. Vocabulary and matrices raw scores were used, as well as a summed score to capture overall cognitive development.

Behavior problems—Youth behavioral and emotional problems were assessed with the 118-item Child Behavior Checklist (CBCL) for children aged 4 to 18 years (Achenbach, 1991). Caregivers rated children's problem behaviors on a 3-point Likert-type scale (0 = *not true*, 1 = *somewhat/sometimes true*, 2 = *very true/often true*). The externalizing subscale captured parent-rated delinquency and aggression. Cronbach's alpha in this sample was high (α = .92). The CBCL has been used extensively, demonstrating adequate validity in nationally representative samples (Achenbach et al., 1995). Raw scores were used in analyses to capture range in symptoms across different ages.

Family instability—Changes in children's family environments were captured through caregiver-reported disturbances in parental figures living with children. Caregivers indicated parental changes due to divorce or separation, marriage or remarriage, or death; parent-child separations due to health or mental health problems, substance abuse, incarceration, or employment changes; return of absent parents to the home; child returns to home after separations; and other disruptions. The number of disruptions was summed 12 months prior to baseline and between interviews; higher scores represented greater family instability.

Child maltreatment—Caregivers self-reported frequency of engaging in minor physical assault and neglect in the past 12 months. The Parent Child Conflict Tactics Scale (CTS-PC) administered using audio computer-assisted self-interview assessed frequency of events from 0 (none) to six (>20 times). Example minor assault items included, "Hit CHILD on the bottom with something life a belt, hairbrush, a stick or some other hard object", and

"slapped CHILD on the hand, arm, or leg". Neglect example items included, "called CHILD dumb or lazy or some other name like that?" and "leave your CHILD home alone, even when you thought some adult should be with him/her?" The current caregiver completed assessments at baseline, 24-months, and 36-months. The CTS-PC has demonstrated strong psychometric properties and has been used in multiple national studies (CTS-PC; Straus, Hamby, Finkelhor, Moore, & Runyan, 1998).

Child welfare services—Families who received services to address child safety through the child welfare system were identified. A dichotomous indicator triangulated information from child protective services and caregiver interviews on in-home service-receipt; 43.0% of families received services to keep children in the home. The remaining investigations were closed without providing any resources.

Abuse Type—Child protective services caseworkers provided the most serious allegations of abuse and neglect that triggered investigation by the child welfare system. From 17 different types of abuse, this study categorized reasons for investigation into four types: physical abuse, sexual abuse, emotional abuse (i.e., emotional maltreatment, moral/legal maltreatment, educational maltreatment, exploitation), and neglect (i.e., physical neglect, no supervision, and abandonment). Each category was dichotomized to compare the primary reason to other types of abuse. Alleged reports were used instead of substantiated cases given evidence from the NSCAW study that suggested this differentiation failed to reflect elevated risk (Kohl, Jonson-Reid, & Drake, 2009).

Caregiver mental health—Caregivers completed the Short Form Health Survey (SF-12) to assess perceived physical and mental health (Ware, Kosinski, & Keller, 1996). This study used the six-item mental health subscale. Sample items included, "During the past 4 weeks, how much of the time have you felt downhearted and blue?" and "During the past 4 weeks, did you feel you didn't do work or other activities as carefully as usual as a result of any emotional problems such as feeling depressed or anxious?" Test-retest reliability was adequate for mental health (α = .76; Ware et al., 1996). Higher scores indicated better mental health.

Family income—Caregivers reported total family income from all sources in the past 12 months at baseline in $5,000 increments from $0 to $50,000 and above. The distribution of income strata was examined, and a four-level interval variable was created to capture the relatively normal distribution of annual incomes: below $10,000, $10,000 – $19,999, $20,000 –$39,999, and $40,000 and more in a 12-month period.

Youth demographics—Child age, race, and gender were assessed using a multi-informant procedure that triangulated reports across sources (child, caregiver, and caseworker). Child age at the initial interview was trichotomized to reflect different developmental periods. Preschoolers included children aged 4 to 6 years (n = 690, M = 4.99, SD = .84); school-aged children aged 7 to 10 years (n = 903, M = 8.45, SD = 1.11); and adolescents aged 11 to 16 years with more than 90% under age 15 (n = 849, M = 12.68, SD = 1.29).

Procedures

Families were selected using a two-stage stratified probabilistic sampling design (Dowd et al., 2003). The first stage divided the United States into nine sampling strata; eight strata comprised the eight states with the largest child welfare caseloads, and one stratum included the remaining 42 states and the District of Columbia. Ninety-two primary sampling units (PSUs) were selected from the nine strata, with each PSU representing the geographic location served by one child protective services agency. The second stage randomly selected families investigated for child abuse or neglect from monthly lists generated by each PSU from October, 1999 to December, 2000. A stratified sampling strategy ensured selected families represented the child welfare population based on age and level of service.

One child from each family was randomly selected as the study target; caregiver and child welfare caseworker report focused on this child, who was administered age-appropriate observation and/or assessments. Trained field representatives conducted structured interviews with children, caregivers, and caseworkers via laptop computers, usually in families' homes. Caregivers provided written consent for surveyed children, and youth aged 11 years and older gave written assent. Children aged 7 to 10 years verbally assented to participate. Data quality was assured through extensive training and supervision.

Analytic Approach

Latent Growth Modeling (LGM) was used to analyze data in three steps (Muthen, 2004). First, initial analyses examined unconditional LGMs for cognitive development to test the extent to which models including intercept and slope factors adequately described patterns of change. Unconditional models examined change without predictors of growth factors. Slopes estimated linear change across three time points at baseline, 18- and 36-month follow-ups. Time was centered at 18-months to examine development across the follow-up period. Model fit was evaluated across multiple indices of absolute and incremental fit (Preacher, Wichman, MacCallum, & Briggs, 2008). The chi-square test was examined, recognizing sensitivity to sample size of this study. The Root Mean Square Error of Approximation (RMSEA) evaluated absolute fit penalizing for model complexity with values below .05 representing adequate fit to the data. The Comparative Fit Index (CFI) assessed incremental fit while correcting for model complexity. Values above .90 on the CFI represented adequate fit to the data. In addition, adjustments based on review of modification indices were conducted iteratively to enhance fit to the data.

Second, conditional models simultaneously estimated change in cognitive development and externalizing problems, including predictors of growth factors. Paths were included from initial levels of growth and cross-domain slope factors to capture potential parallel influences on cognition and externalizing behavior over time. Conditional models incorporated time-invariant and variant covariates. Growth factors were regressed on baseline report of housing mobility, primary abuse type investigated by child protective services, child welfare services receipt, child gender, child ethnicity, family income, and caregiver mental health. Lagged time-varying covariates that assessed family instability, child maltreatment, and address changes were regressed on outcomes at each wave. Similar

models examined change in verbal and nonverbal abilities separately to investigate co-occurring patterns.

Third, multiple group analyses tested whether child age or early exposure to mobility moderated the relationship between recent housing mobility and growth factors. Analyses compared model fit when paths between housing mobility and growth factors were allowed to estimate freely across moderating conditions versus when paths were constrained to be equal. Scaled difference test evaluated differences in models (Satorra & Bentler, 2001). Significant omnibus tests were followed up by testing specific paths between housing mobility and particular intercept and slope factors. Figure 2 presents the overall analytic framework. All models were estimated using MPLUS Version 5.0 (Muthen & Muthen, 2007). Maximum likelihood estimation enabled use of full information to address missing data.

Results

Table 1 presents correlations among all study variables, as well as variable means and standard deviations for the full sample. Youth in this sample obtained lower scores on the cognitive assessment compared to normative samples, likely reflecting the risks experienced by the population. Patterns of relationships between study variables generally reflected findings from prior research on mobility and risk. Of importance, small negative correlations existed between housing mobility and cognitive development across time points. African Americans, lower-income families, families receiving child welfare services, and instable families were more likely to experience moves, as were families who reported early mobility. Minority and lower-income children had lower scores on cognitive development, as did children investigated for suspected neglect and children who received child welfare services. Investigations for sexual abuse related with cognitive scores. Similar patterns emerged when examining verbal and nonverbal cognitive abilities separately.

Unconditional Latent Growth Models

Preliminary unconditional models examined whether LGMs adequately described patterns of change in cognitive development when including intercept and slope parameters. The unconditional model of cognitive development provided reasonable fit to the data [$\chi^2(1) = 35.05$, $p<.01$; *CFI* = .96, *RMSEA* = .12], with significant values of intercept (estimate = 66.58, SE = 41) and slope (estimate = 6.79, *SE* = .13). Positive growth existed in cognitive ability. Model fit improved when separately examining change in verbal abilities ($\chi^2(1) = 24.57$, *RMSEA* = .10, *CFI* = .97) and nonverbal abilities ($\chi^2(1) = 26.54$, *RMSEA* = .10, *CFI* = .98).

Conditional Latent Growth Models

Conditional models estimated the effect of housing mobility on cognitive development, accounting for time-variant and invariant covariates. Fit statistics presented in Table 2 suggested reasonable model fit across indicators and outcomes. Although significant chi-squares were expected given the relatively large sample size, the *CFI* fell above .90 and RMSEAs fell at or below .05. Estimates suggested adequate fit for the relatively complex

parallel process models. Cognitive development demonstrated positive growth over time (intercept estimate = 62.45, *SE* = 2.41; slope estimate = 7.67, *SE* = .79) with significant unexplained variance in growth terms (intercept residual variance = 348.56, *SE* = 10.71; slope residual variance = 24.70, *SE* = 3.50). A similar pattern emerged within cognitive domains; youth exhibited improvements in verbal development (intercept estimate = 39.07, *SE* = 1.58, slope estimate = 4.55, *SE* = .49 and nonverbal development (intercept estimate = 23.78, *SE* = .89, slope estimate = 2.89, *SE* = .41). Cognitive abilities grew with time, while individual differences existed in overall levels and rate of change.

Early housing mobility also related to cognitive development. Children whose caregivers reported two or more moves in infancy had lower overall cognitive scores that remained suppressed over time. A differential pattern emerged when examining performance by cognitive domain. Verbal development demonstrated a similar rebound as housing mobility in the past 12 months (e.g., Figure 3); children scored lower on verbal abilities that partially rebounded over time. Early mobility related with poorer nonverbal abilities that remained lower over time compared to children who moved once or less in infancy.

Table 3 provides estimates of time varying and invariant covariate effects on growth parameters for overall development and by cognitive domain. Results suggested increased housing mobility in the 12 months before baseline related with lower overall levels of cognitive development, after adjustments for co-occurring development of behavior problems, as well as various dimensions of family instability, child maltreatment, child welfare involvement, and socioeconomic status. Housing mobility predicted significant increases in the slope of cognitive development across time, which suggested partial cognitive rebounds. As displayed in Figure 3, children who moved two or more times within 12 months demonstrated lower cognitive abilities that partially rebounded over time. A threshold existed such that a single move within a 12-month period did not relate with cognitive deficits, but two or more moves related with lower scores that partially caught up across the follow-up period. The same pattern emerged when examining cognition by verbal and nonverbal domains separately; housing mobility predicted poorer overall verbal and nonverbal abilities and related to improvements in both domains over time.

Housing effects emerged above and beyond effects of other individual and familial risks as shown in Table 3. Higher levels of caregiver-reported externalizing problem behaviors slowed co-occurring growth of cognitive development for both verbal and nonverbal abilities. As in prior research, children from lower-income families, African Americans, and children whose parents reported worse mental health scored lower on initial cognitive development. Latino children also initially scored lower but scores increased more sharply over time. Boys exhibited significantly slower growth in cognitive scores over time compared to girls. Exposure to minor abuses related with poorer cognitive scores at wave 2.

Counterintuitive associations also existed. As expected, neglect as a primary reason for child protective services investigation related with lower overall levels of cognitive abilities over time, however caregiver reported frequency of neglect related with higher baseline scores. These variables were uncorrelated, suggesting they represent different constructs. In addition, contemporaneous family instability predicted higher cognitive ability scores at the

18-month follow-up, and change of address between Wave 3 and Wave 4 related with higher verbal abilities at the 36-month follow-up.

Multiple Group Moderating Analyses

To examine whether youth age and early exposure moderated the relationships between housing mobility in the past 12 months and growth in cognitive outcomes, multiple group analyses compared model fit of freely estimating versus fixing the paths between housing mobility and cognitive growth factors. Model comparisons for child age appear in Table 2. Child age at exposure to housing mobility did not moderate the effects of mobility on growth of cognitive development; constraining these effects across age groups did not worsen model fit to the data. Support for moderation also did not exist when testing verbal and nonverbal abilities separately. Thus, the effects of mobility in the past 12 months were similar for preschoolers, school-aged, and adolescents.

Analyses also tested whether early mobility exacerbated the effects of more recent housing mobility on cognitive development. As shown in Table 2, early exposure to mobility – multiple moves within the child's first 12 months – moderated the effect of recent housing mobility on cognitive development. Constraining housing mobility effects to be equal across early mobility groups worsened model fit for overall cognitive development and verbal development in particular. Effects did not vary on nonverbal development across early mobility groups. Table 4 displays housing mobility coefficients on overall and verbal cognitive development by early mobility group. The pattern of effects showed a similar partial cognitive rebound (see Figure 3) among youth who had *not* experienced early mobility, and the effect on cognitive abilities was driven by the impact on verbal abilities. For youth who experienced early mobility, more recent housing mobility did not relate with cognitive development.

Discussion

The present study tests an ecobiodevelopmental model of housing stability for healthy child development. Longitudinal analyses suggest housing mobility relates with disruptions in cognitive development beyond other multilevel risks experienced by a vulnerable population of children and families. Children who move two or more times in a 12-month period exhibit cognitive deficits that partially catch-up over a three-year follow-up. The rebound associated with housing mobility occurs across cognitive domains and for preschoolers, school-aged children, and adolescents. Frequent moves in infancy exhibit more enduring effects on nonverbal development and desensitize youth to disruptions associated with subsequent mobility. The pattern of effects emerges in the context of co-occurring threats associated with socioeconomic status, child maltreatment, family instability, and parallel growth of behavior regulation.

Findings extend prior research on cognitive development in the context of inadequate housing and other environmental adversities. As seen in previous research on poverty, the at-risk children in this study exhibit suppressed cognitive development (Farah et al., 2008; Noble et al., 2006; Noble et al., 2005), and mobile children exhibit even poorer cognitive performance after controlling for socioeconomic status. This result contradicts previous

conclusions that poverty explains the effects of housing mobility (Hango, 2006; Pribesh & Downey, 1999). Moreover, the partial rebound of abilities associated with housing mobility resembles the context-dependent effects of severe maltreatment and physical deprivation experienced in childhood which rebound following stabilization of the environment (Beckett et al., 2010; Jaffee, 2007; Straus & Paschall, 2009). The current results suggest that children partially adapt to the time-limited shock to learning introduced by inadequate housing, and this potential for adaptation to housing instability remains consistent across childhood and adolescence.

Results correspond with the proposed ecobiodevelopmental framework although not as expected. The theory supposes unique effects of housing through exposure to environmental adversities and disruption of important relationships that support learning. However, families stabilize and adapt to new environments, which helps explain partial rebounds in cognitive performance. Moreover, single moves and other short-term family changes fail to impair and may enhance cognitive development over time; movement toward stability likely promotes connections between systems that support learning. The ecobiodevelopmental theory also contextualizes prior research showing inconsistent effects of housing mobility on development (Coley et al., 2015; Hango, 2006). Threshold effects and developmental timing differences mask potentially important developmental processes triggered by inadequate housing. The dynamics of housing mobility and stabilization depend on characteristics and timings of moves.

Counterintuitive findings of the study also point to the complexity involved in raising children in the context of family instability. Unexpectedly, greater frequency of neglect as reported by caregivers was associated with higher baseline cognitive abilities, indicating a measure of parenting stress and lack of support. Caregiver reports of neglect focused on difficulties providing for children, such as inability to make sure the child had food, unable to make sure the child got to a doctor or hospital when needed, and left the child home alone. Increased scores might reflect greater recognition of important parenting behaviors that support child development. A second unexpected finding related to family instability, with family structure disruptions predicting higher scores of cognitive abilities. Similar to single residential moves, family changes could represent movement toward stabilization that promotes learning. The pattern of effects across cognitive domains suggested effects are not random or a function of multiple tests; however, interpretations are made cautiously and require future research.

An important implication of study findings reflects the failure of mobile children to fully catch-up in cognitive processes. Housing mobility related with persistent deficits in both verbal and nonverbal abilities over the three-year follow-up period and in the context of other co-occurring risks. Similar to poverty, inadequate housing might trigger neuropathophysiological processes that disrupt stress responses and subsequent brain development (Blair et al., 2011; Evans & Kim, 2012). Yet, malleability exists for children to overcome chaos associated with instable housing. Housing effects beyond poverty suggest unique but parallel pathways of mobility and poverty on cognitive development. Although improvements occur over time, housing mobility remains a unique threat to child well-being with meaningful implications for future functioning. The current study emphasizes the need

for empirically informed early intervention and prevention of housing instability among at-risk families.

Affordable housing remains limited in most communities across the country. Only one-in-four eligible families receive rental assistance through public housing programs (Rice & Sard, 2009), and communities struggle to provide timely emergency housing through the homeless system. Although mobile families frequently interact with other public agencies including the child welfare system, housing resources are scarce with little evidence to support their utility in stabilizing families (Fowler et al., 2013). Opportunities to intervene with insecurely housed families are frequently missed.

Interventions that promote cognitive functioning must be developed and tested to provide mobile children opportunities to catch-up. Strategies that pair cognitive and behavioral preventive interventions may prove most effective given developmental cascades associated with housing instability (Fowler et al., 2014). Targeted and timely services depend on reliable and valid assessments of housing instability, as well as other housing problems related to child development, such as overcrowding, dilapidated conditions, and unaffordability. Simply asking families about current and past housing experiences presents clinically meaningful information. As demonstrated in this study, a single item queried to caregivers under child welfare investigation on number of moves in the past year provides information on a risk to child development that exceeds maltreatment and other environmental adversities. Risk assessments in child welfare should include this indicator, while future research will augment measurement to briefly and accurately capture concurrent risks with other aspects of housing, such as unaffordability, overcrowding, and doubling-up. Moreover, coordinated screenings across social service systems affords the best chance for prevention. Inadequately housed families interact with multiple social service systems, including healthcare, mental health, schools, speech pathology, homelessness services, public assistance, child welfare, as well as others. Few comprehensive approaches exist to triage high-risk families (Fowler et al., 2013). Connections between service systems provide opportunities to direct housing resources to prevent instability and promote healthy child development.

A number of limitations contextualize study findings. Although models include an extensive array of potential confounds that explain associations between mobility and child outcomes, the observational design limits the ability account for selection processes that lead to frequent moves, which may bias estimates of housing effects. In particular, models that more comprehensively investigate the multilevel processes that lead to moves will enhance future research. The measurement of housing mobility is also limited; the study depends on retrospective reports of moves, as well as tracking address changes at follow-up interviews. Memory and recall biases threaten validity and fail to capture contributors to moves and other meaningful aspects of housing. In addition, a gap remains in housing histories between infancy and initial child proactive services investigation that provide meaningful information on child outcomes. Future research will benefit from examining onset and offset of housing instability and the subsequent effects on child development using a life course perspective.

Another limitation reflects lack of data on infants and toddlers. The study included youth as young as 4 years of age to capture developmentally congruent constructs of cognitive development. Future work that explicitly tests models of housing mobility in younger children will provide a more comprehensive picture of instability and stabilization effects. Furthermore, this study used broad assessments of cognitive ability that do not directly target specific cognitive domains, such as executive functioning, working memory, processing speed, or associations with specific academic skills and social-cognition. Research that identifies mediating cognitive processes further supports targeted preventive interventions. Finally, the study uses a nationally representative sample of families under investigation for child abuse and neglect. Although the population provides a rigorous test of housing mobility effects in the presence of co-occurring family risks, findings may not generalize to other populations.

Despite limitations, the present study provides a useful test of the ecobiodevelopmental model of housing stabilization on child development. The study demonstrates a unique cognitive rebound in verbal and nonverbal abilities associated with frequent mobility. However, failure of mobile children to catch-up fully in cognitive development highlights the importance of interventions aimed to stabilize families.

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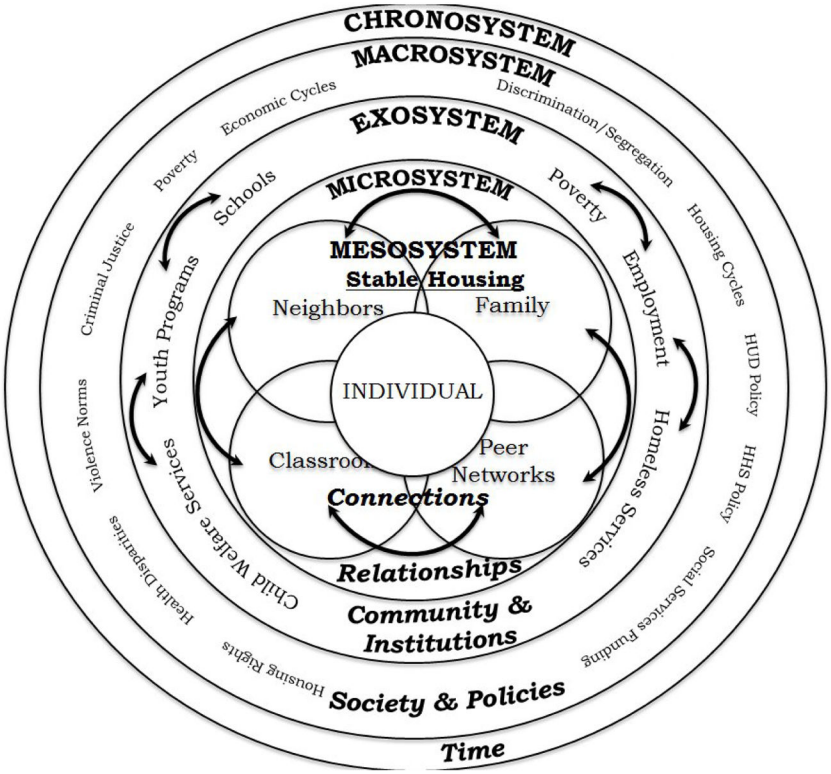

Figure 1.
An ecobiodevelopmental model of housing stability for healthy child development.

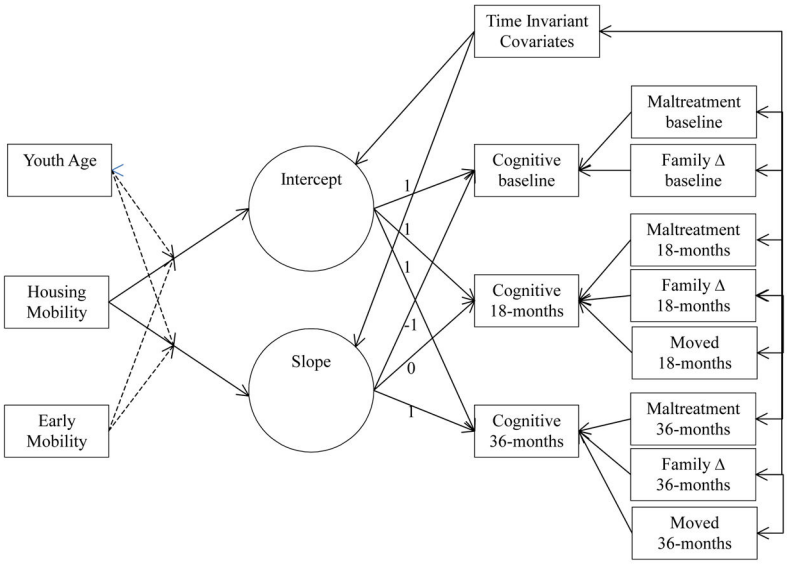

Figure 2.

Conceptual latent growth model testing housing mobility effects on cognitive development over a three-year follow-up period in context of other family instability. Separate models estimated moderating effects of the timing of mobility.

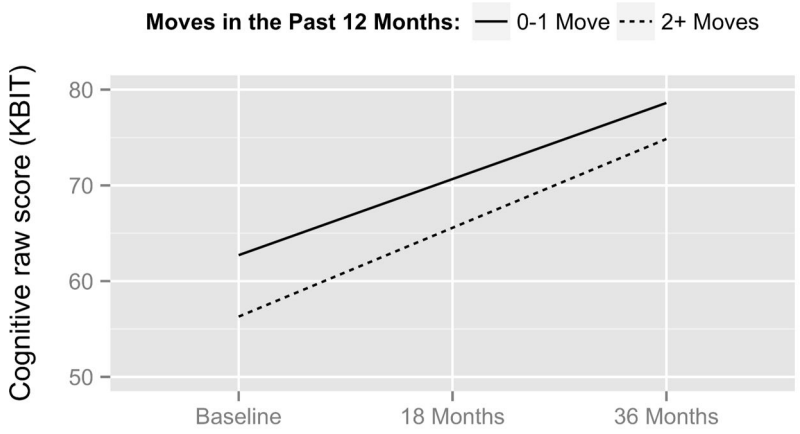

Figure 3.

Growth in cognitive development over time by number of housing moves in the prior 12 months. Two or more moves associated with poorer overall abilities that partially rebounded over time. Similar patterns emerged for verbal and nonverbal skills.

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Table 1

Summary of Intercorrelations, Percentages, Means, and Standard Deviations for Study Variables

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	Mobility	1																		
2	EarMob	.105**	1																	
3	Cog1	−.055**	−.065**	1																
4	Cog2	−.041	−.077**	.914**	1															
5	Cog3	−.049*	−.067**	.863**	.901**	1														
6	Ext1	.045*	.087**	.071**	.053*	.044	1													
7	Female	−.022	.033	.042*	.025	.005	−.118**	1												
8	Af.Am	.039	−.021	−.104**	−.136**	−.158**	−.036	−.014	1											
9	Latino	−.032	.010	−.124**	−.120**	−.118**	−.074**	.044*		1										
10	Income	−.115**	−.094**	.132**	.129**	.148**	−.035	−.013	−.173**	−.034	1									
11	CgrMH	−.082**	−.088**	−.033	−.057*	−.054*	−.300**	−.009	.023	.017	.111**	1								
12	PhyAb	−.079**	−.003	.027	.040	.061**	.094**	−.069**	−.012	.054*	.102**	.057**	1							
13	SexAb	−.030	.010	.027	.034	.028	.000	.173**	−.018	.035	.037	−.038	−.282**	1						
14	Neglect	.071**	.000	−.076**	−.092**	−.101**	−.048*	−.055**	.044	−.058**	−.135**	−.001	−.512**	−.384**	1					
15	OtherAb	.034	−.006	.043*	.044	.036	−.053*	−.023	−.029	−.025	.022	−.030	−.249**	−.187**	−.339**	1				
16	CW serv	.063**	.029	−.006	−.008	.007	.082**	.022	.044	.037	−.049*	−.084**	−.037	.075**	−.022	−.003	1			
17	CgrAb	.024	.107**	−.134**	−.141**	−.136**	.257**	−.104**	.029	−.035	−.070**	−.150**	.075**	−.072**	.023	−.050*	−.007	1		
18	CgrNeg	.083**	.075**	.113**	.118**	.079**	.213**	−.030	.077**	.032	−.031	−.206**	−.021	−.038	.029	.028	.077**	.127**	1	
19	FamΔ1	.108**	.100**	−.009	−.014	−.010	.064**	.035	−.092**	−.035	.017	−.075**	−.017	−.023	.025	.012	.060**	−.001	.010	1
	Mean	0.48	0.61	59.53	67.26	73.18	15.57	1.52	0.36	0.18	2.34	−13.77	0.27	0.18	0.41	0.14	1.57	7.07	3.74	0.41
	SD	0.91	--	22.77	20.37	18.17	11.2	--	--	--	1	11.6	--	--	--	--	--	11.37	8.49	0.66

Notes. Mobility = housing mobility; EarMob = early housing mobility; Cog = overall cognitive development; Af.Am = African-American; Ext1 = externalizing problems; CgrMH = caregiver mental health; PhyAb = Physical abuse investigation; SexAb = Sexual abuse investigation; Neglect = Neglect investigation; OtherAb= Other abuse investigation; CWserv = Child welfare services; FamΔ= family instability.

* $p<.05$.

** $p<.01$.

Table 2

Model fit for multiple group moderation analyses testing age at exposure to mobility and early mobility in infancy

	Cognitive Development					Verbal Development					Nonverbal Development				
	χ^2	*df*	Δ*df*	*CFI*	*RMSEA*	χ^2	*df*	Δ*df*	*CFI*	*RMSEA*	χ^2	*df*	Δ*df*	*CFI*	*RMSEA*
Direct Effects	545.67	79	--	0.94	0.05	609.64	79	--	0.94	0.05	335.84	79	--	0.96	0.04
Moderating Effects															
Early Mobility															
Freed	709.42*	176	--	0.94	0.05	751.57*	176	--	0.93	0.05	472.487	176	--	0.95	0.04
Constrained	718.271	178	2	0.94	0.05	760.429	178	2	0.93	0.05	476.776	178	2	0.95	0.04
Baseline Age															
Freed	625.066	275	--	0.95	0.04	647.07	275	--	0.94	0.04	704.293	275	--	0.91	0.04
Constrained	629.19	279	4	0.95	0.04	624.434[a]	279	4	0.95	0.04	706.457	279	4	0.91	0.04

Notes.

* $p \leq .05$.

df = degrees of freedom, Δ*df* = change in degrees of freedom between constrained and unconstrained models.

[a] Models would not converge when fixing parameters.

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Table 3

Unstandardized coefficients (standard errors) describing covariate effects on growth processes for cognitive development (n = 2,442)

	Cognitive Development						Verbal Development						Nonverbal Development					
	I	***SE***	***α***	***S***	***SE***	***α***	***I***	***SE***	***α***	***S***	***SE***	***α***	***I***	***SE***	***α***	***S***	***SE***	***α***
Time-invariant																		
Housing mobility - past 12 mos	−0.90	0.43	*	0.29	0.13	*	−0.51	0.28	†	0.20	0.08	*	−0.34	0.15	*	0.14	0.07	*
Housing mobility - infancy	−3.20	1.06	*	0.39	0.31		−2.21	0.70	**	0.55	0.19	**	−0.98	0.38	*	−0.02	0.18	
Child gender	1.21	0.80		−0.68	0.27	*	0.80	0.52		−0.36	0.17	*	0.51	0.29		−0.29	0.14	*
African American child	−4.05	0.89	**	−0.56	0.31		−3.27	0.60	**	−0.34	0.20		−0.82	0.34	*	−0.20	0.16	
Hispanic/Latino child	−8.08	1.19	**	0.72	0.36	*	−5.84	0.77	**	0.11	0.20		−0.41	0.41		0.09	0.17	
Other child ethnicity	0.29	1.56		0.29	0.47		−0.07	1.03		0.12	0.30		0.33	0.59		0.14	0.26	
Family income	2.43	0.43	**	−0.05	0.14		1.60	0.29	**	−0.02	0.09		0.70	0.16	**	0.02	0.07	
Caregiver mental health	−0.10	0.04	**	0.00	0.01		−0.05	0.02	*	−0.01	0.01		−0.03	0.01	*	0.00	0.01	
Physical abuse	−0.47	1.34		0.68	0.41		−0.47	0.89		0.25	0.25		0.05	0.49		0.23	0.22	
Sexual abuse	−1.06	1.50		0.61	0.45		−0.63	0.98		0.11	0.28		−0.24	0.55		0.24	0.24	
Neglect	−3.66	1.25	*	0.40	0.39		−2.66	0.83	**	0.32	0.24		−1.10	0.46	*	0.11	0.21	
Child welfare services	0.46	0.80		0.24	0.26		0.29	0.53		0.19	0.17		0.12	0.30		0.01	0.13	
Externalizing intercept	--	--		−0.09	0.02	**	--	--		−0.05	0.01	**	--	--		−0.04	0.01	**

Time-variant	Cognitive Development						Verbal Development						Nonverbal Development					
	b	***SE***	***α***				***b***	***SE***	***α***				***b***	***SE***	***α***			
Family instability Wave 1	−0.26	0.31		--	--	--	−0.27	0.19		--	--	--	−0.13	0.17		--	--	--
Family instability Wave 3	0.42	0.16	**	--	--	--	0.25	0.10	*	--	--	--	0.22	0.10	*	--	--	--
Family instability Wave 4	−0.04	0.22		--	--	--	−0.07	0.13		--	--	--	0.12	0.13		--	--	--
Minor abuse Wave 1	−0.12	0.02	**	--	--	--	−0.06	0.01	**	--	--	--	−0.06	0.01	**	--	--	--
Minor abuse Wave 2	−0.06	0.02	**	--	--	--	−0.03	0.01	**	--	--	--	−0.03	0.01	*	--	--	--
Minor abuse Wave 3	−0.03	0.02		--	--	--	−0.01	0.02		--	--	--	−0.03	0.01	*	--	--	--
Neglect Wave 1	0.10	0.03	**	--	--	--	0.06	0.01	**	--	--	--	0.04	0.01	**	--	--	--
Neglect Wave 2	0.04	0.03		--	--	--	0.02	0.01		--	--	--	0.03	0.02		--	--	--
Neglect Wave 3	−0.06	0.04		--	--	--	−0.03	0.02		--	--	--	−0.01	0.02		--	--	--

Time-variant	Cognitive Development						Verbal Development						Nonverbal Development					
	b	***SE***	***α***				***b***	***SE***	***α***				***b***	***SE***	***α***			
Address change Wave 3	0.22	0.32		--	--	--	0.03	0.19		--	--	--	0.03	0.20		--	--	--
Address change Wave 4	0.80	0.40	*	--	--	--	0.45	0.24	*	--	--	--	0.11	0.22		--	--	--

Note.

$^{\dagger}p<.10$,

$^{*}p\leq.05$,

$^{**}p\leq.01$.

Cognitive development represented summed verbal and nonverbal abilities scores at each assessment. W1 = 12 months before baseline; W3 = 18-month follow-up; W4 = 36-month follow-up

Table 4

Multiple group analyses: Moderating effects of the relationship between housing mobility and growth factors for cognitive development and verbal development as unstandardized coefficients (standard errors).

	Early Mobility					
	0–1 moves			2≥ moves		
DEVELOPMENTAL OUTCOMES	***b***	***SE***	***a***	***b***	***SE***	***a***
Cognitive Development Intercept	−1.21	0.53	*	−0.26	0.81	
Cognitive Development Slope	0.52	0.16	**	−0.27	0.20	
Verbal Development Intercept	−0.73	0.35	*	−0.15	0.53	
Verbal Development Slope	0.36	0.10	**	−0.11	0.13	

Note.

* $p < .05$,

** $p < .01$.

No significant moderation existed for nonverbal development and thus, effects are not presented.