20

Skill-Experience Transactions across Development

Bidirectional Relations Between Child Core Language and the Child's Home Learning Environment

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Introduction

Parents foster the development of their children, as shown by cumulative research on unidirectional influences of caregiving on offspring outcomes (Bornstein, 2015). In doing so, parents provide diverse effective proximal experiences, some of which are direct and others indirect (Bronfenbrenner & Morris, 1998). For example, parents who name objects for their children are also likely to enrich their children's home learning environment, and parent language as well as physical parameters of the child's

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environment exert independent influences on children's language development (Rijlaarsdam et al., 2013; Tamis-LeMonda & Bornstein, 2015; Tamis-LeMonda, Bornstein, & Baumwell, 2001; Wachs & Chan, 1986). In turn, children reciprocate in affecting their parents and their environments and thereby children's own development (Lerner, 2018). This study traces how children's core language skill and their home learning environment transact across five waves from infancy (15 months) up to adolescence (11 years) in 1,751 low socioeconomic status (SES) families.

Child Core Language Skill and the Home Learning Environment

Child language and the child's home environment were selected as transacting factors for three principal reasons. First, the two are consensually, manifestly, and self-evidently key features and determiners of child development and so of substantial concern to developmental, psychological, and educational researchers (National Early Literacy Panel, 2008; Wasik, 2012). Language acquisition is critical to development and shapes subsequent social, emotional, cognitive, and academic development as well as well-being into adulthood (Hart & Risley, 1995; MacWhinney & Bornstein, 2003; McCabe, 2005; McCabe & Meller, 2004; McCain, Mustard, & Shanker, 2007; Tomblin et al., 1997; Young et al., 2002). The child's home learning environment, that is the set of conditions provisioned and arranged by parents, stands among the best candidates for explaining individual differences in child development (Carneiro, Meghir, & Parey, 2013; Firkowska et al., 1978; Gottfried & Gottfried, 1984; Luster & Dubow, 1992) and assists or impedes children's language acquisition (Boerma, Mol, & Jolles, 2018; Rodriguez & Tamis-LeMonda, 2011). Second, children reared in rich home learning environments perform better on language tasks (Bus, Van IJzendoorn, & Pellegrini, 1995; Chansa-Kabali & Westerholm, 2014; Dowd & Friedlander, 2016; Dynia, Lawton, Logan, & Justice, 2014; Mol & Bus, 2011; Rijlaarsdam et al., 2013; see Klauda, 2009, for a review). Third, the two constructs can be studied across prolonged developmental time frames (here 15 months to 11 years).

Child Core Language Skill

From the organizational theory of development (Sroufe, 1979), the only way to study ontogeny of the same construct faithfully is to examine that same construct if it maintains its integrity across age or to examine different surface indicators of that construct if it needs be adjusted to be age appropriate. An additional challenge in the second case is that surface indicators that are appropriate to changing age are normally statistically noncomparable. A potential solution to this additional challenge, which we implemented here,

is the use of latent variables. Latent variables capture shared variance among their surface indicators and so allow for measures of a construct to vary across time, with different age-appropriate indicators and different loadings for the same indicators at different ages permissible. The latent variable approach also accommodates the advantageous perspective of converging operations of, say, multiple raters, methods, and even subdomains of a construct. Previous studies that combined multiple measures of child language into latent variables have demonstrated the consistency and robustness of this method across different samples, age groups, and languages (see Bornstein, Hahn, & Putnick, 2016a, 2016b; Bornstein, Hahn, Putnick, & Suwalsky, 2014; Putnick, Bornstein, Eryigit-Madzwamuse, & Wolke, 2017, and studies cited therein). In this transactional study, we used latent variables constructed of multiple different language measures at different ages to represent children's core language skill.

Home Learning Environment

We also used different age-appropriate representations of the Home Observation Measurement of the Environment (HOME) to represent the child's home learning environment. The HOME Inventory is designed to assess the quality of stimulation and support available to a child in the home; information needed to score the HOME is obtained through observation and interview done in the home with the child and the child's primary caregiver. Age-appropriate versions of the HOME have been used consistently in the published literature (Bradley, Caldwell, & Rock, 1988; Bradley et al., 1989; Bradley & Corwyn, 2007, 2013; Luster & Dubow, 1992; National Institute of Child Health and Human Development Early Child Care Research Network, 2005; Willerman, 1979). Moreover, the HOME or home learning environments (otherwise measured) uniquely relate to children's language development in the United States and internationally (Bradley, 2010; Elardo, Bradley, & Caldwell, 1977; Fan, 2001; Gottfried & Gottfried, 1984; Hill & Tyson, 2009; Luster & Dubow, 1992; Rijlaarsdam et al., 2013; Sui-Chu & Willms, 1996; Wu & Qi, 2006; Yeates, MacPhee, Campbell, & Ramey, 1983; Zadeh, Farnia, & Ungerleider, 2010), even net maternal intelligence.

Models of Transaction, Child Core Language Skill, and the Home Learning Environment

Much research which has attempted to capture parent-child relationships is correlational and cross-sectional in design and, so, limited. However true it may be that parents influence children and vice versa, correlation alone does not prove causation, and the arrows of influence in concurrent associations may run in either or both directions (*viz*., that parents influence children

and children influence parents). One way to transcend the limitations inherent in common correlational and cross-sectional assessments of would-be parent effects and child effects is to explore longitudinal bidirectional—*transactional*—parent-child relationships. Unfortunately, relatively few published studies have examined ongoing reciprocal relations between parental caregiving and children's development. Fewer still have examined these transactions over multiple developmental waves or over extended periods of time. To do so requires overcoming two central challenges of, first, gathering repeated assessments with long-term longitudinal data and, second, marshaling the same constructs in parent or environment and in the child. The present study employs just such a multiwave long-term longitudinal design to examine transactions between the parent-provided home learning environment and children's language development. It does so stretching from infancy through early adolescence. Research as in the current study on bidirectional transactions is fundamental to elucidating stabilities of and covariations between parent and child as well as unique and independent effective reciprocal parent-child relationships through time.

Transactional models in development stipulate that children and parents influence one another through time (Lerner, 2018; Overton, 2015; Sameroff, 2009; Chapter 8). Concretely, child and parent/environment bring distinctive characteristics to, and each is understood to change subsequently as a result of, their interactions; child and parent/environment then enter succeeding transactions changed. Transactions are conservative, as to evaluate transactions properly it is necessary first to acknowledge and account for stabilities in each actor as well as concurrent covariations between the two. For example, parents' use of harsh verbal discipline and corporal punishment predicts subsequent adolescent behavior problems, and adolescents with more behavior problems elicit harsher verbal discipline and corporal punishment from their parents (Lansford et al., 2011). Parental psychological control and adolescent depressive symptoms exert similar reciprocal effects through development (Soenens, Luyckx, Vansteenkiste, Duriez, & Goossens, 2008). To date, however, transactional research has often been limited to two closely spaced waves (Bates, Schermerhorn, & Petersen, 2012), so extant findings carry reciprocal models only so far. The Fullerton Longitudinal Study stepped beyond this limitation (Sy, Gottfried, & Gottfried, 2013): Two types of parental home involvement (academic instruction and academic socialization) transacted with children's reading achievement across three developmental waves from 3 to 17 years.

Here, we studied transactions between the home learning environment that parents provide their children and children's developing core language skill. At least three transactional pathways might be modeled, and there is extant support for each. First, the parent-provided home learning environment and child core language skill might correlate at any given time, but the environment exerts no unique effect on language at a later time and thereby

no effect on the environment itself at a still later time … or vice versa. With respect to the home learning environment and child core language skill, it is more plausible that reciprocal relations of influence are in force across development. Second, then, in an "angel's spiral," the home learning environment at any given time might improve child core language skill at a later time, which in turn might provoke an improved home learning environment at a still later time … or vice versa. For example, higher-quality parenting in Year 1 predicts improved cognitive performance in children in Year 2 and that improved cognitive performance evokes higher-quality parenting in Year 3 (Lugo-Gil & Tamis-LeMonda, 2008). Third, the home learning environment at any given time could improve child core language skill at a later time but in a "devil's spiral" reduces the home learning environment at a still later time … or vice versa. In this case, parents initially support their children's learning, which increases children's abilities, but as children's abilities increase, parents diminish their learning support or investment as no longer deemed necessary. For example, the amount of time parents spend reading to children from kindergarten to first grade positively predicts children's reading from first grade to third grade; however, as children's reading improves from kindergarten to first grade, parents provide less support in subsequent elementary grades (Booth-LaForce & Oxford, 2008; Gershoff, Aber, & Clements, 2009). In addition, it could be that one or the other "spiral" applies at different developmental periods across childhood. For example, parents may be more involved in the lives of their younger than older children, and younger children may be more influenced by parents than older children (Jeynes, 2007; Stevenson & Baker, 1987). Which transactional model between children's core language skill and the quality of their home learning environment obtains? Transactional studies have typically focused on brief periods of time leading to uncertainty about the stability of bidirectional effects across development (Pardini, 2008); therefore, which model applies across a broad swath of childhood or is restricted to certain developmental periods remains unclear. The current study was undertaken also to address these theoretical questions.

This Study

Based on the foregoing theoretical conceptualizations, empirical findings, and design considerations, in this study we examined longitudinal stabilities, contemporaneous correlations, and lagged transactional relations between children's core language skill and children's home learning environments across five waves from infancy up to adolescence. Three specific goals are addressed by our design. The first and main goal was to evaluate models of transaction by testing whether and how the child's core language skill transacts with the child's home learning environment from infancy up to adolescence over and above stability of each and concurrent relations between the two.

A second goal was to test the same transactions controlling for threats to the validity of the models by accounting for meaningful confounding common-cause third variables, not often attended to (Sy et al., 2013). It could be that effective transactions are not carried by reciprocal relations between child language and the learning environment, but by some other characteristics of the child and some characteristics of the mother. To this second goal, therefore, we investigated unique transactions between children's core language skill and the parent-provided home learning environment over and above children's social competence and their mothers' educational achievement, each of which is known to contribute to child language (Bornstein, Haynes, & Painter, 1998; Firkowska et al., 1978). The third goal was to assess potential moderators of the resultant transactional model: We investigated child gender, ethnicity, birth order, and risk status to ascertain differences in parameter estimates across groups.

To achieve these three goals, and to overcome methodological shortcomings of most previous studies having to do with potential confounders, reliance on parental reports, and limiting sample characteristics, we marshaled a multivariate multi-informant longitudinal design. Also, with an eye directed toward eventual intervention, we addressed the three goals in a large low-SES Early Head Start sample. To our knowledge, no previous study has investigated any dynamic relation in human development with such fundamental constructs, across so many time points, during a life phase that is so formative, with such a large socially at-risk sample, and implementing the number of controls we do here between child core language skill and the parent-provided home learning environment. In a nutshell, to fill an elemental gap in understanding the dynamics of human development, we adopted a transactional approach to assessing temporal stability, concurrent reciprocity, and unique and independent lagged transactions between child core language skill and the home learning environment from age 15 months to age 11 years.

Method

Participants

The national Early Head Start Research and Evaluation study (EHSRE) was designed to evaluate the impact of Early Head Start programs on low-income families with infants and toddlers (Love et al., 2005; Paulsell, Kisker, Love, & Raikes, 2002). Seventeen Early Head Start programs across the United States recruited participating families. Of the final EHSRE data sets composed of 2,977 families (Administration for Children and Families, 2011), for this analysis we excluded children of very or extremely low birth weight (<1,500 g) and included only European American and African American children from English-speaking households who

provided language data and whose home learning environment data were available at any of the five data-collection waves (15, 25, and 37 months and 5 and 11 years). (Rationales for these exclusion/inclusion criteria appear in the original article.)

Altogether, 1,751 families met the inclusion criteria: 49.8% were girls, 51.9% European Americans and 48.1% African Americans, 63.4% first-borns, and 30.0% identified as at risk for an adverse developmental outcome (e.g., congenital birth defects, severe chronic diseases, parental substance abuse). On average, children were 15.00 months (SD = 1.75, n = 1,523), 25.09 months (SD = 1.93, n = 1,423), 37.18 months (SD = 1.90, n = 1,093), 5.27 years (SD = .33, n = 1,236), and 11.07 years (SD = .32, n = 1,061) of age at the five successive assessment waves. As is expected in longitudinal studies, the EHSRE experienced attrition: 79% of the sample completed three or more waves, but only 32% completed all five waves. The number of waves completed was associated only with a better home environment at 14 months, $F(4, 1239) = 7.62$, $p < .001$, $\eta^2 = .024$. The differential missingness of the home environment makes it particularly important to use all available data in model estimation (rather than pairwise or listwise deletion); missingness was handled analytically using full information maximum likelihood estimation (FIML).

Parents averaged 21.82 years old (SD = 5.30) at the child's birth. At the time of EHS program enrollment, 39.5% of parents lived alone with their children, 60.8% had at least a General Education Development diploma or high school degree, and 24.5% were employed. At enrollment, 71.8% of families had incomes below the U.S. poverty line, 57.5% were welfare recipients, and 52.2% received EHS services. This study received research ethics committee approval from each institution that collected data as overseen by the Administration for Children and Families, U.S. Department of Health and Human Services, under contract 105-95-1936.

Measures

The EHSRE technical report includes informed consent procedures and detailed descriptions and psychometric information of the measures administered (Administration for Children and Families, 2002a, 2002b); summaries follow. (See the original article for details on each measure.)

Child Core Language Skill

At 15 months, parents reported on children's language using a short-form version of the MacArthur Communicative Development Inventory-Words and Gestures (Administration for Children and Families, 2002a, 2002b). At 25 months, parents reported on children's language using the short-form of the

MacArthur Communicative Development Inventory-Words and Sentences (Fenson et al., 2000a, 2000b); the Bayley Scales of Infant Development, Second Edition was also administered (Bayley, 1993). At 37 months, the Peabody Picture Vocabulary Test, Third Edition (PPVT-III; Dunn & Dunn, 1997), which measures receptive vocabulary and listening comprehension of spoken words, was administered. At 5 years, the PPVT-III and Letter-Word Identification subtest in the Woodcock-Johnson III tests of cognitive academic competence were administered (Woodcock, McGrew, & Mather, 2001). At 11 years, the PPVT-III and language and literacy assessments from the Early Childhood Longitudinal Study, Kindergarten Cohort study (ECLS-K) were administered (Pollack, Rock, Weiss, & Arkins-Burnett, 2005).

Home Learning Environment

At each of the five waves, an age-appropriate version of the HOME was administered (Bradley, 2010; Bradley et al., 2000; Caldwell & Bradley, 1984, 2003). The HOME assesses the quantity and quality of social, emotional, and cognitive support made available to children through their home environment, planned events, and family surroundings. Information needed to complete these inventories was obtained through observations and interviews conducted in the home with the parent. Observed items cover the quality of parent-child interactions, cleanliness and order of the home, and distinct features of the dwelling. Interview items with parents include questions about their child's activities over the past days or weeks, discipline, and parent-child interactions. At each age, there is a HOME Total score which is composed of several scales: At 15 and 25 months, Nonpunitive, Language and Cognitive Stimulation, Emotional Responsivity, and Verbal/Social Skills; at 37 months, Harsh, Language and Cognitive Stimulation, Warmth, Internal Physical Environment, and External Physical Environment; at 5 years, Learning Environment, Warmth, and Physical Environment; and at 11 years, Parental Lack of Hostility, Parental Verbal Skills, Warmth, Internal Environment, and External Environment.

Covariates

First, we considered whether being enrolled in the EHSRE (compared to the comparison group) was associated with better language skills and home environments. Consistent with previous research (e.g., Bornstein et al., 2016a, 2016b; Love et al., 2005), program enrollment had negligible relations with language skills, ϕs = −.00–.06, *p*s = .938–.016, and the home environment, ϕs = −.03–.05, *p*s = .537–.074; therefore, program status was not considered in the analyses.

Based on the extensive body of research on factors associated with child core language skill and the parent-provided home learning environment, we controlled for two well-established covariates that might threaten the validity of the transactional model: one personological to the child, namely, children's social competence, and one about the environment, namely, maternal education.

Social competence in children relates to their language skills directly and influences their parents' language (Belsky, 1984; Bornstein et al., 1998; Smolak, 1987). For example, children aged 18–34 months who score lower in socialization skills are also slow in expressive vocabulary acquisition (Paul, Looney, & Dahm, 1991), and parents of socially withdrawn children engage in less contingent verbal interaction than do parents of typically developing children (LaFrenière & Dumas, 1992). We examined child social competence as this common-cause variable could be where the "action" is, which would change the interpretation and implications of transactional findings: Rather than intervening on the home environment and early language, if effects are attenuated by child social competence, then social competence would be the intervention target. We obtained ratings of children's social competence during parent-child interactions at the 15-month data collection wave from videorecords of a semistructured free-play task adapted from the NICHD Early Child Care Research Network Three Box coding scales (Brady-Smith, O'Brien, Berlin, Ware, & Brooks-Gunn, 1999; Kopack Klein, Kemmerer, West, & Lim, 2016). The three scales rated children's engagement of parents (extent to which children initiate and/or maintain interaction with parents), sustained attention (degree of children's involvement with toys in the three bags), and negativity toward parents (degree to which children show anger or hostility toward the parent, subsequently reverse coded as positivity toward the parent); each was rated on a 7-point scale with higher scores representing greater amounts. In the current sample, one principal component accounted for 56.4% of the variance in the three scales with unrotated loadings ranging from .71 to .82. A mean score from ratings of child engagement, sustained attention, and positivity was computed to represent a measure of child social competence and used in the covariate model (below). Importantly, child sociability was obtained in interaction with the parent and may also serve as an indicator of the child's receptiveness to the parent-constructed environment.

Maternal education relates positively to the quality of the home environment and to child language (Bornstein et al., 1998; Carneiro et al., 2013; Davis-Kean, Tang, & Waters, 2019; Firkowska et al., 1978). Less educated parents tend to talk less and use fewer different words with their children, possess less sophisticated literacy skills, and read to their children less frequently (Arriaga, Fenson, Cronan, & Pethick, 1998; Hart & Risley, 1995;

Hoff & Laursen, 2019; Raikes et al., 2006; Rowe, Pan, & Ayoub, 2005). We controlled for maternal education because, if this single factor explained relations between the home environment and child language development, the intervention message would be simply to educate mothers. If, however, transaction effects are robust to maternal education, more can be done to intervene early to promote child language and outfit the child's learning environment regardless of the mother's education. Maternal education, coded as an ordinal variable ranging from *no school completed* (1) to *bachelor's degree or higher* (13), was used in the covariate model.

Analytic Plan

Transactional effects linking child core language skill and the parent-provided home learning environment were evaluated using autoregressive cross-lagged structural equation models (SEMs). A series of nested SEMs was examined to test the first goal involving lagged reciprocal relations between child core language skill and the home learning environment within and across time from infancy up to early adolescence. Model building details are available in the original article. Next, we reevaluated the transactional model controlling for child social competence and maternal education. Finally, we tested multiple group models across child gender, ethnicity, birth order, and risk status to ascertain differences in parameter estimates across groups.

In a sensitivity analysis, we explored correlations between the child language latent factors and subscales of the HOME to determine whether one or more components of the HOME was driving the effects of the total scale.

Results

The original article displays the pairwise correlation matrix among child core language skill and home learning environment measures on the total sample. All indicators of child core language skill loaded significantly (all *p*s < .001) on their factors at each age.

Figure 20.1 presents the standardized solution of the autoregressive cross-lagged panel model. This model fits the data well, $\chi^2(89) = 558.22$, $p < .001$, CFI = 1.00, SRMR = .07, RMSEA = .00. Significant and large stabilities for child core language skill (range = .39–.90, all *p*s < .001) and the home learning environment (range = .31–.53, all *p*s < .001) obtained between succeeding developmental waves controlling for all other variables in the model. Core child language was indexed by latent variables at 15 and 25 months and 5 and 11 years. We chose to include the only available ESHRE measure of language at 37 months (the PPVT) rather than omit that wave altogether. Having a single measure of vocabulary at

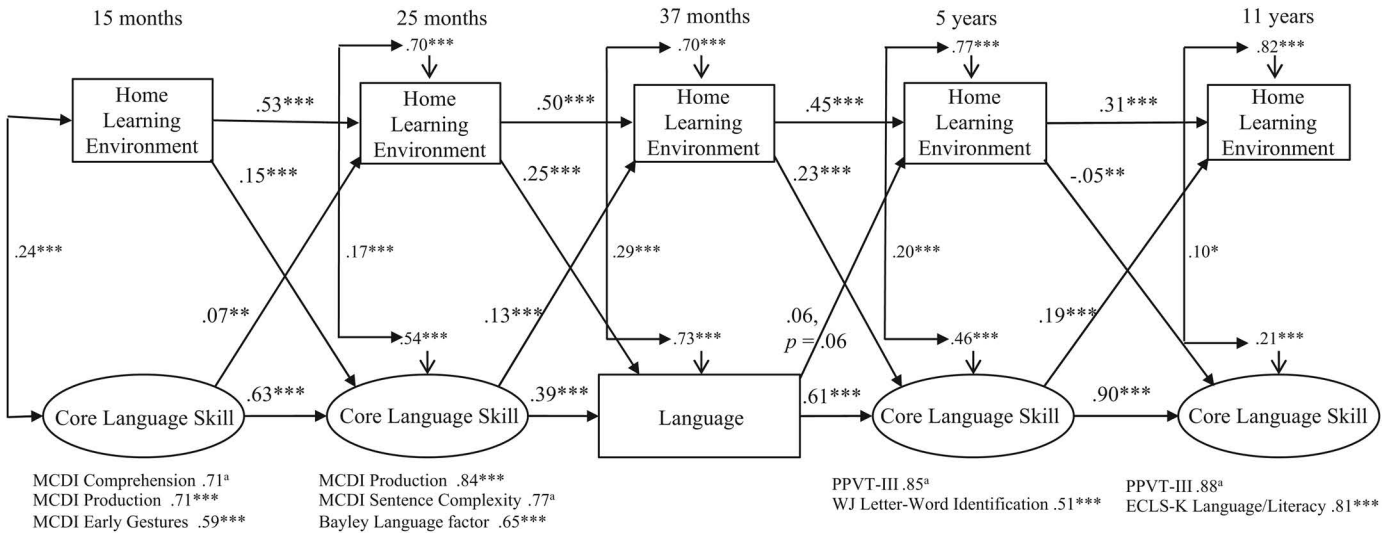

Figure 20.1 Transactional Model Linking Child Core Language Skill and the Home Learning Environment from Ages 15 Months to 11 Years. Numbers associated with single-headed arrows are standardized path coefficients; numbers associated with dashed single-headed arrows are disturbances, the amount of variance not accounted for by paths in the model. Indicators of each language latent variable are listed below the latent variable with their factor loadings; marker indicators of the latent factors are indicated by the superscript letter "a". $N = 1{,}751$; $^{**}p < .01$. $^{***}p < .001$

37 months, and the switch from mostly maternal report measures of productive vocabulary at 25 months, likely reduced stability of language from 25 to 37 months, which was still a medium effect, $r = .39$. Child core language skill and the home learning environment were reciprocally related within each developmental wave controlling for stabilities in the model. On our first goal, overall, controlling for stabilities of and contemporaneous associations between child core language skill and the home learning environment, higher-quality stimulation and support available to a child in the home learning environment at each earlier time contributed positively to child core language skill at the next later time, and more advanced child core language skill at each earlier time evoked a higher-quality home learning environment at the next later time. Only the transactions from child core language skill at 37 months to the home learning environment at 5 years, and from the home learning environment at 5 years to child core language skill at 11 years, failed to reach significance; however, the zero-order correlations and analyses in the original article support significant lagged associations.

As a check against threats to the validity of the transactional model, our second goal, we evaluated a covariate model adding child social competence and maternal education as exogenous variables to the SEM. Direct paths from child social competence and maternal education to all core language variables and HOME scores were added to the transactional model. This covariate model fit the data well: $\chi^2(101) = 525.01$, $p < .001$, CFI = 1.00, SRMR = .05, RMSEA = .00. On the second goal of the study, levels of significance of all transactional paths remained unchanged from those reported in Figure 20.1. Parameter estimates of significant HOME effects on child core language skill ranged from .09 (from 15 to 25 months) to .19 (from 37 months to 5 years), and significant child core language skill effects on HOME scores ranged from .08 (from 15 to 25 months) to .15 (from 5 to 11 years), controlling for child social competence and maternal education.

On goal three, findings supported one unified transactional model for girls and boys, European American and African American children, firstborns and laterborns, and children who did not have any developmental risk factors and those who had one or multiple risks. (Multiple group models are reported in the original article.)

The HOME is a complex composite measure, constructed of individual variables at each age. Do one or another of those variables correlate with child core language skill more than others? Table 20.1 presents correlations of HOME scales with child core language skill at each age. As can be seen in this sensitivity analysis, subdomain relations do not differ (but are always lower) than the total scale score, and relations are not dominated by one or even two subscales.

Table 20.1 Correlations of HOME scales with child core language skill at each age

HOME scale	*15-month language*	*25-month language*	*37-month language*	*5-year language*	*11-year language*
15 months					
HOME total	.211***	.211***	.328***	.355***	.325***
Nonpunitive	.038	.039	.089**	.146***	.112***
Language and cognitive stimulation	.200***	.191***	.231***	.267***	.227***
Emotional responsivity	.179***	.180***	.300***	.272***	.267***
Verbal/Social skills	.088***	.109***	.209***	.207***	.211***
25 months					
HOME total	.172***	.244***	.334***	.367***	.333***
Nonpunitive	.083**	.107***	.115***	.162***	.145***
Language and cognitive stimulation	.147***	.217***	.272***	.299***	.282***
Emotional responsivity	.117***	.158***	.268***	.240***	.211***
Verbal/Social skills	.073**	.124***	.162***	.157***	.161***
37 months					
HOME total	.141***	.221***	.448***	.430***	.368***
Harsh	–.059*	–.082**	–.157***	–.177***	–.110***
Language and cognitive stimulation	.192***	.241***	.392***	.385***	.347***
Warmth	.075**	.121***	.277***	.270***	.235***
Internal physical environment	.002	.083**	.221***	.172***	.138***
External physical environment	.028	.085**	.315***	.253***	.219***
5 years					
HOME total	.120***	.121***	.265***	.338***	.268***
Learning environment	.044	.068	.186***	.258***	.190***
Warmth	.100***	.080**	.142***	.199***	.173***
Physical environment	.025	.067*	.166***	.212***	.167***
11 years					
HOME total	.034	.179***	.227***	.249***	.262***
Parental lack of hostility	.032	.044	.021	.032	.032
Parental verbal skills	.059	.159***	.168***	.169***	.190***
Warmth	.078*	.162***	.142***	.153***	.212***
Internal environment	–.035	.080**	.144***	.171***	.143***
External environment	.010	.148***	.216***	.230***	.222***

HOME = Home Observation Measurement of the Environment

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

Discussion

The present study examines reciprocal relations between child language and the child's home environment over an extended time period. Testing transactional models allowed us to analyze stabilities in child core language skill and in the quality of the home learning environment as well as their concurrent relations at different developmental waves across childhood and to determine lagged cross-construct relations over and above those stabilities and concurrent covariations (Burkholder & Harlow, 2003). Time precedence is not necessarily indicative of causality (Reiss, 1995), but the multiple and consistent cross-lagged effects that emerged (see Figure 20.1) suggest bidirectional transactions between the child's core language skill and the quality of the child's home learning environment.

Our conceptual transactional model specifies continuing direct effects from the home environment to children's language as well as continuing direct effects from children's language to their home environment, while controlling for temporal stabilities of each and concurrent relations between two. Thus, the emergent cross-lagged effects are conservative. It is important too to identify and account for covariates in the child and environment that might artificially contribute to relations between the two constructs, as we have done. Finding that lagged predictions remain between child language and the environment even when models are adjusted for possible common-cause third-variable influences further supports the conclusion that these transactional relations are not reducible to artifacts of other factors. Transactions define dynamics in which the child changes the parent or environment and the child is, in turn, changed by the changed parent or environment, and the parent or environment changes the child who in turn changes the parent or environment (Chapter 8). Transactions are central to parenting and child development (Jenkins, McGowan, & Knafo-Noam, 2016), and even if demonstrations of them are still rare in the developmental science literature, they are likely standard in everyday life.

In our transactional model, we found, first, as have others who have previously longitudinally assessed child language (Bornstein et al., 2014, 2016a, 2016b; Putnick et al., 2017) and the HOME (Bradley, 1986; Bradley et al., 1989; Bradley & Corwyn, 2007, 2013; National Institute of Child Health and Human Development Early Child Care Research Network, 2005; even in different countries: Bradley, 2010; Tietze, Hundertmark-Mayser, & Rossbach, 1999), that both core child language and the HOME are relatively stable from 15 months to 11 years. Second, we found that core child language and the HOME covaried significantly at each of the five child ages studied.

The temporal transactions we uncovered as our first and second goals are consistent with a relational developmental systems perspective that posits the continual and progressive interplay between the organism and the environment (Lerner, 2018; Overton, 2015). Transactional models highlight

plasticities of the environment and of the child as an active participant in his or her own development. In the end, this study demonstrates that socialization effects run in both directions—parent to child and child to parent—and operate in a consistent angel spiral that is mutually reinforcing and consolidating (Gershoff et al., 2009; Gonzalez-DeHass, Willems, & Holbein, 2005; Hirsh-Pasek & Burchinal, 2006; Landry, Smith, Swank, Assel, & Vellet, 2001; Rodriguez, Umaña-Taylor, Smith, & Johnson, 2009). In an angel spiral, parents and their children co-construct positive childhoods and parenthoods.

This research elucidates developmental pathways emanating from experiences provided to infants and young children for language outcomes measured at the cusp of adolescence. Such long-term longitudinal studies are important in determining the vital roles that experiences in infancy and early life play in charting the course of later development (Bornstein, 2014). This investigation unveils two ways that experiences provide a foundation for success: The quality of the parent-provided home learning environment during the opening years of children's lives benefits their language almost into adolescence and the quality of children's home learning environments at all moments through early development feeds forward to enhance children's core language competence. Reciprocally, and not to be neglected, are the consistent child effects also unveiled by these findings. At three of four possible developmental waves, children who were more advanced in their core language skill stimulated a more sophisticated home learning environment at the next succeeding developmental wave. Notably, at each of the three, core language skill was instantiated in a latent variable; at the fourth only marginally significant wave (37 months to 5 years) language was measured by a single indicator. It could be that latent variables are more robust or stable representations of child language and so more precise predictors than is a single variable indicator, or it could be that language at 3 years is (for some reason) in greater flux and so less representative of children. Child effects are much talked about theoretically (e.g., parents who perceive their child as an interested reader reportedly engage more frequently in literacy activities, even when the parents are not interested readers themselves; Boerma et al., 2018; Dobbs-Oates, Pentimonti, Justice, & Kaderavek, 2015; Gonzalez-DeHass et al., 2005; Grolnick & Slowiaczek, 1994), but much less frequently demonstrated empirically, as we have done here. Children's language skill promoted parents' behaviors and provisioning supportive home activities. It is likely rare to find that 15-month-olds (compared, say, to preschool-age children) already instigate parental advances in the home learning environment (Lonigan, 1994). Our findings show parallel and consistent child effects over a long stretch of time.

Of several different possible models of transaction, we found that children's language directly predicts parents' later provision of a higher-quality home learning environment as well as vice versa. Other possible models,

such as an autoregressive model with structured residuals (Curran, Howard, Bainter, Lane, & McGinley, 2014) or a random intercept cross-lagged panel model (Hamaker, Kuiper, & Grasman, 2015), were considered but ruled out because the measurement scales of language and the home environment changed across development. This study spanned 10 years, during which the language and supportive home environment for an infant and a preadolescent should be different, and so the measures changed appropriately to reflect the primary skills and needs of the different age groups. The above alternative models would be feasible with single measures of language that applied across a wide age range (e.g., vocabulary) and limited aspects of the home environment, but such simplified measures would limit the validity and interpretation of the results.

The fact that this transaction obtained for girls and boys, European American and African American children, firstborns and laterborns, and children at biological risks and those not, as well as accounting for covariate threats of child social competence and parent education to model validity, attests to the robustness of this transaction (see also Rijlaarsdam et al., 2013). Children from low-SES or resource-disadvantaged families, such as participated in this study, tend to experience low language growth, cognitive development, school readiness, and academic achievement (Bradley et al., 1988; Snow, Porche, Tabors, & Harris, 2007); however, they, like children everywhere, display substantial variation in their language competencies (Rodriguez & Tamis-LeMonda, 2011), suggesting that individual variation transcends circumstance and can be enhanced.

The present study provides insights into continuing relations between the parent-provided home learning environment and children's language development. Few other long-term longitudinal studies have addressed transactional relations between the home environment and children's language achievement over such an extensive time period. The results thus paint a more detailed cross-time portrait of transactional processes during childhood than is common and highlight the dynamic interplay between parents and children. At the same time, the results raise additional questions that should provoke future research. For example, is one or another parent or person more responsible for provisioning the child's environment? An extensive review revealed that parental involvement in children's reading is more important than support from teachers or peers in enhancing children's reading interest (Klauda, 2009), and dialectics even appear to differ in mother-child and father-child relationships (Paquette, 2004).

Is the child's core language skill promoted by the home learning environment globally (i.e., the HOME composite), or are specific constituent features of the child's home learning environment differentially effective, such as literacy activities, supportive parental engagement, or availability of age-appropriate learning materials (Rodriguez & Tamis-LeMonda, 2011); shared reading, talking about books, library visits, or number of books in

the home; parental beliefs and attitudes about reading or parental reading habits (Boerma et al., 2018); or synchrony and responsiveness features of parent-child interactions or mere media exposure (Bus et al., 1995; Rijlaarsdam et al., 2013; Vigil, Hodges, & Klee, 2005)? The HOME is constructed of multiple similar and different scales at different ages (see Table 20.1). Asking whether the whole HOME or one or another subscale of the HOME is a more effective "active ingredient" in promoting children's core language skill across age, we found that the HOME composite is more strongly related to child language than its subscales at every age. One might consider the home learning environment to be a multifaceted construct that consists of a variety of interrelated parental cognitions (such as attitudes, beliefs, and habits; Phillips & Lonigan, 2009; Tichnor-Wagner, Garwood, Bratsch-Hines, & Vernon-Feagans, 2016; Yeo, Ong, & Ng, 2014), parental activities (such as shared reading, talking about books, and library visits; Burgess, Hecht, & Lonigan, 2002; Tichnor-Wagner et al., 2016), or parent-provided resources (such as the number of books at home; Burgess et al., 2002; Katzir, Lesaux, & Kim, 2009). In reality, such cognitions, activities, and resources often tend to go together, and so it is unsurprising that a composite measure of them more faithfully reflects the real situation of the home and more strongly relates to child core language acquisition than any one alone (see also Boerma et al., 2018; Gottfried, Schlackman, Gottfried, & Boutin-Martinez, 2015; Rijlaarsdam et al., 2013). Moreover, indications in the extant literature are that children often respond, not simply to a given behavior as it is manifested at a given time in a given situation, but to the aggregate or "bundle" of behaviors manifested during different times and situations (Maccoby, 2000; Stormshak, Bierman, McMahon, & Lengua, 2000). At a proximal level, parents promote children's language learning and development by their cognitions, practices, and provisions altogether (Bradley, 2006; Rodriguez et al., 2009). In this light, practitioners should promote a multipronged approach to supporting child language development (Rodriguez & Tamis-LeMonda, 2011).

The present study highlights unique advantages of long-term longitudinal research in clarifying distinct pathways by which diverse constructs mutually transact in development. Transactional and dynamic systems theories suggest that key patterns of development emerge over time from recurring, microlevel dyadic interactions (Bronfenbrenner & Morris, 1998; Granic & Patterson, 2006). Although the quality of the home learning environment provides an ongoing source of support for children's language development, promoting the home learning environment well before children enter preschool may be critical to set children on a positive developmental trajectory and likely redounds advantageously in children's later language capacities. Furthermore, from the transactional perspective, these findings underscore that development is not located in the child or in the parent/context, but in their unfolding relationship.

On a final practical note, the fact that the transactional model applies to Early Head Start low-SES families opens the possibility of designing efficacious tailored interventions for socially at-risk populations. That is, the efficacy of the home learning environment in predicting language acquisition in children points to environmental characteristics as plausible targets of intervention for improving child language or for remediating or preventing language deficits in otherwise resource-disadvantaged children. Indeed, a meta-analysis of literacy interventions on reading skills in 32 low- and middle-income countries employing more than 200,000 participants from 67 studies demonstrated positive average effects of literacy interventions on language growth (Kim, Lee, & Zuilkowski, 2020). It is generally believed that parents are more involved in the lives of their younger children, and that younger children are more influenced by parenting than are older children (Bornstein, 2015; Jeynes, 2007). The fact that the home learning environment had positive effects on child core language skill at all points from infancy to adolescence suggests that children's language skills are open to enrichment at multiple points in development, and so the additional lesson for policy and practice is that it is never too late for intervention. National reading campaigns might make both parents and professionals more aware of the importance and benefits of consistently engaging in enriched home learning activities and environments. The seeds of later language achievements are sewn in childhood. It is important to disseminate this knowledge to parents as well as other caregivers and professionals and to develop methods and practices that will encourage them to enrich young children's home learning environments. Our findings advocate for multimodal policies that aim to promote and foster children's language competencies themselves as well as children's home learning environments.

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