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The Legacy of Early Experiences in Development: Formalizing Alternative Models of How Early Experiences Are Carried Forward Over Time

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Psychologists have long debated the role of early experience in social and cognitive development. However, traditional approaches to studying this issue are not well positioned to address this debate. The authors present simulations that indicate that the associations between early experiences and later outcomes should approach different asymptotic values across time, given alternative assumptions about the developmental significance of early experience. To test the predictions of alternative developmental models, the authors examine data from the National Institute of Child Health and Human Development (NICHD) Study of Early Child Care and Youth Development (SECCYD) on maternal sensitivity in the first 3 years of life and its association with social competence and academic skills through age 15. Across multimethod, multi-informant outcome data, results suggest that there may be enduring effects of early caregiving experiences in both of these domains.

Keywords: early experience, developmental models, continuity, attachment

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In 1976, a noteworthy volume was published titled *Early Experience: Myth and Evidence* that brought together diverse chapters from eminent scholars in developmental science (Clarke & Clarke, 1976). One of the themes of this volume was that early experiences do not leave an immutable mark on people's lives. Contrary to the assumptions of many psychological perspectives, the authors argued that early experiences are often overshadowed by later ones and that the first few years of life are either inconsequential or held in undue high regard by most developmental thinkers. In the years since this volume was published, some researchers have offered rebuttals to these conclusions, citing evidence that, in fact, the legacy of early experiences can be observed in many domains (Sroufe, Egeland, Carlson, & Collins, 2005). For example, the effects of early child care on cognitive and social functioning appear to persist through age 15 (Vandell et al., 2010). Similarly, in a report from the Minnesota Longitudinal Study of Risk and Adaptation, infant attachment security was shown to be associated with the security of participants' romantic relationships in young adulthood, even after accounting for the observed quality of these relationships (Roisman, Collins, Sroufe, & Egeland, 2005). These kinds of findings would seem to suggest that early experiences can—and do—play an enduring role in human development.

Despite the existence of such data, the notion that early experiences may play an important role in human development is just as controversial today as it was decades ago (see Bruer, 2002; Clarke & Clarke, 2000; Kagan, 1996; Lamb, Thompson, Gardner, Charnov, & Estes, 1984; Lewis, 1997). Why might this be the case? Is it possible that some experiences are more enduring than others? Is it that some investigators have used more careful assessment procedures than others? Perhaps. But, in our view, there is a more significant reason these issues continue to be debated. Specifically, the methods many researchers use to address the legacy of early experiences are, perhaps paradoxically, not capable of doing so. In a typical study, experiences are measured at some point early in the life course and the correlates or consequences of those experiences are assessed at another point in time. If those early experiences are related to later outcomes, researchers conclude that those early experiences played a crucial role in organizing development. If those experiences are only weakly related or unrelated to later outcomes, researchers assume that those experiences were largely inconsequential in shaping development.

To better understand why this familiar methodological approach is not well suited for investigating the significance of early experiences in child development, consider the following example. Let us assume that researchers assessed maternal sensitivity (a salient variable in theories of social development, such as attachment theory [De Wolff & van IJzendoorn, 1997] and one for which there is little evidence of heritability [Roisman & Fraley, 2008]) when children were 1 year old. Seven years later, they assess children's social and emotional competence in peer groups. The researchers find a significant association between these variables, such that the correlation between maternal sensitivity and social competence is .22. At face value, it would seem that maternal sensitivity has enduring consequences for social and emotional development. Consider, however, alternative ways in which this conclusion

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could differ if we had access to additional waves of data. Let us assume that the researchers go on to conduct follow-up assessments and find that the association between maternal sensitivity and social competence is .15 at age 10, .10 at age 15, and .08 at age 20. In other words, as the temporal interval increases between early experiences and later outcomes, the association between early experiences and later outcomes approaches 0.00 in the limit (see the solid curve in Figure 1). This pattern of associations suggests that, although maternal sensitivity may play a role in shaping a child's social competence, the association eventually disappears over time—a finding that is compatible with the notion that the long-term effects of early experiences are negligible.

Contrast this scenario with another. Assume instead that the researchers found the association between early maternal care and social competence to be .22 at age 7, .22 at age 15, and .22 at age 20 (see the dashed line in Figure 1). This particular pattern of associations has dramatically different implications than the previous one. Namely, it suggests that the effects of early experience, although not overwhelming, are *enduring*. The legacy of early experiences can be traced in a steady, constant fashion over time. And while early experiences may not play a powerful role in shaping individual differences, the residue they leave is undeniable and likely to be consequential (McCartney & Rosenthal, 2000).

It is important to note that these fundamentally distinct situations cannot be differentiated using traditional methods for analyzing data from longitudinal studies. Many empirical articles based on longitudinal data sets report data from only two assessment waves, thereby making it impossible to discern the *pattern* of associations over time (i.e., whether those associations approach zero in the limit or stabilize at a nonzero value). As illustrated in Figure 1, both kinds of situations are equally able to explain the original observation—a correlation of .22 between early maternal sensitivity and social competence 7 years later. However, the problem does not lie with two-wave data per se. Even when data from multiple waves are available, they are rarely analyzed in a manner that enables one to determine the value the predictive associations are approaching in the limit. For example, in a recent article, multiwave data was used to demonstrate that the quality of child care children received early in life directly predicted externalizing behavior at age 15 (Vandell et al., 2010). The effects of quality of care on externalizing behavior at other ages, however, were not estimated, which makes it difficult to discern whether the association was persistent over time or whether it was diminishing.

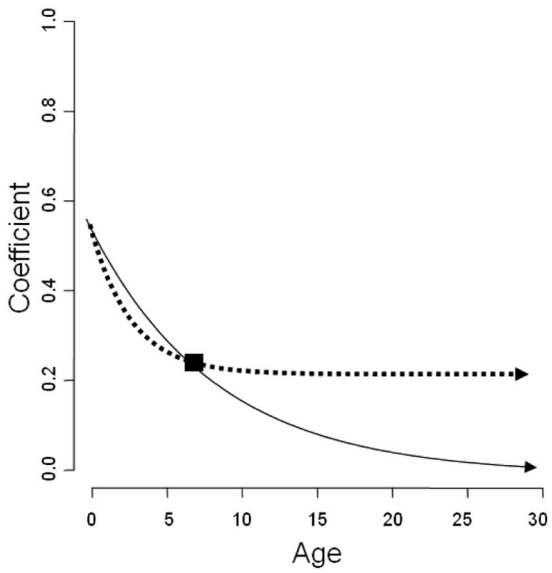

Figure 1. An illustration of the limitations of two-wave studies on understanding the impact of early experiences on developmental adaptation. The same observation (a correlation of .22 between early experiences and later outcomes) can be explained by a model that assumes that early experiences diminish in their significance over time (solid line) and a model that assumes that early experiences exhibit a persistent, even if modest, influence over time (dashed line). Age is in years.

The objective in the present article is to present a method designed to differentiate the two kinds of situations described previously: One in which an association between early experiences and subsequent outcomes persists and one in which that association gradually decays over time. As we will explain in depth later, these alternative patterns reflect different kinds of developmental processes—differences that, in many respects, lie at the heart of both historical and contemporary controversies concerning the role of early experiences in human development. Thus, being able to determine whether the effects of early experiences are enduring has implications not only for studying empirically the legacy of early experiences but for advancing long-standing theoretical debates in developmental psychology.

We begin by discussing a conceptual framework that enables the different kinds of developmental associations we have described to be modeled. Next, we illustrate the value of these methods using data from the National Institute of Child Health and Human Development (NICHD) Study of Early Child Care and Youth Development (SECCYD). We examine the association between maternal sensitivity experienced in early childhood and measures of subsequent social and academic skills. We focus on early maternal sensitivity in particular because this variable plays a fundamental role in many theories of social development, such as attachment theory (Cassidy & Shaver, 2008), and because many debates about the enduring significance of early experiences directly or indirectly concern the impact of parenting on child outcomes. Finally, we discuss the implications of our methods for advancing research more broadly in the study of human development.

Alternative Models of the Legacy of Early Experiences

All developmental theories assume that early experiences play some role in shaping social and cognitive adaptation. What is typically debated is the question of whether those early experiences play a *unique* and *enduring* role in this process. At the risk of oversimplifying matters, we open our discussion by considering Kagan's (1980) classic tape recorder metaphor concerning the fate of early experiences. Despite being formulated decades ago, the metaphor continues to provide a valuable starting point for comparing and contrasting alternative ways of thinking about development. According to Kagan, the way in which the mind represents experiences is similar to the way in which an audio cassette represents sound. When sounds are recorded to a tape, they are stored in a relatively permanent manner and can be replayed at any time. However, should an individual choose to record new sounds

to the cassette, the existing recording is overwritten. It may still be possible to perceive traces of the old recording, but even those traces eventually decay as more sounds are recorded. In this metaphor of development, the impression left by early experiences is eventually overwritten by more recent ones. As a consequence, the legacy of those early experiences is expected to decay as the individual develops. Early experiences are thought to matter early in life, but they are not exceptional and their significance diminishes as children develop.

Although the tape recorder metaphor might appear a bit dated, the themes underlying it continue to be represented in contemporary psychology (see Bruer, 2002; Clarke & Clarke, 2000; Lewis, 1997). Lamb et al. (1984), for example, have argued that there might be associations between early experiences and later adaptation not because early experiences per se play a unique organizing role in development but because the caregiving environment itself is relatively stable and continues to impact developmental adaptation. Similar points have been made more recently by Lewis (1997), who has emphasized the way in which representations of early experiences can be revised and reinterpreted. According to Lewis, the contextual nature of development necessarily diminishes the long-term consequences of early experiences.

In contrast, other scholars have argued that early experiences play a unique and enduring role in development. For example, Sroufe, Egeland, and Kreutzer (1990) have written that "earlier patterns may again become manifest in certain contexts, in the face of further environmental change, or in the face of certain critical developmental issues. While perhaps latent, and perhaps never even to become manifest again in some cases, the earlier pattern is not gone" (p. 1364). According to such scholars, early experiences are thought to play a privileged role in development for several reasons. Because they are represented in a procedural, nonverbal fashion, they have the potential to coexist in a largely unmodified way when verbal representations are acquired. Moreover, because those experiences are some of the first to shape the developing child, they may serve as a scaffold for the way subsequent representations are built, thereby anchoring and organizing a child's developmental trajectory. According to this perspective, it may be the case that later experiences continue to transform and revise existing representations, as Lewis and others have argued. But it is also the case that early experiences continue to have the potential to influence later adaptation via a set of mechanisms that become relatively consolidated in early childhood (e.g., internal working models; Bretherton & Munholland, 2008).

Formalizing Alternative Perspectives and Studying Their Differential Predictions

Although these different perspectives have implicitly anchored debates in developmental psychology for decades, there is not a clear appreciation for exactly what they predict about the correlates of early experience. On the surface, it would appear that a perspective in which early experiences were superseded by more recent ones would predict low to zero associations over time, whereas a perspective that assumes that early experiences play a unique role in development would predict large associations over time. As we later report, the predictions of these alternative frameworks are not quite so clear cut and, in some ways, might be somewhat surprising. To examine these predictions more precisely, we have developed and examined some formal, but simple, mathematical models of each perspective and illustrated the implications those models have for the associations that should be observed between early experiences and later outcomes.

We begin by noting that the alternative perspectives we have discussed have a number of assumptions in common, and, therefore, it is useful to model them within the same basic framework. Figure 2 illustrates the key processes using a familiar path modeling approach. In short, both perspectives assume that an outcome variable of interest (e.g., social competence) has some degree of stability over time (Path *c*) and is also influenced by factors external to the core variables being studied (represented by the residual arrows feeding into the circles). Where the two perspec-

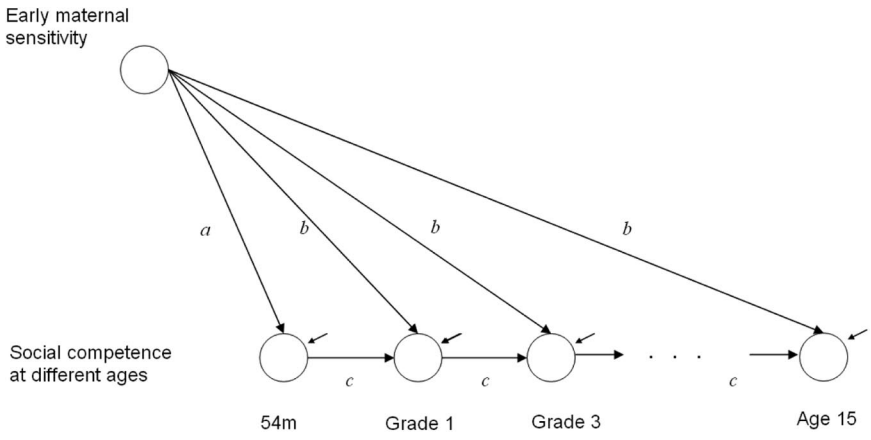

Figure 2. The core structural relations among variables according to revisionist and enduring effects perspectives. Both models assume that early experiences have the potential to influence early outcomes (Path *a*), that those outcomes have some degree of stability over time (Path *c*), and that those outcomes are potentially affected by experiences that uncorrelated with the processes in question (i.e., the residual arrows). The enduring effects model, however, also assumes that early experiences continue to have ongoing effects on outcomes across time (Path *b*), whereas a revisionist model does not make this assumption ($b = 0$). 54m = 54 months.

tives differ is in the way they represent the influence of early experiences per se. In the perspective articulated by Kagan, Lamb, Lewis, and others, which we will refer to as *revisionist* from this point forward (see Fraley, 2002), it is assumed that early experiences influence social competence (Path *a*). However, the effects of early experience on subsequent outcomes are assumed to be indirect. There is no direct path between early sensitivity and competence at, say, age 15; the paths labeled *b* in the diagram are assumed to equal zero.

An alternative way of conceptualizing these processes is to assume that early experiences play a unique role in development and have the potential to influence an outcome of interest at each point in time, as discussed by Sroufe and others (e.g., Fraley & Roberts, 2005; Grossmann, Grossmann, & Waters, 2006). We refer to this as the *enduring effects* perspective from this point forward. As with the previous model, this one assumes that the outcome of interest has the potential to be influenced by many factors at each point in time. Moreover, like the revisionist model, the enduring effects model explicitly allows for a portion of the predictive significance of early experiences to be indirect. However, this model also assumes that early experiences (or, more precisely, their stable representation or embodiment in the person) continue to influence the outcome in question over time. This is represented by the direct paths, labeled *b* in Figure 2, between maternal sensitivity at Time 1 and social competence at every time point.[1]

To illustrate the implications of these alternative ways of conceptualizing the influence of early experiences, we varied the values of these paths and solved the equations for the correlations of interest. The results for the revisionist model are illustrated in left-hand portion of Figure 3. The curves in the graph illustrate the correlations between maternal sensitivity at Time 1 and social competence at varying points over time (e.g., age 2, age 3, age 20). Several curves are shown in each panel to illustrate the kinds of curves that emerge in light of this developmental process. Notice that the correlations between early experience and later outcomes start off moderately high (exactly how high depends on the specific parameter values used in the model) but decay in an exponential fashion, approaching zero in the limit. (This simplex pattern of correlations is common to autoregressive models [Kenny & Zautra, 2001]). In short, the revisionist model predicts that the association between early experiences and social competence will eventually dissipate until it is nonexistent.

What are the consequences of assuming that early experiences have an enduring effect on developmental outcomes over time? The implications of this assumption are striking, as illustrated in the right-hand portion of Figure 3. Notice that, in contrast to the results from the previous model, the effects of the early experience on the outcome of interest do not approach zero in the limit. Instead, they approach a nonzero value. The precise value of this asymptote is determined largely by the magnitude of the effect of early experience on the outcome of interest (as is illustrated by the different curves in the graph), but that value is not of primary concern here. The important point for now is that this model makes fundamentally different predictions than the previous about the patterning of correlations between early experiences and later outcomes across multiple assessment waves.

Summary, Caveats, and Implications

Up to this point we have highlighted two distinct ways in which early experiences might be carried forward over time. However, it is not our intent to imply that the simplistic ways in which we have formalized these perspectives represent the full range of developmental processes that are discussed in psychology. Indeed, in the empirical examples that follow, we expand upon these rudimentary models by modeling the effects of potential confounds, the ongoing effects of stability in the environment, and the role of transactional processes. Our goal at this point is to distill the core assumptions that have anchored debates in the study of development and to contrast, via relatively simple formalizations of those assumptions, the distinctive implications they have for understanding the long-term impact of early experiences or the lack thereof.

In summary, depending on the precise assumptions that one is willing to make about the role of early experiences in human development, there are dramatically different patterns of associations that might be observed over time between early experiences and developmental outcomes. If one assumes that early experiences have their effects on later outcomes via a chain of intervening events, then the association between those early experiences and subsequent outcomes will gradually diminish over time, approaching zero in the limit. If one assumes instead that, in addition to these indirect effects of early experience, early life events have their effects on later outcomes via a relatively consolidated mediator, then those associations will persist across time.

These results are noteworthy for two reasons. First, they reveal that these alternative theoretical perspectives cannot be differentiated with respect to the size of associations that they predict between any two time points. It is commonly assumed, for example, that, if early experiences do not strongly correlate with later outcomes, then those early experiences do not matter. However, both models are capable of predicting large or small associations between any two time points. This point is worth emphasizing because the kinds of processes represented by the revisionist model are often used to explain why early experiences should not have lasting effects. We want to be clear that the framework is quite capable, perhaps ironically, of predicting a large association between early experiences and later outcomes. What it cannot do, however, is predict nonzero correlations that persist in magnitude over increasing temporal intervals. Another reason we wish to emphasize this point is that many scholars who predict that there should be long-term effects of early experience would consider it sufficient that the quality of early experiences are related to later outcomes at some arbitrary point in time regardless of the asymptotic properties of the correlation across future assessments. Our point is not to claim that revisionist processes do not provide a mechanism by which early experiences might be reflected in

[1] In the figure, we have diagramed the enduring effects model as positing that there are direct paths from early experiences to subsequent outcomes. However, it is not our intention to imply that these effects are literally direct or unmediated. In fact, we assume that all effects are mediated in some sense, regardless of how they are represented in structural models. However, it is important to note that the number of mediating factors is assumed to not increase over arbitrarily long spans of time. It is assumed that whatever these mediators may be, they become relatively consolidated early in development (see Fraley & Roberts, 2005).

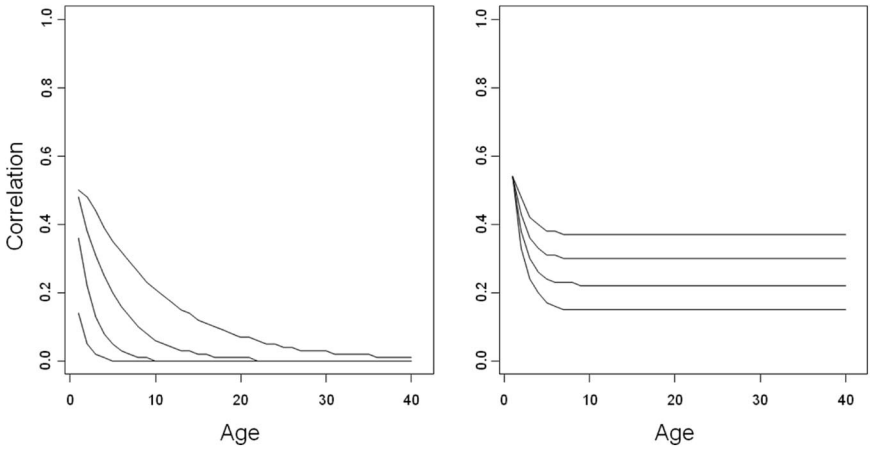

Figure 3. Predicted correlations between early experiences and developmental outcomes across various ages, under alternative models and varying parameter values. The left-hand panel illustrates the pattern of correlations that should be observed between early experiences and subsequent outcomes across age if revisionist processes govern development in a given domain. The varying curves represent illustrate the different forms the curves can take under various parameter values. The right-hand panel illustrates the pattern of correlations that should be observed between early experiences and subsequent outcomes across age for the enduring effects model. Again, the varying curves illustrate the way in which the curves might vary under various parameter values. Age is given in years.

outcomes later in time. Nor do we claim that an enduring effects model is the only kind of model that is capable of producing long-term correlations over time. Our point is that these kinds of correlations cannot be sustained ad infinitum without additional assumptions, namely, the assumption that early experiences produce some kind of consolidated mediator that contributes to the outcome of interest over time independently of the inherent stability of the outcome itself.

A second noteworthy implication of these simulations is that they demonstrate that the two perspectives differ with respect to the asymptotic properties of the predictive curves—the *pattern* of effects over time. The revisionist model predicts that the associations between early experiences and later outcomes will get smaller over time, approaching zero in the limit. The enduring effects model predicts, in contrast, that the associations between early experiences and later outcomes, whether large or small, will be relatively constant over time and will not approach zero in the limit. By studying the pattern of associations across time, it should be possible to gain greater insight into the legacy of early experiences.

An Empirical Examination of Early Sensitivity on Social Competence and Academic Skills

Given that these two models make different predictions about the pattern of associations that should be observed over time, it is possible to test them (and, hence, the enduring effects of early experiences) by estimating the parameters of these models and comparing their relative fit to the data. The revisionist model is nested within the enduring effects model, thereby enabling the two models to be compared in a direct fashion.

To illustrate this approach, we drew on data used in the NICHD SECCYD (NICHD ECCRN, 2005). This study is particularly well suited for examining questions related to the enduring significance of early experiences because it is a long-term, prospective longitudinal study of more than 1,000 children tracked from infancy through age 15 that includes extensive data on the observed quality of early and later interpersonal experiences as well as multimethod, multi-informant outcome measures of child adaptation. In this report, we focused on an operationalization of early experiences central to many theoretical accounts of developmental adaptation—maternal sensitivity. We examined the consequences of early sensitivity in two domains central to developmental adaptation over time: (a) social competence and (b) academic skills. For each domain, we focused on outcome data from multiple informants using similar or identical methods across time from early in the life course through age 15. Although we begin by analyzing the key distinction between revisionist and enduring effects processes in the way illustrated in the introduction of this article, we also elaborated upon those basic models by examining a number of other processes that could potentially account for the long-term effects of sensitivity, including potential confounds (i.e., factors, such as maternal education, that correlate with maternal sensitivity and child outcomes), the ongoing stability and concurrent effects of maternal sensitivity, and transactional processes that sustain continuity in the outcomes themselves.

Method

Participants

Families were recruited for the NICHD SECCYD in 1991 from hospitals located near various research sites around the United States. Details about recruitment and selection procedures are available in prior publications from the study (see NICHD Early Child Care Research Network [ECCRN], 2005) and http://secc.rti.org. The analysis sample for this study included the 1,306

children (52% males) for whom any observational data were collected at ages 6, 15, 24, and/or 36 months that focused on the quality of the maternal caregiving they experienced in the first 3 years of life. White/non-Hispanic was the race/ethnicity of 77% of the children in the analysis sample. Note that for all modeling analyses described, full-information maximum likelihood was used with raw case-level analytic data as input. All analyses were performed in Mplus Version 6 (Muthén & Muthén, 1998–2010).

Measures

Measures are presented in four sets corresponding to their function in the analytic plan, as follows: (a) variables used to create a composite measure of the observed quality of participants' experience with caregivers in the first 3 years of life, (b) later assessments of maternal sensitivity assessed concurrently with the dependent variables (i.e., social competence, academic skills), (c) measures of social competence, as assessed by primary caregivers and teachers through the latest assessment for which these data were available (mother reports: age 15; teacher reports: Grade 6), and (d) measures of academic skills, as rated by teachers and assessed using standardized tests—again, through the latest assessment for which relevant data were acquired (teacher-reports: Grade 6; standardized assessments: age 15). In all cases, we selected variables that were measured multiple times by multiple reporters using standard assessment tools.

Early maternal sensitivity. Mother–child interactions were videotaped during 15-min semistructured tasks at 6, 15, 24, and 36 months. Several scales were used to rate the mothers' behavior from these videotapes. More specifically, when children were 6 months old, mothers were instructed to play with their children, first with toys available in the home (or none at all) and then with a standard set of toys. At 15, 24, and 36 months, mothers were asked to show their children age-appropriate toys in three containers in a set order. As in prior studies of this sample (e.g., NICHD ECCRN, 2001), observations of maternal sensitivity from the first 3 years of life (6, 15, 24, and 36 months) were standardized and averaged to create a composite of the observed early sensitivity. For more information on this variable, please see Haltigan, Roisman, and Fraley (in press).

Later maternal sensitivity. Subsequent to the four assessments of maternal sensitivity through 36 months, a total of five additional observations of sensitivity were acquired by the NICHD ECCRN—at age 54 months, during Grades 1, 3, and 5, and most recently at age 15. As with the early sensitivity composite, in each of these assessments, participants and their primary caregivers were videotaped while target participants engaged tasks just beyond their capacity to successfully complete while primary caregivers provided aid. For example, the age 54-month and Grade 1 assessment involved the child completing a set of three activities, including using an Etch-a-Sketch maze to traverse a maze (54 months) and reproduce a simple picture (Grade 1). Tasks were updated to be developmentally appropriate—during Grades 3 and 5, primary caregivers and target participants completed both activities and engaged in discussion tasks. Finally, at age 15, maternal sensitivity was assessed in the context of an 8-min home discussion of one or two areas of disagreement between the adolescent and mother (e.g., chores, homework).

Maternal sensitivity was operationalized when children were 54 months old and in Grades 1, 3, and 5 with scales measuring supportive presence, respect for autonomy, and hostility (reversed), which were composited (internal consistencies of composites were .84, .82, .80, and .85, respectively; Interrater reliabilities [intraclass correlations] were .88, .91, .84, and .85, respectively). At the age-15 assessment, 7-point rating scales of the interaction were used (Owen et al., 2006), based on adaptations of the more microanalytic coding systems of Allen and his colleagues (Allen, Hauser, Bell, McElhaney, & Tate, 1996; Allen et al., 2003) and coding systems used at earlier ages in the NICHD SECCYD (e.g., Owen, Klausli, & Murrey, 2000). The age 15 maternal sensitivity composite comprised the sum of the mother's ratings for validation (enthusiastic, positive reactions to and agreement with the teen's expressed points of view), engagement (expressed interest in the listening to the teen's thoughts and feelings), inhibition of relatedness (reversed; cutting off and devaluing the teen's point of view), hostility/devaluing (reversed; expressions of anger, discounting or rejection of the teen or the teen's ideas), respect for autonomy (encouragement of and respect for the teen's own ideas and points of view), and valuing/warmth (expressions of positive regard, warmth, and affection). The internal consistency of the age 15 measure was moderately high, with Cronbach's alpha of .81. (interrater reliability [intraclass correlation] was .86).

Social competence. Mothers completed the 38-item Social Skills Questionnaire (SSQ) from the Social Skills Rating System (SSRS; Gresham & Elliott, 1990) when children were age 54 months; in kindergarten; in Grades 1, 3, 4, 5, and 6; and at age 15, indexing general social competence with adults and other children. To obtain a standardized measure of total social skills, we created an a priori scale by summing all items that index social competence with other children, with higher scores indicating more socially skilled children (αs ranged from .87 to .91; $M = .89$). In a parallel fashion, teachers completed the 30-item school version of the SSQ from the SSRS when children were in kindergarten as well as Grades 1, 2, 3, 4, 5, and 6. As with the mother reports, a standardized Total Social Skills Scale was created by summing items indexing social competence (αs ranged from .93 to .94; $M = .94$).

Academic skills. Teachers also used the SSRS to rate participants' academic skills when children were in kindergarten and Grades 1, 2, 3, 4, and 5 (αs ranged from .94 to .95; $M = .95$). For use in this study, we created an a priori standardized Academic Skills Scale by summing items indexing academic success. In addition, we used the Woodcock–Johnson Psycho-Educational Battery–Revised (WJ–R; Woodcock, 1990; Woodcock & Johnson, 1989) scores at 54 months; Grades 1, 3, and 5; and age 15 as an objective measure of academic skills. Note that for the WJ–R, a slightly different sub-set of scales were used at each assessment point. For purposes of this analysis, we averaged the *W* (standard) scores for all available subscales at each time point (within time αs ranged from .81 to .91; $M = .87$).

Control variables. Although there are a large number of potential control variables to consider, we selected four that we have examined in previous research (e.g., Roisman, Booth-LaForce, et al., 2009; Roisman, Susman, et al., 2009) and that are known to correlate with maternal sensitivity and social and academic outcomes: child gender, child ethnicity, maternal education, and family income-to-needs ratio. Child gender was coded in a

binary fashion (1 = female, 0 = male). Because the majority of the children in the sample were White/non-Hispanic, we created a binary variable to represent ethnicity (1 = White/non-Hispanic, 0 otherwise). Maternal education was coded on an ordered metric representing the number of years of education/highest degree. Family financial resources were operationalized as an income-to-needs ratio. Income-to-needs was computed separately within each of four assessment waves (6, 15, 24, and 36 months) and averaged to create a mean income-to-needs index for early childhood.

Results

We present our analyses in two major sections. In the first section, we analyze the most basic form of the revisionist and enduring effects models with respect to the four outcome domains of interest (i.e., maternal reports of children's social competence, teacher reports of children's social competence, teacher reports of children's academic skills, and objective measures of children's academic skills). Our goal in these initial analyses is to establish whether an enduring effects model is capable of explaining the longitudinal data better than a revisionist one. In these basic analyses, as well as in the more complex analyses that follow, we also model the effects of child sex, child ethnicity, income-to-needs ratio, and maternal education.

In the second major section, we expand the models to address two specific issues. In the first set of analyses, we address the potential role of stability in maternal sensitivity and the ongoing influence of sensitivity on the outcomes of interest. Such a model allows us to examine the possibility that early experiences might appear to have enduring effects on various outcomes, not because they continue to impact development in unique ways but because the quality of the caregiving environment itself is relatively stable and continues to contribute to variation in adaptation (Kagan, 1996; Lamb et al., 1984; Lewis, 1997). The second set of analyses is designed to address whether transactional processes are sufficient to sustain the correlations between early experience and later outcomes without literally assuming that early experiences have unique effects on later outcomes. Finally, we examine some models that are explicitly designed to integrate each of these mechanisms.

Basic Comparisons of the Revisionist and Enduring Effects Models

The first set of analyses was designed to capture the most basic dynamics of interest: the implications of assuming revisionist versus enduring effects processes. The structure of the most basic model is depicted in Figure 4A. According to the figure, early experiences have effects on the outcome of interest at each measurement occasion (Paths *a* and *b*). Moreover, the outcome itself exhibits some stability over time (Path *c*), while also being influenced by residual factors that are independent of the early experience (denoted by the residual arrows). It is important to note that the revisionist model is nested within this more inclusive enduring effects model. Specifically, by fixing paths from the early experience to the later outcome variables to 0.00 (paths labeled *b*), the model captures the notion that early experience directly shapes the outcome of interest early in life, but not thereafter. In the analyses that follow we compared the fit of the enduring effects model and the revisionist model. It is important to note that we also modeled the effects of potential confounds as if they were enduring in the way assumed by the enduring effects model. We did this not because we assumed a priori that these covariates have enduring effects. We did this because the most conservative test of the enduring effects model assumes that the potential confounds have enduring effects as well. Thus, the primary tests involved constraining the value of the paths from early maternal sensitivity to later outcomes to zero, while always allowing direct and enduring paths for the covariates. (Each of the four covariates were modeled simultaneously, along with the covariation between them. The illustrations in Figure 4 include only one covariate to simplify the structural diagrams.)

In each analysis, we also compared versions of the enduring effects model in which each parameter is freely estimated with one in which the enduring effect paths (i.e., the paths labeled *b* in the diagram) are constrained to be equal.[2] Although this test is not a formal requirement of the enduring effects model (i.e., the enduring effects model can accommodate increasing unique effects over time [sleeper effects, though see Clarke & Clarke, 1981] or short-term dips and increases over time), we reasoned that a prototypical enduring effects model is one in which the unique predictive significance of early experience is homogeneous in magnitude across time. At the very least, the magnitude of the paths should not be decreasing systematically over time.

We should note that our primary goal in this initial set of analyses was not to model the data as completely as possible. In other words, the absolute fit of the models was not our main concern. As noted previously, we deliberately worked with oversimplified models to highlight a fundamental distinction between two ways of thinking about the predictive significance of early experience. As such, we did not expect the simplified models to explain the data with a high degree of fidelity. What is of primary interest to us instead is the *relative* fit of the two models—the extent to which one model is able to explain the data better than the other. To compare the relative fit of the models, we examined the change in chi-square for the two models. In the second section, in which we introduce and test more complex models, we attend more explicitly to absolute model fit statistics.

Maternal reports of social competence. The correlations among the variables used in these analyses are reported in Table 1. It is of note that the correlations between early maternal sensitivity and maternal reports of social competence at each age are fairly constant (about .27) and exhibit no evidence of approaching zero in the limit. The formal model comparisons are presented in the section of Table 2 headed with "Basic model with covariates." The enduring effects model (both the version with freely estimated *b* paths and the one using equality constraints) fit the data better than did the revisionist model. Specifically, when the revisionist model

[2] In the models that contain equality constraints, we modeled the parameter *a* separately from the multiple constrained *b* parameters because the association between early maternal sensitivity and the first assessment of the outcome is exclusively a direct effect, whereas the association between early maternal sensitivity and subsequent outcomes thereafter can be represented as a combination of direct and indirect effects. The parameter estimates presented in Figure 5 forced *a* to equal *b* for simplicity of presentation.

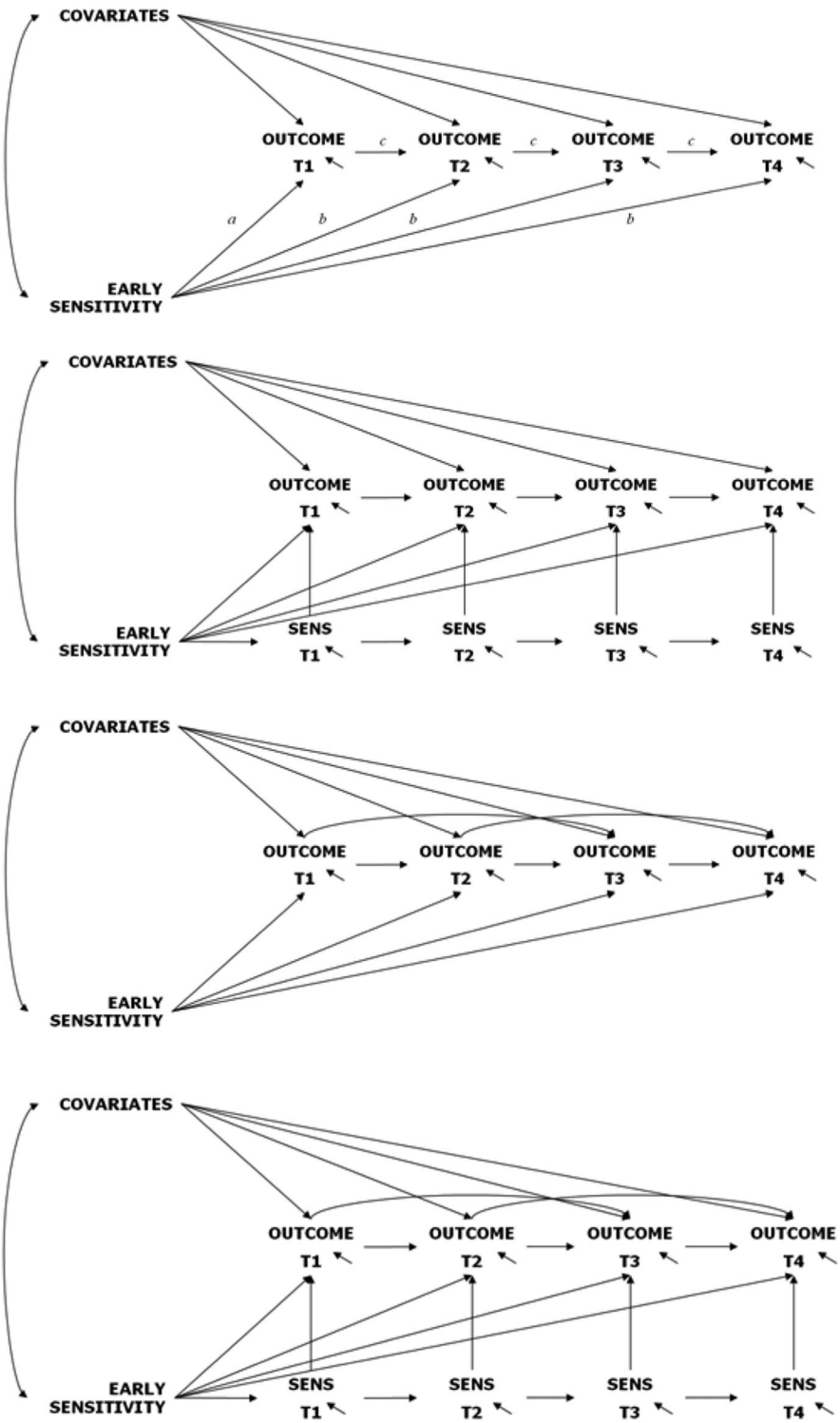

Figure 4. Models of the effects of early experiences. The upper panel illustrates the most basic model analyzed in the present study, which assumes that early maternal sensitivity and various covariates have enduring effects on the outcome of interest. The second model builds on the previous by also taking into consideration the stability of maternal sensitivity and its ongoing effects on the outcomes of interest. The third model builds on the initial model by including second-order stability paths to represent the ways in which early processes may be carried forward via transactional mechanisms. The lower model in an inclusive one. T = Time; SENS = sensitivity.

Table 1
Correlations Between Early Maternal Sensitivity Composite, Covariates, Later Maternal Sensitivity, and Maternal Reports of Social Competence Over Time

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. Early sensitivity	—																	
2. Gender	.092	—																
3. Ethnicity	.378	.002	—															
4. Income-to-needs ratio	.410	.040	.233	—														
5. Maternal education	.497	.037	.220	.542	—													
6. Maternal sensitivity 54 months	.549	.006	.306	.262	.353	—												
7. Maternal sensitivity Grade 1	.551	−.054	.365	.275	.382	.493	—											
8. Maternal sensitivity Grade 3	.457	.125	.191	.299	.369	.392	.458	—										
9. Maternal sensitivity Grade 5	.454	.107	.242	.269	.317	.375	.426	.470	—									
10. Maternal sensitivity 15 years	.320	.046	.144	.185	.265	.321	.334	.328	.377	—								
11. Social competence 54 months	.250	−.149	.167	.165	.180	.163	.236	.174	.194	.161	—							
12. Social competence kindergarten	.242	−.119	.176	.158	.232	.160	.217	.194	.209	.163	.676	—						
13. Social competence Grade 1	.255	−.088	.176	.190	.227	.185	.228	.233	.237	.206	.642	.736	—					
14. Social competence Grade 3	.310	−.024	.203	.179	.242	.204	.226	.291	.294	.183	.563	.672	.708	—				
15. Social competence Grade 4	.315	−.011	.169	.195	.264	.196	.255	.288	.305	.242	.540	.630	.688	.779	—			
16. Social competence Grade 5	.270	−.018	.204	.173	.221	.170	.211	.271	.292	.229	.494	.591	.638	.735	.765	—		
17. Social competence Grade 6	.281	−.016	.201	.225	.224	.204	.238	.257	.289	.226	.483	.577	.598	.698	.719	.744	—	
18. Social competence 15 years	.272	−.001	.151	.195	.245	.255	.267	.294	.319	.301	.389	.439	.479	.583	.596	.590	.633	—
M	−0.02	0.48	0.77	3.45	14.28	16.95	16.88	16.34	16.51	31.13	98.27	102.69	105.25	106.18	107.30	107.56	107.08	103.93
SD	0.77	0.50	0.42	2.71	2.50	2.91	3.03	2.50	2.42	5.05	13.53	14.73	14.93	15.89	16.38	15.09	15.93	14.79

Note. Gender was coded 1 = female; 0 = male; ethnicity was coded 1 = White/non-Hispanic; 0 = non-White.

Table 2
Estimates of the Influence of Early Experience on Mother Reports of Social Competence Across Childhood and Adolescence

Model	Model fit						Nested model comparisons		
	χ^2	*df*	*p*	CFI	RMSEA	SRMR	χ^2_{diff}	*df*	*p*
Basic model with covariates									
A. Enduring	724.69	49	<.001	.89	.11	.10	B − A = 37.61	7	<.001
B. Revisionist	762.30	56	<.001	.88	.11	.11	B − C = 24.97	1	<.001
C. Enduring: Equality constraint	737.33	55	<.001	.89	.10	.10	C − A = 12.64	6	.049
Controlling for the stability of maternal sensitivity									
A. Enduring	1407.70	114	<.001	.84	.10	.14	B − A = 26.99	7	<.001
B. Revisionist	1434.69	121	<.001	.84	.10	.15	B − C = 14.28	1	<.001
C. Enduring: Equality constraint	1420.41	120	<.001	.84	.10	.14	C − A = 12.71	6	.047
Transactional: 2nd order stability paths									
A. Enduring	181.31	43	<.001	.98	.05	.04	B − A = 28.64	7	<.001
B. Revisionist	209.95	50	<.001	.97	.05	.05	B − C = 12.27	1	<.001
C. Enduring: Equality constraint	197.68	49	<.001	.98	.05	.04	C − A = 16.37	6	.012
Inclusive									
A. Enduring	870.93	108	<.001	.90	.08	.12	B − A = 20.71	7	.014
B. Revisionist	891.64	115	<.001	.90	.08	.12	B − C = 6.01	1	.004
C. Enduring: Equality constraint	885.63	114	<.001	.90	.07	.12	C − A = 14.7	6	.023

Note. CFI = comparative fit index; RMSEA = root mean-square-error of approximation; SRMR = standardized root-mean-square residual.

was estimated by fixing the enduring effects of maternal sensitivity (the paths labeled *b*) to 0.00, there was a significant decrement in fit. When the enduring effects paths were constrained to be equivalent over time, there was a small decrement in fit relative to model in which the enduring effects of early experience were freely estimated. However, the estimates of these parameters did not vary systematically with time: When we modeled the *b* estimates as a linear function of assessment wave, the slope of the regression function was essentially zero (−.003). When these paths were constrained to be equal, the estimated effect of early experiences on maternal ratings of social competence was .07 ($p < .05$)—a small, yet persistent, effect.

Teacher reports of social competence. The correlations among the variables used in these analyses are reported in Table 3. It is of note that the correlations between early maternal sensitivity and teacher reports of social competence at each age are fairly constant (about .27) and exhibit no evidence of approaching zero in the limit (see Table 4, section headed with "Basic model with covariates"). The enduring effects model (both the freely estimated and constrained versions) fit the data better than did the revisionist model. Specifically, when the revisionist model was estimated by fixing the enduring effects to 0.00, there was a significant decrement in fit. Also, when the enduring effects paths were constrained to be equivalent over time, there was no decrement in fit relative to model in which the enduring effects of early experience were freely estimated. When we modeled the freely estimated *b* parameters as a linear function of assessment wave, the slope of the regression function was essentially zero (−.003). The constrained estimated effect of sensitivity on teacher ratings of social competence was .12 ($p < .05$)—again, a small, yet persistent, effect.

Teacher reports of academic skills. The correlation matrix for the variables is reported in Table 5. As before, the correlations between early maternal sensitivity and teacher reports of academic skills at each age are fairly constant (about .32) and exhibit no evidence of approaching zero in the limit (see Table 6, section headed with "Basic model with covariates"). The enduring effects model (both the freely estimated and constrained versions) fit the data better than did the revisionist model. Moreover, when the enduring effects paths were constrained to be equivalent over time, there was no decrement in fit relative to model in which the enduring effects of early experience were freely estimated. When we modeled the freely estimated *b* parameters as a linear function of assessment wave, the slope of the regression function was essentially zero (.003). The constrained estimated effect of early experiences on academic skills was .06 ($p < .05$).

Objective reports of academic skills. The correlation matrix for the variables is reported in Table 7. As before, the correlations between early maternal sensitivity and objective tests of academic skills were fairly constant (about .43) and exhibited no evidence of approaching zero in the limit (see Table 8, section headed with "Basic model with covariates"). The enduring effects model (both the freely estimated and constrained versions) fit the data better than did the revisionist model. Moreover, when the enduring effects paths were constrained to be equal over time, there was no significant decrement in fit relative to model in which the enduring effects of early experience were freely estimated: When we modeled the freely estimated *b* parameters as a linear function of assessment wave, the slope of the regression function was essentially zero (.011). The estimated constrained effect of early experiences on academic skills was .04 ($p < .05$).

Summary. Visual inspection of the correlation matrices reveals that the associations between early sensitivity and later measures of social competence and academic skills are moderate to large and, more important, that these associations do not decrease systematically as children develop. Our formal analyses indicated that models that included an enduring effects component for maternal sensitivity were better able to explain the data than models that did not include a path representing the ongoing influence of early sensitivity. The estimated effects of early experiences on later outcomes were small by conventional standards (*b*s ranged from .04 to .12). However, the sums of the direct and indirect paths of early sensitivity on the last assessment available were moderate,

Table 3
Correlations Between Early Maternal Sensitivity Composite, Covariates, Later Maternal Sensitivity, and Teacher Reports of Social Competence Over Time

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. Early sensitivity	—																
2. Gender	.092	—															
3. Ethnicity	.378	.002	—														
4. Income-to-needs ratio	.410	.040	.233	—													
5. Maternal education	.497	.037	.220	.542	—												
6. Maternal sensitivity 54 months	.549	.006	.306	.262	.353	—											
7. Maternal sensitivity Grade 1	.551	−.054	.365	.275	.382	.493	—										
8. Maternal sensitivity Grade 3	.457	.125	.191	.299	.369	.392	.458	—									
9. Maternal sensitivity Grade 5	.454	.107	.242	.269	.317	.375	.426	.470	—								
10. Maternal sensitivity 15 years	.320	.046	.144	.185	.265	.321	.334	.328	.377	—							
11. Social competence kindergarten	.235	−.024	.131	.149	.226	.199	.238	.258	.186	.099	—						
12. Social competence Grade 1	.244	−.012	.161	.148	.256	.220	.161	.232	.228	.135	.401	—					
13. Social competence Grade 2	.292	.019	.152	.200	.250	.265	.187	.286	.243	.132	.392	.493	—				
14. Social competence Grade 3	.247	.018	.161	.188	.254	.228	.202	.243	.225	.180	.356	.422	.485	—			
15. Social competence Grade 4	.313	.023	.211	.267	.278	.266	.203	.297	.258	.188	.351	.395	.504	.517	—		
16. Social competence Grade 5	.298	.025	.232	.262	.288	.231	.210	.279	.220	.172	.313	.383	.443	.430	.514	—	
17. Social competence Grade 6	.282	.105	.192	.207	.232	.252	.205	.235	.203	.135	.246	.379	.365	.397	.417	.481	—
M	−0.02	0.48	0.77	3.45	14.28	16.95	16.88	16.34	16.51	31.13	103.47	103.22	105.09	102.25	102.45	102.81	102.92
SD	0.77	0.50	0.42	2.71	2.50	2.91	3.03	2.50	2.42	5.05	14.05	13.65	14.53	14.47	13.95	14.43	14.27

Note. Gender was coded 1 = female; 0 = male; ethnicity was coded 1 = White/non-Hispanic; 0 = non-White.

ranging from .20 (teacher academic) to .29 (objective academic). Finally, in each of the analyses, making the simplifying assumption that the effect of early experiences was constant (as opposed to freely estimating the enduring effects paths) generally did not result in significant decrements in fit.

These models contained a number of simplifying assumptions that naturally handicapped their ability to capture the data well in an absolute sense. In the next section, we elaborate upon these basic models and examine some additional dynamics that might potentially explain the enduring effects. In the process, we also hope to systematically elaborate and refine the models in ways that improve their ability to explain the data.

Extensions of the Basic Model

In the following sections, we expand upon the basic framework to explore three questions. First, is the concurrent association between maternal sensitivity and social and academic outcomes adequate to explain the enduring association between early maternal sensitivity and those outcomes? Second, are transactional processes able to explain the enduring association between early maternal sensitivity and child outcomes? Third, is there a combination of the various processes that provides an optimal fitting model?

Controlling for the stability of maternal sensitivity over time. Some scholars have argued that, to the extent to which investigators find associations between early experiences, such as maternal sensitivity, and later outcomes, one potential explanation for those associations is the stability of maternal experiences over time (e.g., Lamb et al., 1984; Lewis, 1997). According to this argument there is no unique effect of early experience on later outcomes per se, but such associations may persist, in part, because maternal sensitivity itself is relatively stable and can have ongoing, concurrent influences on the outcomes of interest.

To model this possibility, we expanded the basic model in the way illustrated in Figure 4B. Specifically, beyond the composite of early maternal sensitivity, we included measures of maternal sensitivity across different ages. Moreover, we assumed that maternal sensitivity at each age had an influence on the outcome of interest, also assessed at that same age. We compared the fit of the enduring effects model and the revisionist model by fixing the paths from the early experience to the later outcome variables to 0.00. We also compared versions of the enduring effects model in which each of the enduring paths were freely estimated with ones in which the enduring effects were constrained to be equal over time.

The results of these analyses are summarized in the sections headed "Controlling for the stability of maternal sensitivity" in Tables 2, 4, 6, and 8 for each of the four outcome domains. To summarize, in each domain, the enduring effects model was able to explain the data better than the revisionist model. Specifically, setting the enduring path to 0.00 resulted in significant reductions in model fit. Constraining the enduring effects paths to be equal impaired fit for each domain, with the exception of teacher-rated academic skills (when constrained, the effect of sensitivity on teacher-rated academic skills was .11, $p < .05$). In each case, the estimated paths of early experiences on subsequent outcomes did not vary in a systematic fashion with respect to time. Specifically, when we modeled the freely estimated b parameters as a linear function of assessment wave, the slope of the regression function

Table 4
Estimates of the Influence of Early Experience on Teacher Reports of Social Competence Across Childhood and Adolescence

Model	Model fit						Nested model comparisons		
	χ^2	*df*	*p*	CFI	RMSEA	SRMR	χ^2_{diff}	*df*	*p*
Basic model with covariates									
A. Enduring	370.80	39	<.001	.84	.09	.09	B − A = 51.41	6	<.001
B. Revisionist	422.21	45	<.001	.82	.09	.09	B − C = 44.40	1	<.001
C. Enduring: Equality constraint	377.81	44	<.001	.84	.08	.09	C − A = 7.01	5	.220
Controlling for the stability of maternal sensitivity									
A. Enduring	1050.05	100	<.001	.76	.09	.14	B − A = 50.34	6	<.001
B. Revisionist	1100.39	106	<.001	.75	.09	.14	B − C = 38.82	1	<.001
C. Enduring: Equality constraint	1061.57	105	<.001	.75	.09	.14	C − A = 11.52	5	.010
Transactional: 2nd order stability paths									
A. Enduring	143.21	34	<.001	.95	.05	.04	B − A = 32.38	6	<.001
B. Revisionist	175.59	40	<.001	.93	.06	.05	B − C = 27.91	1	<.001
C. Enduring: Equality constraint	147.68	39	<.001	.95	.05	.05	C − A = 4.47	5	.484
Inclusive									
A. Enduring	825.75	95	<.001	.81	.08	.12	B − A = 32.00	6	<.001
B. Revisionist	857.75	101	<.001	.81	.08	.13	B − C = 24.80	1	<.001
C. Enduring: Equality constraint	832.95	100	<.001	.81	.08	.13	C − A = 7.20	5	.206

Note. CFI = comparative fit index; RMSEA = root mean-square-error of approximation; SRMR = standardized root-mean-square residual.

was essentially zero (−.006, −.004, and .019 for mother-rated social skills, teacher-rated social skills, and objective measures of academic skills, respectively).

In summary, when we elaborated upon the basic model to allow outcomes to be influenced not only by early maternal sensitivity but also by concurrent sensitivity, we found that an enduring effects model fit the data best. Thus, the data indicate that maternal sensitivity assessed early in life continues to explain social and academic functioning independently of its concurrent effects.

Transactional processes. To determine whether transactional processes could potentially account for long-term effects of early sensitivity on developmental outcomes, we modeled second-order stability paths between outcome assessments (Grade 1→Grade 3, Grade 2→Grade 4, and so forth; see Figure 4C). This modification was designed to approximate processes (e.g., transactional dynamics) that allow variation in social competence at Grade 1, for example, to carry forward to Grade 3 in ways that are not directly attributable to the path from Grade 2 or from the enduring effects of early experience. Note that integrating second-order paths into our basic model represents a more stringent test of the enduring effects hypothesis, given that less unexplained variance in the outcome is available to be explained by early sensitivity.

The results of these analyses are summarized in the sections headed "Transactional: 2nd order stability paths" of Tables 2, 4, 6, and 8 for each of the four outcome domains. In each domain, the enduring effects model was able to explain the data better than the revisionist model. Specifically, setting the enduring path to 0.00 resulted in significant reductions in model fit. Moreover, constraining the enduring effects paths to be equal did not impair fit, with one exception. Namely, relaxing the equality constraint for mother reports of social competence improved fit to a minor degree. The resulting paths did not vary systematically as a function of age. Specifically, when we modeled the freely estimated *b* parameters as a linear function of assessment wave, the slope of the regression function was essentially zero (−.009).

It is of note that the absolute fit indices of these models are more favorable than those that do not include transactional processes. For example, our root-mean-square error of approximation (RMSEA) values (.04–.06) were within the range that is typically taken to suggest a reasonable error of approximation (.05–.08; Browne & Cudeck, 1993). In short, these analyses suggest that the inclusion of transactional processes is necessary to model the data well. Moreover, they indicate that a transactional model that assumes enduring effects of early experiences is superior to a transactional model that does not include a unique role for the enduring effects of early experiences.

Integration and simplification. Finally, for the purposes of integrating the various processes considered thus far and to summarize our core findings more compactly, we examined a series of models that embodied all of the complexities discussed previously, but in way that allowed them to be modeled simultaneously (see Figure 4D). This model included the potential enduring effects of the various covariates and transactional paths, as well as the stability of sensitivity and its concurrent effects. It should be noted that these models fit adequately but not as well as the more basic models that included the covariates and transactional processes without including the ongoing stability and effects of sensitivity (see the section "Inclusive" in Tables 2, 4, 6, and 8). Removing the ongoing effects of sensitivity, however, improved the fit of the models considerably, as might be intuited from the results presented previously. Thus, taken together, the most parsimonious models for each domain involved the covariates, enduring effects of early maternal sensitivity, and second-order stability paths.

Although the freely estimated version of the enduring effects model fit better than the revisionist model for the inclusive model for objective measures of cognitive skills, the constrained version of the enduring effects model did not significantly differ from the revisionist model (see Table 8). Given that the enduring effects model performed better than the revisionist model in every other analysis of cognitive skills, we are inclined to view this finding as an anomaly. In addition, the freely estimated version of the en-

Table 5
Correlations Between Early Maternal Sensitivity Composite, Covariates, Later Maternal Sensitivity, and Teacher Reports of Academic Skills Over Time

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Early sensitivity	—															
2. Gender	.092	—														
3. Ethnicity	.378	.002	—													
4. Income-to-needs ratio	.410	.040	.233	—												
5. Maternal education	.497	.037	.220	.542	—											
6. Maternal sensitivity 54 months	.549	.006	.306	.262	.353	—										
7. Maternal sensitivity Grade 1	.551	−.054	.365	.275	.382	.493	—									
8. Maternal sensitivity Grade 3	.457	.125	.191	.299	.369	.392	.458	—								
9. Maternal sensitivity Grade 5	.454	.107	.242	.269	.317	.375	.426	.470	—							
10. Maternal sensitivity 15 years	.320	.046	.144	.185	.265	.321	.334	.328	.377	—						
11. Academic skills kindergarten	.327	.013	.160	.240	.325	.284	.262	.273	.185	.057	—					
12. Academic skills Grade 1	.305	−.093	.162	.244	.314	.257	.193	.271	.232	.135	.577	—				
13. Academic skills Grade 2	.292	−.017	.159	.246	.309	.288	.213	.291	.222	.139	.541	.722	—			
14. Academic skills Grade 3	.332	−.044	.235	.262	.347	.295	.263	.285	.246	.190	.548	.691	.746	—		
15. Academic skills Grade 4	.327	−.013	.234	.297	.358	.292	.257	.306	.260	.229	.509	.625	.696	.725	—	
16. Academic skills Grade 5	.350	.035	.245	.279	.364	.302	.257	.270	.258	.213	.462	.570	.636	.647	.719	—
M	−.02	.48	.77	3.45	14.28	16.95	16.88	16.34	16.51	31.13	98.56	98.35	99.51	99.06	98.98	99.61
SD	.77	.50	.42	2.71	2.50	2.91	3.03	2.50	2.42	5.05	11.76	11.70	12.03	11.86	12.09	11.72

Note. Gender was coded 1 = female; 0 = male; ethnicity was coded 1 = White/non-Hispanic; 0 = non-White.

during effects model fit better than the constrained version for maternal-rated social skills and objectively rated academic skills. In both cases, however, the freely estimated paths of early experiences on subsequent outcomes did not vary in a linear fashion with respect to time (bs = −.010 and .019, respectively).

In an effort to summarize our some of our findings in a relatively condensed fashion, we focused upon teacher ratings of social competence and examined a model that did not include the ongoing effects of sensitivity. We examined teacher ratings of social competence in particular because the results from this domain were representative of those based on other outcomes. In this analysis, we excluded child gender as a covariate because it did not have a significant enduring effect on social competence in the more inclusive analysis. Some of the parameter estimates for this model are illustrated in Figure 5. For simplicity in presentation, only estimates from the first four of the seven assessment waves are presented. The estimates are based on a model that constrains the enduring effects to be equivalent over time. This model fit the data well, $\chi^2(34) = 149.55$, comparative fit index = .94, RMSEA = .06, standardized root-mean-square residual = .06. The path from early maternal sensitivity to later social competence was .11 ($p < .05$). The total of direct and indirect effects of early maternal sensitivity on social competence by age 15 is .21 ($p < .05$). For simplicity of presentation, we have only illustrated in Figure 5 the effects of one covariate: maternal education. The estimated enduring effects of income-to-needs ratio and ethnicity were .03 and .05, respectively (ps < .05).

Alternative ways to formalize revisionist processes. Across our various analyses, there were seven cases in which a model that freely estimated the b paths fit the data better than a model that constrained the b paths to be equal across time (see Tables 2, 4, 6, and 8). It is important to note that the freely estimated values of the b coefficients did not systematically decrease over time, as has already been summarized.[3] Nonetheless, we recognize that there are alternative ways to formalize revisionist processes that may explain the data better. An alternative way to examine revisionist processes is to estimate a version of the enduring effects model that constrains the b paths to decrease in a monotonic fashion from one assessment wave to the next (e.g., $b_1 > b_2 > \ldots > b_k > 0.00$). This pattern of constraints forces the b coefficients to get increasingly smaller over time, potentially approaching zero in the limit, and is capable of representing a wide array of patterns that could be construed as revisionist. When we examined such a constraint, there were only two cases (i.e., the transactional model for mother reports of social competence and the inclusive model for objective measures of cognitive skills) in which the model produced a better fit compared with one that imposed strict equality constraints in the b coefficients. In those two cases we further examined a model that forced the last two b coefficients to 0.00 while freely estimating the others. Doing so resulted in significantly worse fits relative to a model in which all b coefficients were freely estimated. In short, models that constrained the b paths to decrease over time or that forced the b paths to eventually reach 0.00 performed worse than models that did not.

[3] The b estimates for these models are reported in the online materials that supplement this article.

Table 6
Estimates of the Influence of Early Experience on Teacher Reports of Academic Skills Across Childhood and Adolescence

Model	Model fit						Nested model comparisons		
	χ^2	*df*	*p*	CFI	RMSEA	SRMR	χ^2_{diff}	*df*	*p*
Basic model with covariates									
A. Enduring	349.99	30	<.001	.91	.10	.07	B − A = 18.94	5	.002
B. Revisionist	368.93	35	<.001	.91	.09	.07	B − C = 15.57	1	<.001
C. Enduring: Equality constraint	353.36	34	<.001	.91	.09	.07	C − A = 3.37	4	.498
Controlling for the stability of maternal sensitivity									
A. Enduring	1027.48	86	<.001	.83	.10	.14	B − A = 15.95	5	.007
B. Revisionist	1043.43	91	<.001	.83	.10	.14	B − C = 11.98	1	<.001
C. Enduring: Equality constraint	1031.45	90	<.001	.83	.10	.14	C − A = 3.97	4	.410
Transactional: 2nd order stability paths									
A. Enduring	92.45	26	<.001	.98	.05	.03	B − A = 13.78	5	.018
B. Revisionist	106.23	31	<.001	.98	.05	.03	B − C = 7.51	1	.006
C. Enduring: Equality constraint	98.72	30	<.001	.98	.05	.03	C − A = 6.27	4	.180
Inclusive									
A. Enduring	771.41	82	<.001	.88	.09	.13	B − A = 12.18	5	.032
B. Revisionist	783.59	87	<.001	.88	.08	.13	B − C = 5.32	1	.021
C. Enduring: Equality constraint	778.27	86	<.001	.88	.08	.13	C − A = 6.86	4	.143

Note. CFI = comparative fit index; RMSEA = root mean-square-error of approximation; SRMR = standardized root-mean-square residual.

Discussion

One of the primary goals of developmental psychology is to understand and explain the impact of early experiences on human development. Unfortunately, most empirical research on the legacy of early experiences has focused on two-wave test–retest analyses, with a binary emphasis on whether an effect exists or not. We have argued that to understand the enduring effects of early experiences, it is necessary to study the *pattern of associations* that are observed over time. Moreover, we have argued that (a) those patterns can only be revealed by examining data collected across multiple waves and (b) alternative models of how early experiences are carried forward over time can be tested with such data to help clarify the developmental processes that operate in a given substantive domain.

We illustrated this approach to studying development with longitudinal data from the NICHD SECCYD, focusing on the long-term effects of early maternal sensitivity on children's social and academic skills. Our analyses suggest that the association between sensitivity and these outcomes is relatively constant over time and does not approach zero in the limit. We also examined the possibility that the enduring association between early experiences and later social and academic functioning is due to (a) the confounding influence of factors associated with sensitivity and child outcomes (e.g., maternal education), (b) the stability of caregiving environments over time rather than a unique role of early interpersonal experiences per se (e.g., Lamb et al., 1984; Lewis, 1997), or (c) transactional processes. Our analyses indicate that the impact of early experiences is sustained over time even after these mechanisms are taken into account. These kinds of findings are difficult to reconcile on the basis of a revisionist perspective on development and suggest that early sensitivity may have an enduring impact on developmental outcomes through mid-adolescence.

Broadening the Scope of Developmental Models

As we mentioned previously, the broad developmental processes we have discussed here are not meant to be exhaustive of all possible developmental mechanisms. Our primary concern has been to disentangle alternative ways in which early experience may leave a mark on adaptation, focusing broadly on processes that enable early experiences to influence subsequent adaptation through a relatively consolidated mediator or indirectly through the stability of the outcomes themselves. That said, it is important to emphasize that the simple framework we have used can be modified relatively easily to incorporate more complex processes. For example, both the enduring effects and revisionist models can easily accommodate so-called *sleeper effects* (i.e., associations between early experience and later adaptation that increase in magnitude over time; Clarke & Clarke, 1981). In fact, the version of the enduring effects model that does not impose equality constraints among the paths naturally allows sleeper effects to emerge, if they exist, without any additional specifications. Such effects can be detected by comparing a model that imposes equality constraints among the *b* paths in Figure 2 with one that allows those paths to be freely estimated. Sleeper effects would be evident if the freely estimated model captures the data better than a constrained one and if the *b* paths are larger at some point later in development than they were previously. In the present research, we found some evidence for potential sleeper effects with respect to objective measures of academic skills for some of our secondary models (e.g., models that controlled for the stability of sensitivity). Namely, the estimated effect of early experiences on objective measures of age 15 academic skills was greater than that estimated at earlier assessment waves. We are not inclined to give this specific finding too much interpretive weight because we do not have theoretical grounds for predicting sleeper effects in this context. Regardless, the point remains: The model is sensitive to such possibilities, even if it was not explicitly designed to model them.

The basic approach we have presented can also be expanded to capture the kinds of transactional processes that are widely discussed in the literature (e.g., Sameroff & MacKenzie, 2003). It is often hypothesized that early experiences have the potential to exert a long-reaching impact on developmental outcomes because

Table 7
Correlations Between Early Maternal Sensitivity Composite, Covariates, Later Maternal Sensitivity, and Objective Reports of Academic Skills Over Time

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Early sensitivity	—														
2. Gender	.092	—													
3. Ethnicity	.378	.002	—												
4. Income-to-needs ratio	.410	.040	.233	—											
5. Maternal education	.497	.037	.220	.542	—										
6. Maternal sensitivity 54 months	.549	.006	.306	.262	.353	—									
7. Maternal sensitivity Grade1	.551	−.054	.365	.275	.382	.493	—								
8. Maternal sensitivity Grade 3	.457	.125	.191	.299	.369	.392	.458	—							
9. Maternal sensitivity Grade 5	.454	.107	.242	.269	.317	.375	.426	.470	—						
10. Maternal sensitivity 15 years	.320	.046	.144	.185	.265	.321	.334	.328	.377	—					
11. WJ–R composite 54 months	.464	.087	.302	.373	.435	.346	.362	.319	.341	.206	—				
12. WJ–R composite Grade 1	.396	−.023	.276	.340	.415	.336	.336	.308	.278	.187	.699	—			
13. WJ–R composite Grade 3	.418	.007	.312	.350	.427	.332	.332	.327	.300	.203	.691	.863	—		
14. WJ–R composite Grade 5	.437	.008	.307	.353	.453	.361	.361	.337	.318	.227	.668	.807	.905	—	
15. WJ–R composite 15 years	.469	−.043	.338	.366	.473	.393	.393	.327	.363	.213	.660	.717	.799	.840	—
M	−0.02	0.48	0.77	3.45	14.28	16.95	16.88	16.34	16.51	31.13	434.70	477.15	496.02	508.44	522.24
SD	0.77	0.50	0.42	2.71	2.50	2.91	3.03	2.50	2.42	5.05	13.95	10.82	10.84	11.66	12.28

Note. Gender was coded 1 = female; 0 = male; ethnicity was coded 1 = White/non-Hispanic; 0 = non-White; WJ–R = Woodcock–Johnson Psycho-Educational Battery–Revised.

they influence a broad suite of factors that covary together in mutually reinforcing ways. The effect of transactional processes on enduring effects is to raise the elevation of the curves illustrated in Figure 3. Specifically, when children's environments influence them and, in turn, children play a role in influencing their environments, the association between early experiences and later outcomes is higher than what would be expected in situations in which transactional dynamics are inoperative or incomplete (see Fraley & Roberts, 2005, for a formal explication). It is important to emphasize, however, that transactional processes do not impact the broader pattern of predictive associations that we have delineated in the present article. Regardless of whether transactional processes operate in a given domain, it is an open question as to whether the predictive significance of early experiences is sustained over time or whether it approaches zero asymptotically. Transactional processes serve to affect the magnitude to the associations, not their asymptotic values.

In our empirical example, we modeled transactional pathways indirectly via second-order stability paths. These paths were designed to represent the assumption that part of the stability in child outcomes can be accounted for by the influence that the child has on various factors that, in turn, influence the child. When we built these paths into the models, the models were better able to capture the empirical data in an absolute sense. We encourage researchers to examine these kinds of processes more formally in the future.

Extensions of the Basic Model into Other Developmental Domains

Although we have framed the methods discussed in this article with respect to their utility for addressing debates about the legacy of early caregiving experiences, we wish to emphasize that these methods have implications for any substantive area of developmental science that is concerned with the contributions of individual differences to social, emotional, cognitive, and biological development. In other words, the general modeling approach we have proposed need not be tied to early experience per se, nor need it be tied to the domains of caregiving or parenting. In fact, scholars in developmental psychology are concerned with a broad array of experiential inputs (e.g., peer rejection, parental divorce, school quality) that are theoretically relevant at varying times in the life span (e.g., childhood, adolescence). The kinds of questions we have posed are as just as relevant to understanding these domains and early-versus-later experiences as they are to understanding the ones we emphasized in our empirical examples.

One potentially valuable application of these methods that warrants special attention concerns intervention research. For the most part, intervention research has focused on examining whether interventions have an impact, how much of an impact exists, and whether that impact is long-term. We want to emphasize this latter point (i.e., the potential long-term impact of interventions) in particular. Knowing that an intervention is effective over a long period of time is informative. But, in and of itself, such knowledge does not speak to the question of whether the intervention continues to have enduring effects across time. Knowing the pattern of associations across multiple assessment periods is critical for fully understanding the way in which the intervention influences developmental adaptation. Moreover, being able to deduce whether the effect of the intervention is more compatible with the kinds of

Table 8
Estimates of the Influence of Early Experience on Objective Measures of Academic Skills Across Childhood and Adolescence

Model	Model fit						Nested model comparisons		
	χ^2	*df*	*p*	CFI	RMSEA	SRMR	χ^2_{diff}	*df*	*p*
Basic model with covariates									
A. Enduring	199.86	22	<.001	.97	.08	.05	B − A = 15.94	4	.004
B. Revisionist	215.80	26	<.001	.97	.08	.05	B − C = 8.75	1	.003
C. Enduring: Equality constraint	207.05	25	<.001	.97	.08	.05	C − A = 7.19	3	.066
Controlling for the stability of maternal sensitivity									
A. Enduring	830.25	72	<.001	.89	.10	.14	B − A = 13.02	4	.015
B. Revisionist	843.27	76	<.001	.89	.09	.14	B − C = 4.97	1	.026
C. Enduring: Equality constraint	838.30	75	<.001	.89	.09	.14	C − A = 8.05	3	.045
Transactional: 2nd order stability paths									
A. Enduring	137.58	19	<.001	.98	.07	.04	B − A = 12.17	4	.016
B. Revisionist	149.75	23	<.001	.98	.07	.04	B − C = 4.73	1	.030
C. Enduring: Equality constraint	145.02	22	<.001	.98	.07	.04	C − A = 7.44	3	.059
Inclusive									
A. Enduring	768.45	69	<.001	.90	.09	.14	B − A = 10.28	4	.036
B. Revisionist	778.73	73	<.001	.90	.09	.14	B − C = 2.27	1	.132
C. Enduring: Equality constraint	776.46	72	<.001	.90	.09	.14	C − A = 8.01	3	.046

Note. CFI = comparative fit index; RMSEA = root mean-square-error of approximation; SRMR = standardized root-mean-square residual.

processes entailed by an enduring effects model versus a revisionist model is crucial for avoiding certain inferential pitfalls. For example, critics of an intervention might correctly note that in multiwave follow-ups, the differences between intervention and control groups get smaller over time. On the basis of those data, critics, drawing implicitly or explicitly on a revisionist model, might incorrectly conclude that the intervention is ineffective or that it does not have lasting effects. However, as the curves shown in Figure 3 illustrate, the effect of any kind of experience or intervention will decay to some extent—even in the context of an enduring effects model. Thus, the interesting question is not whether the differences get smaller over time (they always will, except in unusual circumstances), but what kind of asymptotic value they are approaching. The differences could very well be approaching a non-zero value, even if that value is smaller than the one documented across the initial two waves. From our point of view, an intervention whose effectiveness fades gradually at first, but persists in the limit, has the potential to be extraordinarily valuable. But it is not possible to know this without attending to some of the issues we have highlighted here.

Further Questions, Limitations, and Caveats

One of our aims in this article was to illustrate how alternative models of developmental processes have distinctive implications for understanding the long-term consequences of early experience

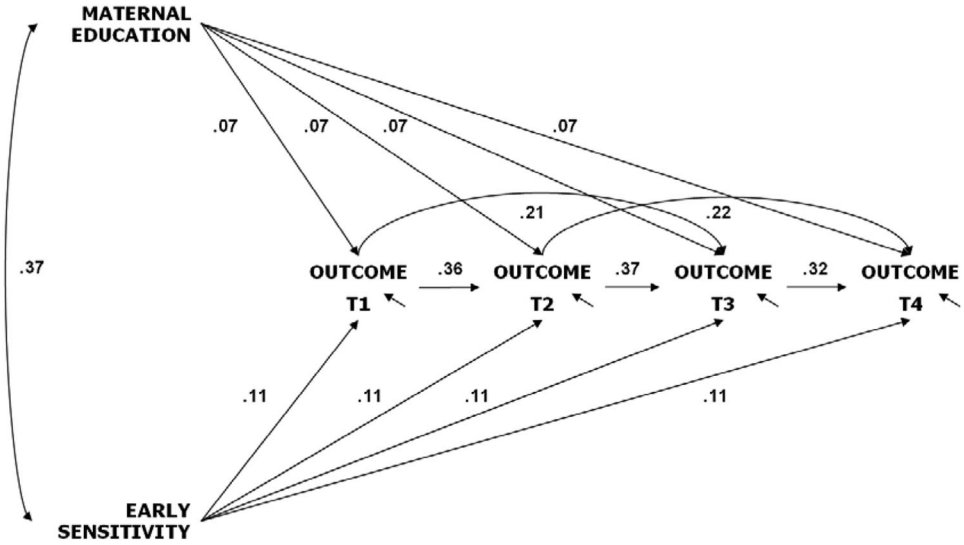

Figure 5. The estimated effects of early maternal sensitivity and maternal education on teacher ratings of social competence. T= Time.

on developmental adaptation. It is important to keep in mind, however, that, although the theoretical models themselves assume specific causal processes, the methods we have employed do not allow causal processes to be tested in an unambiguous fashion. In the absence of random assignment, there are always alternative explanations for why measures of early experiences might continue to relate to measures of subsequent adaptation.

We encourage researchers who employ these methods to be sensitive to this issue. With respect to our specific empirical examples, we followed a two-stage procedure that other researchers might find useful. We first sought to determine whether the pattern of associations was most compatible with an enduring effects or a revisionist model. Then, having established that a model which posits that early experiences continue to have an effect on subsequent outcomes in a manner that was not fully explained via stability in the outcome itself, we sought to examine other explanations for the findings by increasing the complexity of the basic models. These more complex model specifications did not make the basic findings disappear. Again, this does not demonstrate that early experiences have an enduring causal influence on social competence and academic skills. But it does represent an incremental advance in knowledge because several plausible explanations were tested and ruled out.

Although we think these analyses represent a useful step toward understanding of the potential legacy of early experiences, we want to be clear that this is merely a first step, and there are many additional questions that need answers. One such question concerns the precise mechanisms that account for the enduring significance of early experiences in the domains we studied. Attachment scholars have hypothesized that early caregiving experiences have the potential to play an organizing role in shaping the kinds of expectations that children develop concerning their caregivers and other significant figures in their lives (e.g., peers, teachers). Some theorists have construed this process as the construction of a unique mental representation—a *prototype*—that guides the child's thoughts, feelings, and behaviors throughout childhood and, potentially, early adulthood (e.g., Sroufe et al., 1990). It should be noted that the prototype is generally regarded as being constructed in a largely procedural fashion and prior to the development of complex language skills. As a result, the structure might function as a relatively autonomous mediator of early experiences on subsequent outcomes—one that is unlikely to change except in unusual circumstances.

Having said that, we should be clear that the present work does little to clarify the nature of prototypes or whatever kind of consolidated mediator might be capable of producing these kinds of data. Our framework helps to identify the *dynamics* of the mechanisms that help explain how early experiences are carried forward over time, but they do not pinpoint the *substance* of those mechanisms. A useful next step would be to investigate exactly how early experiences might be embodied in ways that allow them to shape social development. We expect that continued research on developmental neurobiology and neuroendocrinology will be useful in this regard, along with traditional research on the cognitive, affective, and behavioral components of representational processes. We also should state that, as a general rule, we believe genetic explanations should be considered in research on the individual differences in early experiences. Indeed, by applying the logic of the framework presented in this article to genetically informed research designs involving twin or adoptive samples, it should also be possible to examine the extent to which genetic sources of variance account for the patterns of association observed. It is worth noting, however, that in analyses of twins drawn from the Early Childhood Longitudinal Study birth cohort; Roisman and Fraley (2006, 2008) have demonstrated that the kind of assessment of early maternal sensitivity discussed in this article reflects little, if any, genetic influence. But that might not be the case in other developmental domains.

Another caveat we should highlight is that any analysis concerning the legacy of early experiences is going to depend on the windows of time that are used for assessment. In the context of our empirical example, although the data are compatible with the notion that early experiences have an enduring impact on subsequent outcomes, that conclusion is based exclusively on data collected from early childhood through age 15. It is possible that these conclusions could change if subsequent assessment waves beyond age 15 point strongly to a gradual decay in the predictive significance of early experiences. More generally, however, we do not wish to suggest that the kinds of conclusions we have reached here about the enduring effects of maternal sensitivity cannot be challenged by subsequent data. Indeed, one issue we have not discussed explicitly yet concerns heterotypic continuity. It is quite possible that the implications of early caregiving experiences manifest themselves only in light of specific age-appropriate developmental tasks (e.g., Sroufe, 1979). If this is the case, it is quite possible that enduring effects of early experience will be difficult to assess unless one explicitly takes heterotypic continuity into consideration and designs tasks that are developmentally appropriate for the constructs under study. It is possible that the meaning and measurement of social competence in early adulthood, for example, might be quite different than those for early childhood. If so, the legacy of early experiences might be more difficult to uncover.

As a final caveat we should note that despite the implicit emphasis throughout this article on the enduring effects model, we do not wish to be viewed as advocating for this kind of model over a revisionist one in a general sense. Indeed, we suspect that the predictive significance of many experiential inputs are governed by revisionist processes. We have demonstrated elsewhere, using the modeling techniques detailed in this article, that there are transient effects of early maternal sensitivity for mother reports (but not teacher ratings) of psychopathology in the NICHD SECCYD (Haltigan, Roisman, & Fraley, in press). We mention this because we want to emphasize that the methods presented here are sensitive to the difference but also to emphasize that it might not always be obvious, prior to investigation, which kind of developmental process best captures the relations in question. The distinctions we have presented in this article point to a vast, uncharted territory in developmental science. We believe the best way to begin surveying it is through empirical research that is sensitive to alternative ways in which early experiences are carried forward over time.

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