

# Early Growth and Development Study

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### 2007

Leve, L. D., Neiderhiser, J. M., Ge, X., Scaramella, L. V., Conger, R. D., Reid, J. B., Shaw, D. S., & Reiss, D. (2007). The Early Growth and Development Study: A prospective adoption design. *Twin Research and Human Genetics*, *10*, 84–95. PMC: 2674795

**Abstract:** The Early Growth and Development Study is a prospective adoption study of birth parents, adoptive parents, and adopted children ( $N = 359$  triads) that was initiated in 2003. The primary study aims are to examine how family processes mediate or moderate the expression of genetic influences in order to aid in the identification of specific family processes that could serve as malleable targets for intervention. Participants in the study are recruited through adoption agencies located throughout the United States, following the birth of a child. Assessments occur at 6-month intervals until the child reaches 3 years of age. Data collection includes the following primary constructs: infant and toddler temperament, social behavior, and health; birth and adoptive parent personality characteristics, psychopathology, competence, stress, and substance use; adoptive parenting and marital relations; and prenatal exposure to drugs and maternal stress. Preliminary analyses suggest the representativeness of the sample and minimal confounding effects of current trends in adoption practices, including openness and selective placement. Future plans are described.

Reiss, D. & Leve, L. D. (2007). Genetic expression outside the skin: Clues to mechanisms of Genotype  $\times$  Environment interaction. *Development and Psychopathology*, *19*, 1005–1027. PMC: 2144738

**Abstract:** The rapidly moving study of Gene-Environment interaction (G-E) needs interim conceptual tools to track progress, integrate findings, and apply this knowledge to preventive intervention. We define two closely related concepts: the social mediation

of the expression of genetic influences and the interaction between the entire genotype and the social environment (G-E). G-E, the primary focus of this report, assesses individual differences in the full genotype using twin, sibling, and adoption designs and, for the most part, employs fine-grained analyses of relational processes in the social environment. In comparison, studies of Allele-Environment interaction assess the influence on development of one or more measured polymorphisms as modified by environmental factors. G-E studies build on work showing how the social environment responds to genetic influences and how genetic influences shape the social environment. Recent G-E research has yielded new insight into variations in the sensitivity of the social environment to genotypic influences and provides clues to the specificity and timing of these environmental responses that can be leveraged to inform preventive interventions aimed at reducing genetic risk for problem behavior.

## 2008

Ganiban, J. M., Leve, L. D., Moore, G. A., & Neiderhiser, J. M. (2008). Strategies for understanding the mechanisms of mothering and fathering. In R. S. Bridges (Ed.), *Neurobiology of the parental brain* (pp. 391–403). Amsterdam, The Netherlands: Elsevier.

**Abstract:** It is well established in the human developmental and family literature that parenting has an important impact on the development of children and adolescents. The mechanisms through which parenting influences child development, however, are less clear. The role of genetic influences, via the parents or via the child, were first considered in the early 1980s (Rowe, 1981, 1983), but it took nearly 10 years for researchers to realize the relevance and importance of such influences (e. g., Plomin & Bergeman, 1991). There is now a sizable literature on the roles of genetic and environmental influences on parenting across the lifespan (see reviews in Towers et al., 2001; McGuire, 2003; Ulbricht, & Neiderhiser, in press), with findings indicating that both genetic and environmental influences are important for explaining individual differences in parenting. Despite this significant advance in our understanding of the roles of genes and environment in influencing child and adolescent development, few studies have attempted to explicate the mechanisms involved in genetic and environmental influences on parenting. In this chapter, we will first provide a brief overview of studies examining genetic influences on parenting and on genotype-environment correlation (rGE; correlation between genes and environment). We then focus more specifically on factors that can explain genetic influences on parenting (e.g., temperament and personality in parents and in children). We then focus on further advancing our understanding of the mechanisms of environmental influences on parenting. We conclude by considering how advances in our understanding of the mechanisms underlying genetic and environmental influences on parenting can be applied.

Ge, X., Natsuaki, M. N., Martin, D., Leve, L. D., Neiderhiser, J. M., Shaw, D. S., Villareal, G., Scaramella, L. V., Reid, J. B., & Reiss, D. (2008). Bridging the divide: Openness in adoption and post-adoption psychosocial adjustment among birth and adoptive parents. *Journal of Family Psychology*, 22, 529–540. PMC: 2638763

**Abstract:** Using 323 matched parties of birth mothers and adoptive parents, this study examined the association between the degree of adoption openness (e.g., contact and knowledge between parties) and birth and adoptive parents' postadoption adjustment shortly after the adoption placement (6 to 9 months). Data from birth fathers ( $N = 112$ ), an understudied sample, were also explored. Openness was assessed by multiple informants. Results indicated that openness was significantly related to satisfaction with adoption process among adoptive parents and birth mothers. Increased openness was positively associated with birth mothers' postplacement adjustment, as indexed by birth mothers' self-reports and the interviewers' impression of birth mothers' adjustment. Birth

fathers' report of openness was associated with their greater satisfaction with the adoption process and better postadoption adjustment.

Leve, L. D., Neiderhiser, J. M., Scaramella, L. V., & Reiss, D (2008). The Early Growth and Development Study: Using the prospective adoption design to examine genotype-environment interplay. *Acta Psychologica Sinica*, 40, 1106–1115.  
PMC: 2674795

**Abstract:** The Early Growth and Development Study (EGDS) is a prospective adoption design consisting of 360 linked sets of birth parents, adoptive parents, and adopted children followed from 3 months postpartum through child age 7 years and an additional 200 linked sets for whom recruitment is underway. The EGDS brings together the study of genotype–environment correlation and Genotype × Environment (G×E) interaction to inform intervention development by examining mechanisms whereby family processes mediate or moderate the expression of genetic influences. Participants in the EGDS are recruited through domestic adoption agencies located throughout the United States of America. The assessments occur at 6-month intervals until child age 4½ years and at ages 6 and 7, when the children are in their 1st and 2nd years of formal schooling (kindergarten and first grade). The data collection includes measures of child characteristics, birth and adoptive parent characteristics, adoptive parenting, prenatal exposure to drugs and maternal stress, birth parent and adopted child salivary cortisol reactivity, and DNA from all participants. The preliminary analyses suggest evidence for G×E interaction beginning in infancy. An intervention perspective on future developments in the field of behavioral genetics is described.

## 2009

Leve, L. D., Harold, G. T., Ge, X., Neiderhiser, J. M., Shaw, D., Scaramella, L. V., & Reiss, D. (2009). Structured parenting of toddlers at high versus low genetic risk: Two pathways to child problems. *Journal of the American Academy of Child and Adolescent Psychiatry*, 48, 1102–1109. PMC: 2780535

**Abstract:** *Objective:* Little is known about how parenting might offset genetic risk to prevent the onset of child problems during toddlerhood. We used a prospective adoption design to separate genetic and environmental influences and test whether associations between structured parenting and toddler behavior problems were conditioned by genetic risk for psychopathology.

*Method:* The sample included 290 linked sets of adoptive families and birth mothers and 95 linked birth fathers. Genetic risk was assessed via birth mother and birth father psychopathology (anxiety, depression, antisociality, and drug use). Structured parenting was assessed via microsocial coding of adoptive mothers' behavior during a cleanup task. Toddler behavior problems were assessed with the Child Behavior Checklist.

*Results:* Controlling for temperamental risk at 9 months, there was an interaction between birth mother psychopathology and adoptive mothers' parenting on toddler behavior problems at 18 months. The interaction indicated two pathways to child problems: structured parenting was beneficial for toddlers at high genetic risk but was related to behavior problems for toddlers at low genetic risk. This crossover interaction pattern was replicated with birth father psychopathology as the index of genetic risk.

*Conclusions:* The effects of structured parenting on toddler behavior problems varied as a function of genetic risk. Children at genetic risk might benefit from parenting interventions during toddlerhood that enhance structured parenting.

Reiss, D., Leve, L. D., & Whitesel, A. (2009). Understanding links between birth parents and the child they have placed for adoption: Clues for assisting adopting families and for reducing genetic risk. In G. M. Wrobel & E. Neil (Eds.), *International advances in adoption research for practice* (pp. 119–146). New York, NY: John Wiley.

**Abstract:** Researchers in the field of adoption research have designed studies to understand more fully the grief and recovery in parents who place their children and the intertwined processes of parenting and child development in adopting families. Rarely are these two domains linked in a single study. However, as studies are now showing (Dunbar et al., 2006) the birth parents and adopting parents are often linked to each other through actual social contact in open adoptions and, even in more closed adoptions, they may be emotionally linked as each set of parents might think about the other over the course of time. Thus, one may consider the birth parents, the placed child, and the adoptive parents as a single social unit in the same sense that step parents, children and divorced birth parents can also be regarded as a single social unit, even if there is little or no face-to-face contact among some members of this unit. Indeed, social units of this kind may be thought of as yoked together by circumstances.

In the case of the adoption “yoke,” ongoing social ties between birth and adoptive parents may vary from pure fantasy to frequent contact but the genetic relationship between birth parents and the adopted child is invariant across time.

## 2010

Leve, L. D., Harold, G. T., Ge, X., Neiderhiser, J. M., & Patterson, G. (2010). Refining intervention targets in family-based research: Lessons from quantitative behavioral genetics. *Perspectives on Psychological Science*, 5, 516–526. PMC: 3008822

**Abstract:** The results from a large body of family-based research studies indicate that modifying the environment (specifically dimensions of the social environment) through intervention is an effective mechanism for achieving positive outcomes. Parallel to this work is a growing body of evidence from genetically informed studies indicating that social environmental factors are central to enhancing or offsetting genetic influences. Increased precision in the understanding of the role of the social environment in offsetting genetic risk might provide new information about environmental mechanisms that could be applied to prevention science. However, at present, the multifaceted conceptualization of the environment in prevention science is mismatched with the more limited measurement of the environment in many genetically informed studies. In this article, we present a framework for translating quantitative behavioral genetic research to inform the development of preventive interventions. The measurement of environmental indices amenable to modification is discussed within the context of quantitative behavioral genetic studies. In particular, emphasis is placed on the necessary elements that lead to benefits in prevention science, specifically the development of evidence-based interventions. We provide an example from an ongoing prospective adoption study to illustrate the potential of this translational process to inform the selection of preventive intervention targets.

Leve, L. D., Kerr, D. C. R., Shaw, D. S., Ge, X., Neiderhiser, J. M., Scaramella, L. V., Reid, J. B., Conger, R. D., & Reiss, D. (2010). Infant pathways to externalizing behavior: Evidence of Genotype × Environment interaction. *Child Development*, 81, 340–356. PMC: 2845990

**Abstract:** To further the understanding of the effects of early experiences, 9-month-old infants were observed during a frustration task. The analytical sample was composed of 348 linked triads of participants (adoptive parents, adopted child, and birth parent[s]) from a prospective adoption study. It was hypothesized that genetic risk for externalizing problems and affect dysregulation in the adoptive parents would independently and interactively predict a known precursor to externalizing problems: heightened infant attention to frustrating events. Results supported the moderation hypotheses involving adoptive mother affect dysregulation: Infants at genetic risk showed heightened attention to frustrating events only when the adoptive mother had higher levels of anxious and depressive symptoms. The Genotype × Environment interaction pattern held when substance use during pregnancy was considered.

Leve, L. D., Neiderhiser, J. M., Scaramella, L. V., & Reiss, D (2010). The Early Growth and Development Study: Using the prospective adoption design to examine

genotype-environment interplay. [Special section] *Behavior Genetics*, 40, 306–314. (Reprinted from 2008 *Acta Psychological Sinica*, 40, 1106–1115. PMC: 2674795)

**Abstract:** The Early Growth and Development Study (EGDS) is a prospective adoption design consisting of 360 linked sets of birth parents, adoptive parents, and adopted children followed from 3 months postpartum through child age 7 years and an additional 200 linked sets for whom recruitment is underway. The EGDS brings together the study of genotype–environment correlation and Genotype × Environment (G×E) interaction to inform intervention development by examining mechanisms whereby family processes mediate or moderate the expression of genetic influences. Participants in the EGDS are recruited through domestic adoption agencies located throughout the United States of America. The assessments occur at 6-month intervals until child age 4½ years and at ages 6 and 7, when the children are in their 1st and 2nd years of formal schooling (kindergarten and first grade). The data collection includes measures of child characteristics, birth and adoptive parent characteristics, adoptive parenting, prenatal exposure to drugs and maternal stress, birth parent and adopted child salivary cortisol reactivity, and DNA from all participants. The preliminary analyses suggest evidence for G×E interaction beginning in infancy. An intervention perspective on future developments in the field of behavioral genetics is described.

Natsuaki, M. N., Ge, X., Leve, L. D., Neiderhiser, J. M., Shaw, D. S., Conger, R. D., Scaramella, L. V., Reid, J. B., & Reiss, D. (2010). Genetic liability, environment, and the development of fussiness in toddlers: The roles of maternal depression and parental responsiveness. *Developmental Psychology*, 46, 1147–1158. PMC: 2936717

**Abstract:** Using a longitudinal, prospective adoption design, the authors of this study examined the effects of the environment (adoptive parents' depressive symptoms and responsiveness) and genetic liability of maternal depression (inferred by birth mothers' major depressive disorder [MDD]) on the development of fussiness in adopted children between 9 and 18 months old. The sample included 281 families linked through adoption, with each family including 4 individuals (i.e., adopted child, birth mother, adoptive father and mother). Results showed that adoptive mothers' depressive symptoms when their child was 9 months old were positively associated with child fussiness at 18 months. A significant interaction between birth mothers' MDD and adoptive mothers' responsiveness indicated that children of birth mothers with MDD showed higher levels of fussiness at 18 months when adoptive mothers had been less responsive to the children at 9 months. However, in the context of high levels of adoptive mothers' responsiveness, children of birth mothers with MDD did not show elevated fussiness at 18 months. Findings are discussed in terms of gene–environment interactions in the intergenerational risk transmission of depression.

Pemberton, C. K., Neiderhiser, J. M., Leve, L. D., Natsuaki, M. N., Shaw, D. S., Reiss, D., & Ge, X. (2010). Influence of parental depressive symptoms on adopted toddler behaviors: An emerging developmental cascade of genetic and



environmental effects. *Development and Psychopathology*, 22, 803–818. PMC: 4014132

**Abstract:** This study examined the developmental cascade of both genetic and environmental influences on toddlers' behavior problems through the longitudinal and multigenerational assessment of psychosocial risk. We used data from the Early Growth and Development Study, a prospective adoption study, to test the intergenerational transmission of risk through the assessment of adoptive mother, adoptive father, and biological parent depressive symptoms on toddler behavior problems. Given that depression is often chronic, we control for a cross-time continuity and find that in addition to associations between adoptive mother depressive symptoms and toddler externalizing problems, adoptive father depressive symptoms when the child is 9 months of age were associated with toddler problems and associated with maternal depressive symptoms. Findings also indicated that a genetic effect may indirectly influence toddler problems through prenatal pregnancy risk. These findings help to describe how multiple generations are linked through genetic (biological parent), timing (developmental age of the child), and contextual (marital partner) pathways.

Reiss, D. (2010). Genetic thinking in the study of social relationships: Five points of entry. *Perspectives on Psychological Science*, 5, 502–515. PMC: 4243012

**Abstract:** For nearly a generation, researchers studying human behavioral development have combined genetically informed research designs with careful measures of social relationships such as parenting, sibling relationships, peer relationships, marital processes, social class stratifications, and patterns of social engagement in the elderly. In what way have these genetically informed studies altered the construction and testing of social theories of human development? We consider five points of entry where genetic thinking is taking hold. First, genetic findings suggest an alternative scenario for explaining social data. Associations between measures of the social environment and human development may be due to genes that influence both. Second, genetic studies add to other prompts to study the early developmental origins of current social phenomena in midlife and beyond. Third, genetic analyses promise to shed light on understudied social systems, such as sibling relationships, that have an impact on human development independent of genotype. Fourth, genetic analyses anchor in neurobiology individual differences in resilience and sensitivity to both adverse and favorable social environments. Finally, genetic analyses increase the utility of laboratory simulations of human social processes and of animal models.

## 2011

Brooker, R. J., Neiderhiser, J. M., Kiel, E. J., Leve, L. D., Shaw, D. S. & Reiss, D. (2011). The association between infants' attention control and social inhibition is moderated by genetic and environmental risk for anxiety. *Infancy, 16*, 490–507. PMC: 3158002

**Abstract:** Infant social inhibition is associated with increased risk for anxiety later in life. Although both genetic and environmental factors are associated with anxiety, little empirical work has addressed how developing regulatory abilities work with genetic and environmental risk to exacerbate or mitigate problem behaviors. The current study was aimed at addressing this gap in research by investigating an early emerging regulatory behavior, attention control, in association with genetic and environmental risk for anxiety. Participants included 9-month-old adopted infants, their birth mothers, and adoptive parents ( $N = 361$ ). Lifetime diagnosis of birth mother social phobia was obtained using structured interviews. Adoptive parents completed self-report measures of anxiety symptoms. Infant social inhibition and attention control were coded during a stranger interaction and a barrier task, respectively. Neither adoptive nor birth parent anxiety was directly associated with social inhibition. The association of attention control with social inhibition in infants was moderated by birth and adoptive parent anxiety symptoms. When infants of birth mothers with social phobia were raised by adoptive parents with high self-reported anxiety symptoms, greater attention control was associated with greater social inhibition. However, when raised by adoptive parents with low self-reported anxiety, greater attention control was associated with less social inhibition.

Lipscomb, S. T., Leve, L. D., Harold, G. T., Neiderhiser, J. M., Shaw, D. S., Ge, X., & Reiss, D. (2011). Trajectories of parenting and child negative emotionality during infancy and toddlerhood: A longitudinal analysis. *Child Development, 82*, 1661–1675. PMC: 3177150

**Abstract:** The current longitudinal study examined trajectories of child negative emotionality, parenting efficacy, and overreactive parenting among 382 adoptive families during infancy and toddlerhood. Data were collected from adoptive parents when the children were 9-, 18-, and 27-month-old. Latent growth curve modeling indicated age-related increases in child negative emotionality and overreactive parenting for adoptive fathers and adoptive mothers (AM), and decreases in parent efficacy among AM. Increases in child negative emotionality were also associated with increases in parent overreactivity and decreases in maternal efficacy. Mothers' and fathers' developmental patterns were linked within but not across parenting domains. Limitations and directions for future research are discussed.

Mannering, A. M., Harold, G. T., Leve, L. D., Shelton, K. H., Shaw, D. S., Conger, R. D., Neiderhiser, J. M., Scaramella, L. V., & Reiss, D. (2011). Longitudinal associations between marital instability and child sleep problems across infancy

and toddlerhood in adoptive families. *Child Development*, 82, 1252–1266. PMC: 3134604

**Abstract:** This study examined the longitudinal association between marital instability and child sleep problems at ages 9 and 18 months in 357 families with a genetically unrelated infant adopted at birth. This design eliminates shared genes as an explanation for similarities between parent and child. Structural equation modeling indicated that T1 marital instability predicted T2 child sleep problems, but T1 child sleep problems did not predict T2 marital instability. This result was replicated when models were estimated separately for mothers and fathers. Thus, even after controlling for stability in sleep problems and marital instability and eliminating shared genetic influences on associations using a longitudinal adoption design, marital instability prospectively predicts early childhood sleep patterns.

Martin, D. M., Leve, L. D., Natsuaki, M. N., Neiderhiser, J. M., & Ge, X. (2011). Toward a greater understanding of openness: A report from the Early Growth and Development Study. *National Council of Adoption's Factbook V*, 471–477.

**Abstract:** Over the last century, adoption practice has moved from only closed adoptions, with no information exchanged or contact between birth and adoptive families, toward availability of more open arrangements, with varying degrees of contact and information exchanged between birth and adoptive families. With these changes came the debate about the detrimental or beneficial effects of openness in adoption. Opponents of open adoption assert that all parties in the adoption will be adversely affected, with adoptive parents feeling insecure in their role as parents and birthparents being unable to “move on” with their lives. Proponents of open adoption assert that it helps adoptive parents assume the parent role by having permission to parent from their child’s birthparents. Birthparents are also thought to be better adjusted in open adoption because they know that the child is well, trust is built between birth and adoptive parents, and the decision to place has been validated. Existing studies, however, have not reached consensus; some studies found open adoption to be detrimental to mental health while others have found it to be beneficial. Given these conflicting results, further investigation is needed to clarify how openness affects birth and adoptive parents who have completed an adoption plan.

Massey, S. H., Lieberman, D. Z., Reiss, D., Leve, L. D., Shaw, D. S., Neiderhiser, J. M. (2011). Association of clinical characteristics and cessation of tobacco, alcohol and illicit drug use during pregnancy. *The American Journal on Addictions*, 20, 143–150. PMC: 3052631

**Abstract:** Pregnancy is a time of relative urgency and opportunity for the treatment of substance use disorders in women, yet little is known about modifiable factors that contribute to successful abstinence. We examined self-worth, depression, anxiety, and novelty seeking in the context of substance use cessation during pregnancy in a sample of women with a high prevalence of substance abuse. Subjects were 448 birth mothers

who participated in a prospective adoption study. Discontinuation rates were: tobacco 22.2%, alcohol 64.7%, marijuana 77.2%, and other drugs, 73.7%–100%. Depression, anxiety, and novelty seeking were lower among women who discontinued substance use, compared to those who did not. Self-worth was higher in women who discontinued substance use. Among 110 polysubstance users, the number of substances discontinued during pregnancy was correlated with depression, anxiety, and self-worth in the hypothesized direction. Possible clinical implications are discussed.

Rhoades, K., A., Leve, L. D., Harold, G. T., Neiderhiser, J. M., Shaw, D. S., & Reiss, D. (2011). Longitudinal pathways from marital hostility to child anger during toddlerhood: Genetic susceptibility and indirect effects via harsh parenting. *Journal of Family Psychology, 25*, 282–291. PMC: 3084154

**Abstract:** We examined direct and indirect pathways from marital hostility to toddler anger/frustration via harsh parenting and parental depressive symptoms, with an additional focus on the moderating role of genetic influences as inferred from birth parent anger/frustration. Participants were 361 linked triads of birth mothers, adoptive parents, and adopted children who were 9 (T1) and 18 (T2) months old across the study period. Results indicated an indirect effect from T1 marital hostility to T2 toddler anger/frustration via T2 parental harsh discipline. Results also indicated that the association between marital hostility and toddler anger was moderated by birth mother anger/frustration. For children whose birth mothers reported high levels of anger/frustration, adoptive parents' marital hostility at T1 predicted toddler anger/frustration at T2. This relation did not hold for children whose birth mothers reported low levels of anger/frustration. The results suggest that children whose birth mothers report elevated frustration might inherit an emotional liability that makes them more sensitive to the effects of marital hostility.

Reiss, D., & Neiderhiser, J. M. (2011). Marital dynamics and child proaction: Genetics takes a second look at developmental theory. In K. A. Dodge & M. Rutter (Eds.), *Duke series in child development and public policy. Gene–environment interactions in developmental psychopathology* (pp. 105-120). New York, NY, US: Guilford Press.

## 2012

Lipscomb, S. T., Leve, L. D., Shaw, D. S., Neiderhiser, J. M., Scaramella, L. V., Ge, X., Conger, R. D., Reid, J. B., & Reiss, D. (2012). Negative emotionality and externalizing problems in toddlerhood: Overreactive parenting as a moderator of genetic influences. *Development and Psychopathology, 24*, 167–179. PMC: 3270900

**Abstract:** The current study examines the interplay between parental over reactivity and children's genetic backgrounds as inferred from birth parent characteristics on the development of negative emotionality during infancy, and in turn, to individual differences in externalizing problems in toddlerhood. The sample included 361 families linked through adoption (birth parents and adoptive families). Data were collected when the children were 9, 18, and 27 months old. Results indicated links between individual levels and changes in negative emotionality during infancy and toddlerhood to externalizing problems early in the third year of life. Findings also revealed an interaction between birth mother negative affect and adoptive mother overreactive parenting on children's negative emotionality. This Genotype x Environment interaction predicted externalizing problems indirectly through its association with negative emotionality and revealed stronger effects of genetic risk for children with less overreactive parenting from their mothers. Limitations of this study and directions for future research are discussed.

Massey, S. H., Neiderhiser, J. M., Shaw, D. S., Leve, L. D., Ganiban, J. M., & Reiss, D. (2012). Maternal self-concept as a provider and cessation of substance use during pregnancy. *Addictive Behaviors, 37*, 956–961. PMC: 3377383

**Abstract:** Self-concept is known to affect motivation to change substance use behaviors and may be particularly salient during pregnancy. To isolate psychological processes specific to pregnancy from psychological processes associated with the transition to parenthood, we examined a sample of birth mothers who made postnatal adoption placements. We hypothesized that self-concept as a provider would be related to cessation of tobacco, alcohol, and illicit drug use during pregnancy. We obtained lifetime and pregnancy substance use history and psychological measures at 3 to 4 months postpartum from 693 birth mothers using Life History Calendar and computer-assisted personal interviewing methods. Using logistic regression, we assessed the association of self-concept as an adequate provider with cessation of substance use during pregnancy, controlling for sociodemographic variables, depressive symptoms experienced during pregnancy, past year antisocial behaviors, familial substance abuse, timing of pregnancy recognition, and timing of initiation of prenatal care. More positive self-concept as an adequate provider was independently associated with cessation of substance use and earlier initiation of prenatal care during pregnancy. Familial substance abuse, depressive symptoms, and antisocial behaviors during pregnancy were inversely related to cessation. Maternal substance use during pregnancy is a common modifiable risk factor for poor birth outcomes, and is associated with long term

psychological risks to offspring. Enhancing maternal identity as a provider for the fetus during pregnancy, along with treatment of depression, may improve motivation to stop substance use.

Rhoades, K. A., Leve, L. D., Harold, G. T., Mannering, A. M., Neiderhiser, J. M., Shaw, D. S., Natsuaki, M. N., & Reiss, D. (2012). Marital hostility and child sleep problems: Direct and indirect associations via hostile parenting. *Journal of Family Psychology, 26*, 488–498. PMC: 3824960

**Abstract:** Sleep problems in early childhood are relatively common and are associated with later behavioral, affective, and cognitive problems. The current study examined two family process predictors of change in child sleep problems from 9 months to 4.5 years in an adoption sample: marital hostility and hostile parenting. Participants were 361 linked triads of birth mothers, adoptive parents, and adopted children. We examined direct and indirect pathways from marital hostility to child sleep via hostile parenting, whether child sleep problems were directly influenced by birth mother internalizing disorders (indicating genetic influences), and whether associations between marital hostility, hostile parenting, and child sleep problems were moderated by birth mother internalizing disorders. Hostile parenting at 27 months was associated with child sleep problems at 4.5 years, and a significant indirect effect was found from marital hostility to child sleep problems at 4.5 years via hostile parenting at 27 months. There was no direct effect from marital hostility at 9 months to child sleep problems at 4.5 years or for birth mother internalizing disorders on child sleep problems. The findings suggest targets for prevention/intervention programs that are potentially modifiable (e.g., hostile parenting, marital hostility), and inform theory by demonstrating that relations among marital hostility, hostile parenting, and child sleep problems are significant after accounting for the effects of shared genes among family members.

Stover, C. S., Connell, C., Leve, L. D., Neiderhiser, J. M., Shaw, D. S., Scaramella, L. V., Conger, R., & Reiss, D. (2012). Fathering and mothering in the family system: Linking marital hostility and aggression in adopted toddlers. *Journal of Child Psychology and Psychiatry, 53*, 401–409. PMC: 3279589

**Abstract:** Previous studies have linked marital conflict, parenting, and externalizing problems in early childhood. However, these studies have not examined whether genes account for these links nor have they examined whether contextual factors such as parental personality or financial distress might account for links between marital conflict and parenting. We used an adoption design to allow for a clear examination of environmental impact rather than shared genes of parents and children, and assessments of parental personality and financial strain to assess the effects of context on relationships between marriage and parenting of both mothers and fathers. Participants were 308 adoption-linked families comprised of an adopted child, her/his biological mother (BM), adoptive mother (AM), and father (AF). BMs were assessed 3 to 6 and 18 months postpartum and adoptive families were assessed when the child was 18 and 27 months old. Structural equations models were used to examine associations between marital hostility, fathers' and mothers' parenting hostility, and child aggressive

behavior at 27 months of age. Additionally the contribution of financial strain and adoptive parent personality traits was examined to determine the associations with the spillover of marital hostility to hostile parenting. A hostile marital relationship was significantly associated with hostile parenting in fathers and mothers, which were associated with aggressive behavior in toddlers. Subjective financial strain was uniquely associated with marital hostility and child aggression. Antisocial personality traits were related to a more hostile/conflicted marital relationship and to hostile parenting. Results clarify mechanisms that may account for the success of early parent-child prevention programs that include a focus on parental economic strain and personality in addition to parent training.

## 2013

Blozis, S. A., Ge, X., Xu, S., Natsuaki, M. N., Shaw, D. S., Neiderhiser, J. M., Scaramella, L. V., Leve, L. D., & Reiss, D. (2013). Sensitivity analysis of multiple informant models when data are not missing at random. *Structural Equation Modeling, 20*, 283–298. PMC: 4162658

**Abstract:** Missing data are common in studies that involve multiple informants to study relationships among individuals within groups. Structural equation modeling (SEM), routinely implemented, allows for incomplete data so that groups may be retained when at least one member contributes data. Missing data are assumed to be missing at random such that whether or not data are missing is independent of the missing data. Multiple imputation and a saturated correlates model that incorporate correlates of missing data into an analysis offer advantages over the standard implementation of SEM when data are not missing at random because these approaches may result in a data analysis problem for which the missingness is then ignorable. This paper considers these approaches in an analysis of family data to assess the sensitivity of parameter estimates to assumptions about missing data, a strategy that may be easily implemented using SEM software.

Gaysina, D., Fergusson, D. M., Leve, L. D., Horwood, J., Reiss, D., Shaw, D., Elam, K., Natsuaki, M. N., Neiderhiser, J. M., & Harold, G. T. (2013). Maternal smoking during pregnancy and offspring conduct problems: Evidence from 3 independent genetically sensitive research designs. *JAMA Psychiatry, 70*, 956–963. PMC: 3828999

**Abstract:** *Context:* A number of studies report an association between maternal smoking during pregnancy (MSDP) and offspring conduct disorder. However, past research evidences difficulty disaggregating prenatal environmental from genetic and postnatal environmental influences.

*Objective:* To examine the relationship between MSDP and offspring conduct problems in genetically-related and genetically-unrelated mother-child pairs. *Design, Setting, and Participants:* Three studies employing distinct but complementary research designs were utilized: The Christchurch Health and Development Study (CHDS) (a longitudinal cohort study that includes biological and adopted children), the Early Growth and Development Study (EGDS) (a longitudinal adoption at birth study), and the Cardiff IVF study (genetically-related and -unrelated families; adoption at conception). MSDP was measured as a number of average cigarettes/day (0, 1–9 or 10+) during pregnancy. A number of possible covariates (child gender, ethnicity, maternal age at birth, maternal education, family SES, family breakdown, birth weight and breast feeding (CHDS), placement age (EGDS), and parenting practices) were controlled in the model. *Main Outcome Measure:* Child conduct problems (age 4–10 years) reported by parents and/or teachers using the Rutter and Conners behavior scales (CHDS), the Child Behavior Checklist and Children's Behavior Questionnaire (EGDS), and the Strengths and Difficulties Questionnaire (Cardiff IVF study). *Results:* A significant dose-response



relationship between MSDP and child conduct problems was observed in both the genetically-related and genetically-unrelated (adoption at birth) mother-child pairs across three individual studies. The results of the meta-analysis confirmed these findings in the pooled samples. The association, however, was not observed in genetically-unrelated mother-child pairs (adoption at conception).

*Conclusions:* The findings across the three studies using a complement of research designs suggest that a dose-specific association between MSDP and child conduct problems is observed when passive gene–postnatal environment correlation is removed, but not when passive gene–prenatal environment correlation is removed.

Harold, G. T., Leve, L. D., Barrett, D., Elam, K., Neiderhiser, J. M., Natsuaki, M. N., Shaw, D. S., Reiss, D., & Thapar, A. (2013). Biological and rearing mother influences on child ADHD symptoms: Revisiting the developmental interface between nature and nurture. *Journal of Child Psychology and Psychiatry*, 54, 1038–1046. PMC: 3767192

**Abstract:** *Background:* Families of children with attention deficit hyperactivity disorder (ADHD) report more negative family relationships than families of children without ADHD. Questions remain as to the role of genetic factors underlying associations between family relationships and children's ADHD symptoms, and the role of children's ADHD symptoms as an evocative influence on the quality of relationships experienced within such families. Utilizing the attributes of two genetically sensitive research designs, the present study examined associations between biologically related and non-biologically related maternal ADHD symptoms, parenting practices, child impulsivity/activation, and child ADHD symptoms. The combined attributes of the study designs permit assessment of associations while controlling for passive genotype-environment correlation and directly examining evocative genotype-environment correlation (*r*GE); two relatively under examined confounds of past research in this area. *Methods:* A cross-sectional adoption-at-conception design (Cardiff IVF Study; C-IVF) and a longitudinal adoption-at-birth design (Early Growth and Development Study; EGDS) were used. The C-IVF sample included 160 mothers and children (age 5–8 years). The EGDS sample included 320 linked sets of adopted children (age 6 years), adoptive-, and biologically-related mothers. Questionnaires were used to assess maternal ADHD symptoms, parenting practices, child impulsivity/activation, and child ADHD symptoms. A cross-rater approach was used across measures of maternal behavior (mother reports) and child ADHD symptoms (father reports). *Results:* Significant associations were revealed between rearing mother ADHD symptoms, hostile parenting behavior, and child ADHD symptoms in both samples. Because both samples consisted of genetically-unrelated mothers and children, passive *r*GE was removed as a possible explanatory factor underlying these associations. Further, path analysis revealed evidence for evocative *r*GE processes in the longitudinal adoption-at-birth study (EGDS) from biologically related maternal ADHD symptoms to biologically unrelated maternal hostile parenting through early disrupted child behavior (impulsivity/activation), with maternal hostile parenting and disrupted child behavior associated with later child ADHD symptoms, controlling for concurrent adoptive mother ADHD symptoms. *Conclusions:* Results highlight the importance of genetically-

influenced child ADHD-related temperamental attributes on genetically unrelated maternal hostility that in turn links to later child ADHD symptoms. Implications for intervention programs focusing on early family processes and the precursors of child ADHD symptoms are discussed.

Harold, G. T., Leve, L. D., Elam, K. K., Thapar, A., Neiderhiser, J. M., Natsuaki, M. N., Shaw, D. S., & Reiss, D. (2013). The nature of nurture: Disentangling passive genotype-environment correlation from family relationship influences on children's externalizing problems. *Journal of Family Psychology, 27*, 12–21. PMC: 3576129

**Abstract:** The relationship between interparental conflict, hostile parenting, and children's externalizing problems is well established. Few studies, however, have examined the pattern of association underlying this constellation of family and child level variables while controlling for the possible confounding presence of passive genotype-environment correlation. Using the attributes of two genetically sensitive research designs, the present study examined associations between interparental conflict, parent-to-child hostility, and children's externalizing problems among genetically related and genetically unrelated mother-child and father-child groupings. Analyses were conducted separately by parent gender, thereby allowing examination of the relative role of the mother-child and father-child relationships on children's behavioral outcomes. Path analyses revealed that for both genetically related and genetically unrelated parents and children, indirect associations were apparent from interparental conflict to child externalizing problems through mother-to-child and father-to-child hostility. Associations between interparental conflict and parent-to-child hostility across genetically related and genetically unrelated parent-child groupings were significantly stronger for fathers compared to mothers. Results are discussed with respect to the role of passive genotype-environment correlation as a possible confounding influence in interpreting research findings from previous studies conducted in this area. Implications for intervention programs focusing on family process influences on child externalizing problems are also considered.

Kerr, D. C. R., Leve, L. D., Harold, G. T., Natsuaki, M. N., Neiderhiser, J. M., Shaw, D. S., & Reiss, D. (2013). Influences of biological and adoptive mothers' depression and antisocial behavior on adoptees' early behavior trajectories. *Journal of Abnormal Child Psychology, 41*, 723–764. PMC: 3681846

**Abstract:** Depression and antisocial behavior are important public health problems. The degree to which parent psychopathology influences the early manifestation and course of these problems in children via genetic and/or environmental mechanisms is unclear. We estimated the influence of maternal depression and antisocial behavior on level and change in child externalizing and internalizing behaviors across early childhood using data from a prospective adoption study. Participants were 346 matched triads of physically healthy children, biological mothers (BM), and adoptive mothers (AM). Latent growth curve models were estimated using AM reports of child internalizing and externalizing behaviors at ages 18, 27, and 54 months. Child outcome growth factors

were regressed on BM lifetime histories of major depressive disorder (MDD) and adult antisocial behavior assessed by interview, and AM self-reported depressive symptoms and antisocial behavior. Mediation of genetic effects was tested via BM reported obstetric complications and adoptive father-reported child temperament at age 9 months. Both child problem types showed linear increases over time. Predictors of intercept (18 months) but not slope were identified. BM MDD and antisocial behavior predicted child externalizing and internalizing behavior, respectively, and AM depressive symptoms and antisocial behavior predicted both child outcomes. Child temperament and obstetric complications did not explain BM effects. This adoption study distinguished risks conferred by biological mothers' depression and antisocial behavior to children's behaviors from those associated with adoptive mothers' related symptoms. Future studies should examine gene-environment interplay to explain the emergence of serious problem trajectories in later childhood.

Laurent, H. K., Leve, L. D., Neiderhiser, J. M., Natsuaki, M. N., Shaw, D. S., Harold, G. T., & Reiss, D. (2013). Effects of prenatal and postnatal parent depressive symptoms on adopted child HPA regulation: Independent and moderated influences. *Developmental Psychology, 49*, 876–886. PMC: 3820365

**Abstract:** This study used a prospective adoption design to investigate effects of prenatal and postnatal parent depressive symptom exposure on child hypothalamic-pituitary-adrenal (HPA) activity and associated internalizing symptoms. Birth mother prenatal symptoms and adoptive mother/father postnatal (9-month, 27-month) symptoms were assessed with the Beck Depression Inventory in a sample of 192 families as part of the Early Growth and Development adoption Study. Child morning/evening cortisol levels and child symptoms of internalizing disorders (according to mother/father report on the Child Behavior Checklist) were assessed at 54 months, and birth mother diurnal cortisol was measured at 48 months postnatal. Hierarchical linear modeling was used to test main effects and interactions of parents' symptoms predicting child cortisol, controlling for birth mother cortisol (inherited risk). Prenatal exposure to birth mother symptoms predicted lower child cortisol (main effect), as did postnatal exposure to adoptive parent symptoms (interaction effects). Adoptive mother 9-month symptoms exacerbated cortisol-lowering effects of both concurrent paternal symptoms and later (27-month) maternal symptoms, and the effect of birth mother cortisol. Lower child cortisol, in turn, was associated with higher child internalizing symptoms. Implications are discussed with respect to the intergenerational transmission of depression risk.

Laurent, H. K., Leve, L. D., Neiderhiser, J. M., Natsuaki, M. N., Shaw, D. S., Fisher, P. A., Marceau, K., Harold, G. T., & Reiss, D. (2013). Effects of parental depressive symptoms on child adjustment moderated by Hypothalamic Pituitary Adrenal activity: Within- and between-family risk. *Child Development, 84*, 528–542. PMC: 3532571

**Abstract:** We investigated child hypothalamic-pituitary-adrenal (HPA) activity as a moderator of parental depressive symptom effects on child problem behaviors in an

adoption sample ( $N = 210$  families). Adoptive parents' depressive symptoms and child internalizing/externalizing were assessed when children were 18, 27, and 54 months, and child morning/evening HPA activity was measured through salivary cortisol at 54 months. Children's daily cortisol levels and day-to-day variability were tested as moderators of longitudinal associations between parent and child symptoms at within- and between-family levels. Mothers' symptoms related directly to child internalizing, but child evening cortisol moderated effects of fathers' symptoms on internalizing, and of both parents' symptoms on externalizing. Different paths of within-family risk dynamics vs. between-family risk synergy were found for internalizing vs. externalizing outcomes.

Leve, L. D., DeGarmo, D. S., Bridgett, D. J., Neiderhiser, J. M., Shaw, D. S., Harold, G. T., Natsuaki, M. N., & Reiss, D. (2013). Using an adoption design to separate genetic, prenatal, and temperament influences on toddler executive function. *Developmental Psychology, 49*, 1045–1057. PMC: 3509265

**Abstract:** Poor executive functioning has been implicated in children's concurrent and future behavioral difficulties, making work aimed at understanding processes related to the development of early executive function (EF) critical for models of developmental psychopathology. Deficits in EF have been associated with adverse prenatal experiences, genetic influences, and temperament characteristics. However, research has had limited ability to disentangle their effects due to limitations inherent to biological parent-child research designs. The present study examined EF and language development in a sample of 361 toddlers who were adopted at birth and reared in non-relative adoptive families. Predictors included genetic and prenatal influences as inherited from birth mothers, and child negative emotionality. Structural equation modeling indicated that the effects of prenatal risk on toddler effortful attention at age 27 months became nonsignificant once genetic influences were considered in the models. In addition, genetic influences had unique effects on toddler effortful attention and language development. Latent growth modeling indicated that increases in toddler negative emotionality from 9 to 27 months were associated with poorer delay of gratification and poorer language development. Mechanisms of intergenerational transmission of EF deficits are discussed.

Leve, L. D., Neiderhiser, J. M., Shaw, D. S., Ganiban, J., Natsuaki, M. N., & Reiss, D. (2013). The Early Growth and Development Study: A prospective adoption study of child behavior from birth through middle childhood. *Twin Research and Human Genetics, 16*, 412–423. PMC: 3572752

**Abstract:** The Early Growth and Development Study is a prospective adoption study of birth parents, adoptive parents, and adopted children recruited in two cohorts ( $N = 561$  triads). The primary study aims are to examine how family, peer, and contextual processes affect children's adjustment, and to examine their interplay (mediation, moderation) with genetic influences. Participants were recruited through adoption agencies located throughout the United States following the birth of a child. Assessments are ongoing, in 9-month intervals until the child reaches 3 years of age and in one-year intervals thereafter through age 9. Data collection includes the following

primary constructs: child temperament, social behavior, school performance, mental health, and health; birth and adoptive parent personality characteristics, mental health, competence, stress, health, context, substance use, parenting, and marital relations; and pregnancy use of drugs and maternal stress during pregnancy. DNA and salivary cortisol samples have also been collected. Analyses have indicated evidence for genotype-environment interactions during early childhood. Study procedures, sample representativeness (including tests of potential confounds in the adoption design), and an overview of findings to date are summarized, and future plans are described.

Lipscomb, S. T., Laurent, H., Neiderhiser, J. M., Shaw, D. S., Natsuaki, M. N., Reiss, D., & Leve, L. D. (2013). Genetic vulnerability interacts with parenting and early care education to predict increasing externalizing behavior. *International Journal of Behavioral Development*, 38, 70–80. PMC: 4109820

**Abstract:** The current study examined interactions among genetic influences and children's early environments on their development of externalizing behaviors during the formative early childhood years. The sample included 361 families linked through adoption (birth parents and adoptive families). Data were collected when the children were ages 9, 18, and 27 months, and 4.5 and 6 years old. Genetic influences were assessed by birth parent temperamental regulation. Early environments included both family (overreactive parenting) and out-of-home (exposure to center-based Early Care and Education programs; ECE). Overreactive parenting predicted more externalizing behaviors as a time-varying predictor. Attending center-based ECE was associated with increasing externalizing behaviors only for children with a genetic liability for dysregulation. Additionally, children who were at risk for externalizing behaviors due to both genetic variability *and* exposure to center-based ECE were more sensitive to the effects of over-reactive parenting on externalizing behavior than other children.

Marceau, K., Hajal, N., Leve, L. D., Reiss, D., Shaw, D., Ganiban, J. M., Mayes, L. C., & Neiderhiser, J. M. (2013). Measurement and associations of pregnancy risk factors with genetic influences, postnatal environmental influences, and toddler behavior. *International Journal of Behavior Development*, 37, 366–375. PMC: 4018759

**Abstract:** Measuring pregnancy complications is important for developmental studies seeking to clarify genetic and postnatal environmental influences on children's behavioral development. This study presents a comprehensive measure of pre- and perinatal risk factors, the Pregnancy Risk Index, and demonstrates the utility of using aggregates of prenatal risk when studying child behavior. The sample is 561 domestic U.S. adoption triads (birth mothers, 18-month-old adopted child, and adoptive parents). Findings show associations between distinct types of aggregate pregnancy risk and measured genetic risk. Toddler behavior varied with different types of pregnancy risk. Genetic influences on toddler behavior may operate through pregnancy risk, whereas postnatal environmental influences are distinct.

Marceau, K., Ram, N., Neiderhiser, J. M., Laurent, H. K., Shaw, D. S., Fisher, P. A., Natsuaki, M. & Leve, L. D. (2013). Disentangling the effects of genetic, prenatal, and parenting influences on children's cortisol. *Stress, 16*, 607–615. PMC: 3928628

**Abstract:** Developmental plasticity models hypothesize the role of genetic and prenatal environmental influences of the development of the hypothalamic-pituitary-adrenal (HPA) axis and highlight the potential for the organizational influences of genes and the prenatal environment to moderate early postnatal environmental influences on HPA functioning. This article examines the interplay of genetic, prenatal, and parenting influences across the first 4.5 years of life on a novel index of children's HPA flexibility at 4.5 years of age using repeated measures of cortisol across three days. Data were obtained from 210 adoption-linked families, adopted children and both their adoptive parents and birth mothers, who participated in a longitudinal, prospective US domestic adoption study. Genetic and prenatal influences moderated associations between within-person changes in over-reactive parenting influences from 9 months to 4.5 years of age and children's HPA flexibility at age 4.5 years in different ways for mothers and fathers' parenting. Findings supported developmental plasticity models and uncovered novel developmental, gene X environment, and prenatal X environment influences on children's cortisol functioning.

Natsuaki, M. N., Leve, L. D., Harold, G. T., Neiderhiser, J. M., Shaw, D. S., Ganiban, J., Scaramella, L. V., & Reiss, D. (2013). Transactions between child social wariness and observed structured parenting: Evidence from a prospective adoption study. *Child Development, 84*, 1750–1765. PMC: 3675176

**Abstract:** This investigation examined the mutual influences between structured parenting and child social wariness during toddlerhood using a longitudinal adoption design. The sample consisted of 361 adoption-linked families, each including an adopted child, adoptive parents, and a birth mother. Heightened social wariness in children at age 18 months predicted reduced levels of observed structured parenting (i.e., less directive parenting with fewer commands and requests) in adoptive mothers at age 27 months. Adoptive fathers' lower structured parenting at age 18 months predicted subsequent elevation in child social wariness. Birth mothers' history of fear-related anxiety disorders was not associated with child social wariness. Findings highlight the role of dynamic family transactions in the development of social wariness during toddlerhood.

Natsuaki, M. N., Leve, L. D., Neiderhiser, J. M., Shaw, D. S., Scaramella, L. V., Ge, X., & Reiss, D. (2013). Intergenerational transmission of risk for social inhibition: The interplay between parental responsiveness and genetic influences. *Development and Psychopathology, 25*, 261–274. PMC: 3576856

**Abstract:** To better understand mechanisms underlying the intergenerational transmission of social anxiety, we used a prospective adoption design to examine the

roles of genetic influences (inferred from birth mothers' social phobia) and rearing environment (adoptive mothers' and fathers' responsiveness) on the development of socially inhibited, anxious behaviors in children between 18 and 27 months of age. The sample consisted of 275 adoption-linked families, each including an adopted child, adoptive parents, and a birth mother. Results indicated that children whose birth mothers met criteria for the diagnosis of social phobia showed elevated levels of observed behavioral inhibition in a social situation at 27 months of age if their adoptive mothers provided less emotionally and verbally responsive rearing environments at 18 months of age. Conversely, in the context of higher levels of maternal responsiveness, children of birth mothers with a history of social phobia did not show elevated levels of behavioral inhibition. These findings on maternal responsiveness were replicated in a model predicting parent reports of child social anxiety. The findings are discussed in terms of genotype x environment interactions in the intergenerational transmission of social anxiety.

Reiss, D. Leve, L. D., & Neiderhiser, J. M. (2013). How genes and the social environment moderate each other. *American Journal of Public Health, 103*, S111–S121. PMC: 3778406

**Abstract:** Recent research suggests that the social environment can moderate the expression of genetic influences on health and that genetic influences can shape an individual's sensitivity to the social environment. Evidence supports four major mechanisms: genes can influence an individual's response to stress in the environment, genes may enhance an individual's sensitivity to both favorable and adverse environments, inherited characteristics may better fit with some environments than with others, and inherited capabilities may only become manifest in challenging or responsive environments. Further progress depends on better recognition of patterns of interaction between genes and the environment, improved methods of assessing the environment and its impact on genetic mechanisms, the use of appropriately designed laboratory studies, identification of heritable differences in receptor or effector systems before environmental moderation occurs, and clarification of the timing of the impact of social and genetic moderation.

## 2014

Brooker, R. J., Neiderhiser, J. M., Ganiban, J. M., Leve, L. D., Shaw, D. S., & Reiss, D. (2014). Birth and adoptive parent anxiety symptoms moderate the link between infant attention control and internalizing problems in toddlerhood. *Development and Psychopathology, 26*, 347–359. PMC: 3981904

**Abstract:** Attention control plays an important role in the development of internalizing symptoms in children. We explored the degree to which infant genetic- and environmentally-based risk moderated the link between attention control and internalizing problems during toddlerhood. These associations were examined within a prospective adoption design, enabling the disentanglement of genetic and environmental risk for internalizing problems. Attention control in adopted infants was observed during periods of distress at age 9 months. Birth parents' anxiety symptoms were used as an index of genetic risk, while adoptive parents' anxiety symptoms were used as an index of environmental risk. Adoptive mothers and fathers reported on children's internalizing problems when children were 18- and 27-months old. Greater attention control in infancy appeared to mitigate genetically-based risk for internalizing problems during toddlerhood when children were raised by adoptive parents who were low in anxiety. Findings suggest that for genetically-susceptible children who are raised in low-risk environments, attention control may provide a protective factor against developing internalizing problems across early life.

Elam, K. K., Harold, G. T., Neiderhiser, J. M., Reiss, D., Shaw, D. S., Natsuaki, M. N., Gaysina, D., Barrett, D., & Leve, L. D. (2014). Adoptive parent hostility and children's peer behavior problems: Examining the role of genetically informed child attributes on adoptive parent behavior. *Developmental Psychology, 50*, 1543–1542. PMC: 4113003

**Abstract:** Socially disruptive behavior during peer interactions in early childhood is detrimental to children's social, emotional, and academic development. Few studies have investigated social behavior using genetically-sensitive designs that allow examination of evocative genotype-environment correlations underlying family process and child outcome associations. Using an adoption at birth design, the present study controlled for passive genotype-environment correlation and examined the evocative effect of genetic influences on toddler inattention on mother-to-child and father-to-child hostility, and the subsequent influence of hostility on disruptive peer behavior during the preschool period. Participants were 316 linked triads of birth mothers, adoptive parents, and adopted children. Path analysis showed that birth mother under arousal predicted toddler inattention, which predicted both mother-to-child and father-to-child hostility, suggesting the presence of an evocative genotype-environment association. In addition, both mother-to-child and father-to-child hostility predicted children's later disruptive peer behavior. Results are discussed with respect to the role of evocative and passive genotype-environment correlation in past research examining family processes and child outcomes.



Laurent, H. K., Neiderhiser, J. M., Natsuaki, M. N., Shaw, D. S., Reiss, D., Fisher, P. A., & Leve, L. D. (2014). Stress system development from age 4.6 to 6: Family environment predictors and adjustment implications of HPA stability versus change. *Developmental Psychobiology*, *56*, 340–354. PMC: 3883974

**Abstract:** This study addressed early calibration of stress systems by testing links between adversity exposure, developmental stability of hypothalamic-pituitary-adrenal (HPA) axis activity, and behavior problems in a sample of adopted children. Families ( $N = 200$ ) were assessed when the child was 9 mos., 18 mos., 27 mos., 4.5 yrs., and 6 yrs. to collect adversity information—parent psychopathology, stress, financial need, and home chaos. Morning and evening cortisol samples at the final 2 assessments indexed child HPA activity, and parent-reported internalizing and externalizing at the final assessment represented child behavior outcomes. Change in cumulative adversity from 4.5–6 related to higher child morning cortisol, whereas age 6 cumulative adversity related to lower, unstable child evening cortisol. Examination of specific adversity dimensions revealed associations between (1) increasing home chaos and stable morning cortisol, which in turn related to internalizing problems; and (2) high parental stress and psychopathology and lower, unstable evening cortisol, which in turn related to externalizing problems.

Natsuaki, M. N., Shaw, D. S., Neiderhiser, J. M., Ganiban, J. M., Harold, G. T., Reiss, D., & Leve, L. D. (2014). Raised by depressed parents: Is it an environmental risk? *Clinical Child and Family Psychology Review*, *17*, 357–367. PMC: 4224978

**Abstract:** The mechanisms explaining how parental depression compromises healthy child development are complex and multifaceted, with genetic and environmental pathways intertwined. Reexamination of whether and how maternal and paternal depression serve as environmental risk factors is important because such an investigation can be helpful to identify modifiable mechanisms that are accessible to interventions. We review studies that have employed designs that isolate the effects of the environment from genetic influences, including adoption studies and children of twin's studies. Findings indicate that maternal depression is an environmental risk factor for the emotional, behavioral, and neurobiological development of children. Although more studies are needed, preliminary findings suggest that paternal depression appears to be a weaker environmental risk as compared to maternal depression, at least during infancy and toddlerhood. Implications for theory and future research are discussed.

## 2015

Beekman, C., Neiderhiser, J. M., Buss, K. A., Loken, E., Moore, G. A., Leve, L. D., Ganiban, J. M., Shaw, D. S., & Reiss, D. (2015). The development of early profiles of temperament: Characterization, continuity, and etiology. *Child Development, 86*(6), 1794–1811. PMC: 4562331

**Abstract:** This study used a data-driven, person-centered approach to examine the characterization, continuity, and etiology of child temperament from infancy to toddlerhood. Data from 561 families who participated in an ongoing prospective adoption study, the Early Growth and Development Study, were used to estimate latent profiles of temperament at 9, 18, and 27 months. Results indicated that four profiles of temperament best fit the data at all three points of assessment. The characterization of profiles was stable over time while membership in profiles changed across age. Facets of adoptive parent and birth mother personality were predictive of children's profile membership at each age, providing preliminary evidence for specific environmental and genetic influences on patterns of temperament development from infancy to toddlerhood.

Brooker, R. J., Neiderhiser, J. M., Leve, L. D., Shaw, D. S., Scaramella, L., & Reiss, D. (2015). Associations between infant negative affect and parent anxiety symptoms are bidirectional: Evidence from mothers and fathers. *Frontiers in Psychology, 6*, 1875. doi: 10.3389/fpsyg.2015.01875. PMC: 4667033

**Abstract:** Little is known about child-based effects on parents' anxiety symptoms early in life despite the possibility that child characteristics may contribute to the quality of the early environment and children's own long-term risk for psychological disorder. We examined bidirectional effects between parent anxiety symptoms and infant fear-based negative affect using a prospective adoption design. Infant fear-based negative affect and adoptive parent anxiety symptoms were assessed at child ages 9, 18, and 27 months. Birth parent negative affect was assessed at child age 18 months. More anxiety symptoms in adoptive parents at child age 9 months predicted more negative affect in infants 9 months later. More infant negative affect at child age 9 months predicted more anxiety symptoms in adoptive parents 18 months later. Patterns of results did not differ for adoptive mothers and adoptive fathers. Birth parent negative affect was unrelated to infant or adoptive parent measures. Consistent with expectations, associations between infant negative affect and rearing parents' anxiety symptoms appear to be bidirectional. In addition to traditional parent-to-child effects, our results suggest that infants' characteristics may contribute to parent qualities that are known to affect childhood outcomes.

Brotnow, L., Reiss, D., Stover, C. S., Ganiban, J., Leve, L. D., Neiderhiser, J. M., Shaw, D. S., & Stevens, H. E. (2015). Expectant mothers maximizing opportunities: Maternal characteristics moderate multifactorial prenatal stress in the prediction

of birth weight in a sample of children adopted at birth. *PLOS ONE*, 10 (11): e0141881. doi:10.1371/journal. Pone. PMC: 4636431

**Abstract:** *Background:* Mothers' stress in pregnancy is considered an environmental risk factor in child development. Multiple stressors may combine to increase risk, and maternal personal characteristics may offset the effects of stress. This study aimed to test the effect of (a) multifactorial prenatal stress, integrating objective "stressors" and subjective "distress," and (b) the moderating effects of maternal characteristics (perceived social support, self-esteem, and specific personality traits) on infant birthweight. *Method:* Hierarchical regression modeling was used to examine cross-sectional data on 403 birth mothers and their newborns from an adoption study. *Results:* Distress during pregnancy showed a statistically significant association with birthweight,  $R^2 = 0.032$ ,  $F(2, 398) = 6.782$ ,  $p = .001$ . The hierarchical regression model revealed an almost two-fold increase in variance of birthweight predicted by stressors as compared with distress measures,  $R^2\Delta = 0.049$ ,  $F(4, 394) = 5.339$ ,  $p < .001$ . Further, maternal characteristics moderated this association,  $R^2\Delta = 0.031$ ,  $F(4, 389) = 3.413$ ,  $p = .009$ . Specifically, the expected benefit to birthweight as a function of higher SES was observed only for mothers with lower levels of harm-avoidance and higher levels of perceived social support. The results were not better explained by prematurity, pregnancy complications, or exposure to drugs, alcohol, or environmental toxins. *Conclusions:* The findings support multidimensional theoretical models of prenatal stress. Although both objective stressors and subjectively measured distress predict birthweight, they should be considered distinct and cumulative components of stress. This study further highlights that jointly considering risk factors and protective factors in pregnancy improves the ability to predict birthweight.

Fearon, P., Reiss, D., Leve, L. D., Shaw, D. S., Scaramella, L. V., Ganiban, J. M., & Neiderhiser, J. M. (2015). Child evoked maternal negativity from 9 to 27 months: Evidence of gene-environment correlation and its moderation by marital distress. *Development and Psychopathology*, 27(4), 1251–1265. PMC: 436274

**Abstract:** Past research has documented pervasive genetic influences on emotional and behavioral disturbance across the lifespan and on liability to adult psychiatric disorder. Increasingly, interest is turning to mechanisms of gene-environment interplay in attempting to understand the earliest manifestations of genetic risk. We report findings from a prospective adoption study, which aimed to test the role of evocative gene-environment correlation in early development. 561 infants adopted at birth were studied between 9 and 27 months with their adoptive parents and birth mothers. Birth mother psychiatric diagnoses and symptoms scales were used as indicators of genetic influence, and multiple self-report measures were used to index adoptive mother parental negativity. We hypothesized that birth mother psychopathology would be associated with greater adoptive parent negativity, and that such evocative effects would be amplified under conditions of high adoptive family adversity. The findings suggested that genetic factors associated with birth mother externalizing psychopathology may evoke negative reactions in adoptive mothers in the first year of

life, but only when the adoptive family environment is characterized by marital problems. Maternal negativity mediated the effects of genetic risk on child adjustment at 27 months. The results underscore the importance of genetically-influenced evocative processes in early development.

Hajal, N. J., Neiderhiser, J. M., Moore, G. A., Leve, L. D., Shaw, D. S., Harold, G. T., Scaramella, L. V., Ganiban, J. M., & Reiss, D. (2015). Angry responses to infant challenges: Parent, marital, and child genetic factors associated with harsh parenting. *Child Development, 86*, 80–93. PMC: 4331203

**Abstract:** We examined whether positive child-, parent-, and family-level characteristics were associated with harsh parenting in families with 9-month-olds ( $N = 561$ ). We were particularly interested in examining evocative gene-environment correlation ( $rGE$ ) by testing the effect of birth parent temperament on adoptive parents' harsh parenting. Additionally, we examined associations among adoptive parents' own temperaments, marital relationship quality, and parenting. Adoptive fathers' harsh parenting was inversely related to marital quality and to birth mother positive temperament, indicating evocative  $rGE$ . Adoptive mothers' and fathers' negative temperaments were also associated with harsh parenting. Findings suggest the importance of enhancing positive family characteristics in addition to mitigating negative characteristics, as well as engaging multiple levels of the family system to prevent harsh parenting.

Mammen, M. A., Moore, G. A., Scaramella, L. V., Reiss, D., Ganiban, J. M., Shaw, D. S., Leve, L. D., & Neiderhiser, J. M. (2015). Infant avoidance during a tactile task predicts Autism Spectrum behaviors in toddlerhood. *Infant Mental Health Journal, 36*, 575–587. PMC: 4715575

**Abstract:** The experience of touch is critical for early communication and social interaction; infants who show aversion to touch may be at risk for atypical development and behavior problems. The current study aimed to clarify predictive associations between infant responses to tactile stimuli and toddler autism spectrum, internalizing, and externalizing behaviors. This study measured 9-month-old infants' ( $N = 561$ ; 58% male) avoidance and negative affect during a novel tactile task in which parents painted infants' hands and feet and pressed them to paper to make a picture. Parent reports on the Pervasive Developmental Problems (PDP), Internalizing, and Externalizing scales of the Child Behavior Checklist were used to measure toddler behaviors at 18 months. Infant observed avoidance and negative affect were significantly correlated; however, avoidance predicted subsequent PDP scores only, independent of negative affect, which did not predict any toddler behaviors. Findings suggest that incorporating measures of responses to touch in the study of early social interaction may provide an important and discriminating construct for identifying children at greater risk for social impairments related to autism spectrum behaviors.

Marceau, K., Laurent, H. K., Neiderhiser, J. M., Reiss, D., Shaw, D. S., Natsuaki, M. N., Fisher, P. A., & Leve, L. D. (2015). Combined influences of genes, prenatal

environment, cortisol, and parenting on the development of children's internalizing vs. externalizing problems. Special issue of *Behavior Genetics* on "Gene-hormone interplay," 45(3), 268–282. PMC: 4416104

**Abstract:** Research suggests that genetic, prenatal, endocrine, and parenting influences across development individually contribute to internalizing and externalizing problems in children. The present study tests the contributions of genetic risk for psychopathology, prenatal maternal drug use and internalizing symptoms, child cortisol at age 4.5 years, and overreactive parenting influences across childhood together on 6-year-old children's internalizing and externalizing problems. An adoption design was used that included 361 domestically adopted children and both biological and adopted parents prospectively followed from birth. Genetic and parenting influences contributed independently to externalizing, and that prenatal risk and cortisol did not mediate genetic or parenting influences on child externalizing problems. However, genetic and parenting factors were both directly and indirectly associated with internalizing problems (through increased prenatal risk and subsequent morning cortisol). Results suggest that prenatal and morning cortisol levels are mechanisms of genetic and environmental influences on internalizing problems, but not externalizing problems in childhood.

McAdams, T. A., Rijdsdijk, F. R., Neiderhiser, J. M., Narusyte, J., Shaw, D. S., Natsuaki, M. N., Spotts, E. L., Ganiban, J. M., Reiss, D., Leve, L. D., Lichtenstein, P., & Eley, T. C. (2015). The relationship between parental depressive symptoms and offspring psychopathology: Evidence from a children-of-twins study and an adoption study. *Psychological Medicine*, 45(12), 2583–2594. PMC: 4523449

**Abstract: Background:** Parental depressive symptoms are associated with emotional and behavioral problems in offspring. However, genetically-informative studies are required to distinguish potential effects from familial confounds, and longitudinal studies are required to distinguish parent-to-child effects from child-to-parent effects.

**Method:** We conducted cross-sectional analyses on a sample of Swedish twins and their adolescent offspring ( $N = 876$  twin families), and longitudinal analyses on a US sample of children adopted at birth, their adoptive parents, and their birth mothers ( $n = 361$  adoptive families). Depressive symptoms were measured in parents and externalizing, and internalizing problems measured in offspring. Structural Equation models were fitted to the data.

**Results:** Results of model fitting suggest that associations between parental depressive symptoms and offspring internalizing and externalizing problems remain after accounting for genes shared between parent and child. Evidence for genetic transmission appeared stronger for the relationship between parental depressive symptoms and youth externalizing problems. Child-to-parent effects were evident in the longitudinal adoption study.

**Conclusions:** We interpret the results as demonstrating that associations between parental depressive symptoms and offspring emotional and behavioral problems are not solely attributable to shared genes, that bidirectional effects may be present in intergenerational associations, and that adult depressive symptoms may share greater genetic overlap with child externalizing than with child internalizing.

Reuben, J. D., Shaw, D. S., Neiderhiser, J. M., Natsuaki, M. N., Reiss, D., & Leve, L. D. (2015). Warm parenting and effortful control in toddlerhood: Independent and interactive predictors of school-age externalizing behavior. *Journal of Abnormal Child Psychology*. Online first. doi: 10.1007/s10802-015-0096-6

**Abstract:** Externalizing symptoms, such as aggression, impulsivity, and inattention, represent the most common forms of childhood maladjustment (Campbell, Shaw, & Gilliom, 2000). Several dimensions of parenting during early childhood have been linked to children's conduct problems (e.g., rejecting, overcontrol), including warm parenting. However, the majority of these studies involve biologically-related family members, thereby limiting understanding of the role of genetic and/or environmental underpinnings of parenting on child psychopathology. This study extends previous research by exploring associations between overreactive and warm parenting during toddlerhood and school-age externalizing problems, as well as the potential moderating effects of child effortful control (EC) on such associations using a longitudinal adoption design. The sample consisted of 361 adoption-linked families (adoptive parents, adopted child, and birth parent[s]), thereby allowing for a more precise estimate of environmental influences on the association between parenting and child externalizing problems. Adoptive mothers' warm parenting at 27 months predicted lower levels of child externalizing problems at ages 6 and 7. Child EC moderated this association in relation to teacher reports of school-age externalizing problems. Findings corroborate prior research with biological families that were not designed to unpack genetic and environmental influences on associations between parenting and child externalizing problems during childhood, highlighting the important role of parental warmth as an environmental influence.

Roben, C., Moore, G., Cole, P., Molenaar, P., Leve, L. D., Shaw, D., Reiss, D., & Neiderhiser, J. (2015). Transactional patterns of maternal depressive symptoms and mother-child interactions in an adoption sample. *Infant and Child Development*, 24, 322-342. PMC: 4498674

**Abstract:** Transactional models of analysis can examine both moment-to-moment interactions within a dyad and dyadic pattern of influence across time. This study used data from a prospective adoption study to test a transactional model of parental depressive symptoms and the dyadic interactional quality between mother and child over time, utilizing contingency analysis of second-by-second behavioral data. In order to consider both genetic and environmental influences on the dyadic interaction, depressive symptoms were examined in both adoptive and birth mothers, and the moment-to-moment quality of the adoptive mother and child interaction was assessed in toddlerhood. Adoptive mother depressive symptoms at 9 months increased the likelihood that, at 18 months, children reacted negatively to their mothers' negative behavior, which in turn predicted higher levels of adoptive mother depressive symptoms at 27 months, suggesting that over time mother depressive symptoms influence and are influenced by the quality of the moment-to-moment interaction with her toddler. Birth mother depressive symptoms moderated the association between the dyadic interaction

at 18 months and adoptive mother depressive symptoms at 27 months, suggesting a child-driven contribution to the mother-child interaction that can be measured by a genetic vulnerability.

Stover, C. S., Zhou, Y., Leve, L. D., Neiderhiser, J. M., Shaw, D. S., & Reiss, D. (2015). The relationship between genetic attributions, appraisals of birth mothers' health, and the parenting of adoptive mothers and fathers. *Journal of Applied Developmental Psychology, 41*, 19–27. PMC: 4547608

**Abstract:** Parenting beliefs and attributions can influence parenting behavior. We used an adoption design to examine the associations among perinatal risk and poor birth mother health, adoptive parent appraisals of birth mothers' mental health, and genetic attributions to adoptive parents' feelings and behaviors toward their adopted infants. A sample of 361 pairs of adoptive parents and birth mothers were interviewed using standardized measures when infants were between 4 and 9 months old. Adoptive mothers and fathers were observed during play tasks when their infants were 9 months old. We found that adoptive mothers' and fathers' appraisals of birth mothers' health were associated with perinatal risk and poor birth mother health. Adoptive mothers' appraisals were linked to hostile parenting, after accounting for characteristics of the child that may influence her appraisals and attributions. These associations were not present for adoptive fathers. Genetic attributions were associated with both adoptive mother and fathers' feelings of daily hassles in parenting. These findings have implications for prevention and intervention.

Van Ryzin, M. J., Leve, L. D., Neiderhiser, J. M., Shaw, D. S., Natsuaki, M. N., & Reiss, D. (2015). Genetic influences can protect against unresponsive parenting in the prediction of child social competence. *Child Development, 86*(3), 667–680. PMC: 4428976

**Abstract:** Although social competence in children has been linked to the quality of parenting, prior research has typically not accounted for genetic similarities between parents and children, or for interactions between environmental (i.e., parental) and genetic influences. In this paper, we evaluate the possibility of a gene-by-environment (G×E) interaction in the prediction of social competence in school-age children. Using a longitudinal, multi-method dataset from a sample of children adopted at birth ( $N = 361$ ), we found a significant interaction between birth parent sociability and sensitive, responsive adoptive parenting when predicting child social competence at school entry (age 6), even when controlling for potential confounds. An analysis of the interaction revealed that genetic strengths can buffer the effects of unresponsive parenting.

## 2016

Brooker, R., Alto, K., Marceau, K., Najjar, R., Leve, L., Ganiban, J., Shaw, D., Reiss, D., & Neiderhiser, J. (2016). *Early inherited risk for anxiety moderates the association between father's child-centered parenting and early social inhibition. Journal of Developmental Origins of Health and Disease, 7*, 602-615.

**Abstract:** Studies of the role of the early environment in shaping children's risk for anxiety problems have produced mixed results. It is possible that inconsistencies in previous findings result from a lack of consideration of a putative role for genetic moderators on the impact of early experiences. Genes not only contribute to vulnerabilities for anxiety problems throughout the lifespan, but can also modulate the ways that the early environment impacts child outcomes. In the current study, we tested the effects of child-centered parenting behaviors on putative anxiety risk in young children who differed in levels of inherited vulnerability. We tested this using a parent-offspring adoption design and a sample in which risk for anxiety problems and parenting behaviors were assessed in both mothers and fathers. Inherited influences on anxiety problems were assessed as anxiety symptoms in biological parents. Child-centered parenting was observed in adoptive mothers and fathers when children were 9 months old. Social inhibition, an early temperament marker of anxiety risk, was observed at child ages 9 and 18 months. Inherited influences on anxiety problems moderated the link between paternal child-centered parenting during infancy and social inhibition in toddlerhood. For children whose birth parents reported high levels of anxiety symptoms, greater child-centered parenting in adoptive fathers was related to greater social inhibition 9 months later. For children whose birth parents reported low levels of anxiety symptoms, greater child-centered parenting in adoptive fathers was related to less social inhibition across the same period.

Hyde, L., Waller, R., Trentacosta, C., Shaw, D., Neiderhiser, J., Ganiban, J., Reiss, D., & Leve, L. D. (2016). Heritable and non-heritable pathways to early callous unemotional behaviors. *American Journal of Psychiatry, 173*, 903-901. doi: 10.1176/appi.ajp.2016.15111381

**Abstract:** *Objective:* Callous-unemotional (CU) behaviors in early childhood identify children at high risk for severe trajectories of antisocial behavior and CU traits that culminate in later diagnoses of conduct disorder, antisocial personality disorder, and psychopathy. Studies have demonstrated high heritability of CU traits, but no research has examined specific heritable pathways to earlier CU behaviors. Additionally, studies indicate that positive parenting protects against the development of CU traits, but genetically informed designs have not been used to confirm that these relationships are not the product of gene-environment correlations. *Method:* Using an adoption cohort of 561 families, biological mothers reported their history of severe antisocial behavior. Observations of adoptive mother positive reinforcement at 18 months were examined as predictors of CU behaviors when children were 27 months old. *Results:* Biological mother antisocial behavior predicted early CU behaviors despite having no or limited contact with offspring. Adoptive mother positive reinforcement also protected against early CU behaviors in children not genetically related to the parent. High levels of



adoptive mother positive reinforcement buffered the effects of heritable risk for CU behaviors posed by biological mother antisocial behavior. *Conclusions:* The findings elucidate heritable and nonheritable pathways to early CU behaviors. The results provide a specific heritable pathway to CU behaviors and compelling evidence that parenting is an important non-heritable factor in the development of CU behaviors. As positive reinforcement buffered heritable risk for CU behaviors, these findings have important translational implications for the prevention of trajectories to serious antisocial behavior.

Mammen, M. A., Moore, G. A., Scaramella, L. V., Reiss, D., Shaw, D. S., Leve, L. D., & Neiderhiser, J. M. (2016). Infant patterns of reactivity to tactile stimulation during parent-child interaction. *Infant Behavior Development*, 44, 121-132.

**Abstract:** Touch is the primary modality infants use to engage with the world; atypical responses to tactile stimuli may indicate risk for disordered outcomes. The current study examined infants' responses to tactile stimulation within parent-child interaction, adding to prior knowledge based on parent report. Nine-month-old infants ( $N = 497$ ) were observed while parents painted and pressed infants' hands and feet to paper to make designs. Positive and negative affect and gazing away, exploring, and resistance behaviors were coded. Latent Class Analysis of observed behaviors yielded four tactile response patterns partially consistent with current nosology for sensory processing patterns: Low Reactive, Sensory Overreactive, Sensory Seeking, and Mixed Over/Underreactive. To evaluate whether patterns made valid distinctions among infants, latent classes were examined in relation to parent-reported temperament. Infants in the Mixed Over/Underreactive class were rated higher in distress to limitations and activity level than other infants. Sensory processing patterns observed in parent-child interaction are consistent with those identified by parent-report and may be used in future research to elucidate relations with temperament and typical and atypical development.

Marceau, K., De Araujo-Greecher, M., Miller, E. S., Massey, S. H., Mayes, L. C., Ganiban, J. M., Reiss, D., Shaw, D. S., Leve, L. D., & Neiderhiser, J. M. (2016). The perinatal risk index: Early risks experienced by domestic adoptees in the United States. *PLOS One*, 11(3): e0150486. doi: 10.1371/journal.pone.0150486

**Abstract:** We aimed to assess comprehensively the prevalence of perinatal risks experienced by a potentially high-risk, yet understudied population of children domestically adopted in the United States. Data are from participant report and medical records from mothers ( $n=580$ ) who completed a domestic adoption placement with nonrelatives at or near birth (Mean placement age=7 days). We describe a comprehensive measure of perinatal risks, including divergences from previous assessment tools and the incorporation of multiple reporters, and report the prevalence of various types of perinatal risks. The prevalence of each specific risk factor was generally low, although several risks were more prevalent in this sample than estimates from nationally representative publicly available data. Nearly the entire sample (99%) experienced some type of risk exposure. Birth mothers who placed their children for

adoption domestically in the US experience higher levels of perinatal risks than the national average, but not for all specific types of risk. Thus, the developmental trajectories of children adopted domestically may systematically differ from the general population to the extent that these specific perinatal risks impact development.

Massey, S. H., Reiss, D., Neiderhiser, J. M., Leve, L. D., Shaw, D. S., & Ganiban, J. M. (2016). Maternal personality traits associated with patterns of prenatal smoking and exposure: Implications for etiologic and prevention research. *Neurotoxicology and Teratology*, 53, 48-54.

**Abstract: Background:** Little is known about the characteristics of women who smoke during pregnancy beyond demographic factors. We examined the relationship between novelty seeking, harm avoidance, and self-directedness and (a) abstinence from smoking during pregnancy and (b) average daily cigarette consumption during pregnancy.

**Methods:** Participants were 826 birth mothers who made adoption placements in the Early Growth and Development Study and completed the Temperament and Character Inventory — Short Form, and interview-based smoking assessments 3–6 months postpartum. Never smokers ( $n = 199$ ), pregnancy abstainers ( $n = 277$ ), pregnancy light smokers ( $n = 184$ ), and pregnancy heavy smokers ( $n = 166$ ) were compared on personality dimensions and smoking-related processes. Using regression analyses we examined relationships between personality and (a) abstinence versus smoking during pregnancy; and (b) average daily cigarette consumption among lifetime smokers, controlling for nicotine dependence, birth father substance dependence, maternal antisocial behavior, and depressive symptoms during pregnancy.

**Results:** Smokers with higher self-directedness and lower harm avoidance were more likely to abstain during pregnancy [O.R. 1.380; 95% C.I. (1.065–1.787);  $B(SE) = .322(.132)$ ;  $p = .015$ ] and [O.R. .713; 95% C.I. (.543–.935);  $B(SE) = -.339(.138)$ ;  $p = .014$ ], respectively. Novelty seeking differentiated never smokers from lifetime smokers ( $t = -3.487$ ;  $p = .001$ ), but was not significant in multivariate models. Lifetime smokers who abstained during pregnancy reported fewer depressive symptoms relative to never smokers.

**Conclusions:** Personality dimensions associated with abstinence from smoking and cigarettes per day during pregnancy may be important to consider in etiologic and intervention research.

McClelland, M. M., Leve, L. D., & Pears, K. C. (2016). Preschool executive functions in the context of family risk. In J. A. Griffin, L. S. Freund, & P. McCardle (Eds.), *Executive function in preschool age children: Integrating measurement, neurodevelopment and translational research* (pp. 241–257). Washington, DC: American Psychological Association.

**Abstract:** The transition from preschool to formal schooling is an exciting and important milestone for young children. Although many young children navigate this transition with ease, a substantial group of children experience difficulty with the demands of more structured school settings compared to relatively less structured preschool classrooms

(McClelland, Morrison, & Holmes, 2000; Rimm-Kaufman, Pianta, & Cox, 2000). This issue has garnered enormous attention as parents, teachers, and policy-makers strive to help children appropriately manage their thoughts, feelings, and behavior while navigating increasingly demanding academic environments. Recently, children's executive function has been identified as key to the development of these skills and to a successful transition to formal schooling. Laying the foundation for strong executive function is important for a range of children's outcomes, including social and academic success (McClelland, Acock, & Morrison, 2006; Moffitt et al., 2011). Of significant concern is research documenting that many young children and especially those growing up in the context of family risk, lack strong executive function and start school significantly behind their peers (Evans & Rosenbaum, 2008; Lengua, 2009; Mistry, Benner, Biesanz, Clark, & Howes, 2010; Sektnan, McClelland, Acock, & Morrison, 2010). In this chapter, we discuss the importance of early executive function for children experiencing family and contextual risk. We first discuss conceptual issues including the components of executive function (cognitive or attentional flexibility, working memory, and inhibitory control) which are especially relevant for academic achievement from childhood to early adulthood. We next review research highlighting how growing up in the context of risk, including contextual, familial, prenatal, or genetic risk, can impede the development of executive function. We then discuss recent studies documenting the compensatory effects of strong executive function for children experiencing early risk, including such adverse environmental contexts as economic adversity or maltreatment and placement in foster care. Finally, we conclude with suggestions regarding future research directions.

Neiderhiser, J. M., Marceau, K., de Araujo-Greecher, M., Ganiban, J. M., Mayes, L. C., Shaw, D. S., Reiss, D. & Leve, L. D. (2016). Estimating the roles of genetic risk, perinatal risk, and marital hostility on early childhood adjustment: Medical records and self-report. *Behavior Genetics*, 46, 334–352.

**Abstract:** A wide variety of perinatal risk factors have been linked to later developmental outcomes in children. Much of this work has relied on either birth/medical records or mothers' self-reports collected after delivery, and there has been an ongoing debate about which strategy provides the most accurate and reliable data. This report uses a parent-offspring adoption design ( $N = 561$  families) to (1) examine the correspondence between medical record data and self-report data, (2) examine how perinatal risk factors may influence child internalizing and externalizing behavior at age 4.5 years, and (3) explore interactions among genetic, perinatal risk, and rearing environment on child internalizing and externalizing behavior during early childhood. The agreement of self-reports and medical records data was relatively high (51–100%), although there was some variation based on the construct. There were few main effects of perinatal risk on child outcomes; however, there were several 2- and 3-way interactions suggesting that the combined influences of genetic, perinatal, and rearing environmental risks are important, particularly for predicting whether children exhibit internalizing versus externalizing symptoms at age 4.5 years.

Roos, L. E., Fisher, P. A., Shaw, D. S., Kim, H. K., Neiderhiser, J. M., Reiss, D., Natsuaki, M. N., & Leve, L. D. (2016). Inherited and environmental influences on a childhood co-occurring symptom phenotype: Evidence from an adoption study. *Development and Psychopathology*, 28, 111-125. PMC: 4598247

**Abstract:** Risk factors for the childhood development of co-occurring internalizing and externalizing symptoms are not well understood, despite a high prevalence and poor clinical outcomes associated with this co-occurring phenotype. We examined inherited and environmental risk factors for co-occurring symptoms in a sample of children adopted at birth and their birth mothers and adoptive mothers ( $N = 293$ ). Inherited risk factors (i.e., birth mothers' processing speed and internalizing symptoms) and environmental risk factors (i.e., adoptive mothers' processing speed, internalizing symptoms, and uninvolved parenting) were examined as predictors for the development of internalizing-only, externalizing-only, or co-occurring symptoms using structural equation modeling. Results suggested a unique pattern of predictive factors for the co-occurring phenotype, with risk conferred by adoptive mothers' uninvolved parenting, birth mothers' slower processing speed, and the birth mothers' slower processing speed in tandem with adoptive mothers' higher internalizing symptoms. Additional analyses indicated that when co-occurring-symptom children were incorporated into internalizing and externalizing symptom groups, differential risk factors for externalizing and internalizing symptoms emerged. The findings suggest that spurious results may be found when children with co-occurring symptoms are not examined as a unique phenotypic group.

Stover, C. S., Zhou, Y., Kiselica, A., Leve, L. D., Neiderhiser, J. M., Shaw, D. S., Natsuaki, M. N., Scaramella, L. V., & Reiss, D. (2016). Marital hostility, hostile parenting, and child aggression: Associations from toddlerhood to school-age. *Journal of the American Academy of Child & Adolescent Psychiatry*. 55, 235–242. PMC: 4764800

**Abstract:** The spill-over hypothesis suggests that childhood aggression results from spill-over of interparental conflict to poor parenting, which promotes aggressive child behavior. This study was designed to examine the spill-over hypothesis in non-genetically related parent-child dyads from the toddler period through age 6.  
**Method:** A sample of 361 sets of children, adoptive parents, and birth parents from the Early Growth & Development Study (EGDS) was assessed from child age 9 months to 6 years on measures of adoptive parent financial strain, antisocial traits, marital hostility, hostile parenting, and child aggression. Structural equation modeling was used to examine links from financial strain, parent antisocial traits, and marital hostility in infancy and toddlerhood to hostile parenting and child aggression at age 4.5 and 6 years.  
**Results:** Spill-over of marital conflict from child age 18 to 27 months was associated with more parental hostility in mothers and fathers at 27 months. In turn, adoptive fathers' parental hostility, but not mothers', was associated with aggression in children at age 4.5 years. However, there was no significant spillover from hostile parenting at 4.5 years to child aggression at 6 years. Birth mother antisocial traits were unassociated with child aggression.

*Conclusions:* This study is the first to examine spill-over of marital hostility to parenting to child aggression from toddlerhood through age 6 years in an adoption design, highlighting the impact of these environmental factors from the toddler to preschool period. The findings support the potential benefit of early identification of marital hostility.

Waller, R., Trentacosta, C. J., Shaw, D. S., Neiderhiser, J. M., Ganiban, J. M., Reiss, D., ... & Hyde, L. W. (2016). Heritable temperament pathways to early callous–unemotional behavior. *The British Journal of Psychiatry*, 209(6), 475-482.

**Abstract:** Early callous–unemotional behaviors identify children at risk for antisocial behavior. Recent work suggests that the high heritability of callous–unemotional behaviors is qualified by interactions with positive parenting.

*Aims:* To examine whether heritable temperament dimensions of fearlessness and low affiliative behavior are associated with early callous–unemotional behaviors and whether parenting moderates these associations.

*Method:* Using an adoption sample ( $n=561$ ), we examined pathways from biological mother self-reported fearlessness and affiliative behavior to child callous–unemotional behaviors via observed child fearlessness and affiliative behavior, and whether adoptive parent observed positive parenting moderated pathways.

*Results:* Biological mother fearlessness predicted child callous–unemotional behaviors via earlier child fearlessness. Biological mother low affiliative behavior predicted child callous–unemotional behaviors, although not via child affiliative behaviors. Adoptive mother positive parenting moderated the fearlessness to callous–unemotional behavior pathway.

*Conclusions:* Heritable fearlessness and low interpersonal affiliation traits contribute to the development of callous–unemotional behaviors. Positive parenting can buffer these risky pathways.

## 2017

Harold, G. T., Leve, L. D., & Seller, R. (2017). How can genetically informed research help inform the next generation of interparental and parenting interventions? *Child Development, 88*, 446-458.

**Abstract:** There is robust evidence that the interparental relationship and parenting behaviors each have a significant influence on children's risk for emotional (internalizing) and behavioral (externalizing) problems. Indeed, interventions targeting the interparental relationship and parenting processes show significant intervention-related reductions in child internalizing and externalizing problems. However, most evidence-based parenting-and couple-focused interventions result in small to medium effects on children's emotional and behavior problems. It is proposed that there is opportunity to improve upon these interventions through incorporation of knowledge from quantitative genetic research. Three core recommendations are provided for practitioners engaging in intervention work with children and families. These recommendations are contextualized relative to what quantitative genetic studies can tell us about the role of the interparental relationship and parenting behaviors on child outcomes.

Klahr, A. M., Burt, S. A., Leve, L. D., Shaw, D. S., Ganiban, J. M., Reiss, D., Neiderhiser, J. M. (2017). Birth and adoptive parent antisocial behavior and parenting: A study of evocative gene-environment correlation. *Child Development, 88*, 503-513.

**Abstract:** Negative parenting is shaped by the genetically influenced characteristics of children (via evocative rGE) and by parental antisocial behavior, however, it is unclear how these factors jointly impact parenting. The current study examined the effects of birth parent and adoptive parent antisocial behavior on negative parenting. Participants included 546 families within a prospective adoption study. Adoptive parent antisocial behavior emerged as a small but significant predictor of negative parenting at 18 months and of change in parenting from 18 to 27 months. Birth parent antisocial behavior predicted change in adoptive father's (but not mother's) parenting over time. These findings highlight the role of parent characteristics and suggest that evocative rGE effects on parenting may be small in magnitude in early childhood.

Leve, L. D. (2017). Applying behavioral genetic research to inform the prevention of developmental psychopathology: Drawing from the principles of prevention science. In P. H. Tolan, & B. L. Leventhal (Eds.), *Advances in development and psychopathology: Vol 2. Gene-environment transactions in developmental psychopathology: Brain research foundation symposium series* (pp. 251-282). New York, NY: Springer.

**Abstract.** This chapter examines the role that findings from behavioral genetics research can play in facilitating a personalized medicine approach in the prevention of behavioral health problems. Ten core standards in prevention science are used as the

framework for evaluating the readiness of the field to proceed with a personalized medicine approach.

Perez-Grabow, A., Khurana, A., Natsuaki, M. N., Neiderhiser, J. M., Shaw, D. S., Ganiban, J. M., Reiss, D., & Leve, L. D. (2017). Using an adoption-biological family design to examine associations between maternal trauma, maternal depressive symptoms, and child internalizing and externalizing behaviors. *Development and Psychopathology*, 29(5), 1707-1720.

**Abstract:** Maternal trauma is a complex risk factor that has been linked to adverse child outcomes. Nevertheless, the mechanisms underlying its association with child behavioral outcomes are not well understood. Using a novel study design which included adoptive and biological families, the present study examined the heritable and environmental mechanisms by which maternal trauma and associated depressive symptoms are linked to child internalizing and externalizing behaviors. Path analyses were used to analyze data from 557 adoptive mother-adopted child (AM-AC) dyads and 126 biological mother-biological child (BM-BC) dyads; the two family types being linked through the same biological mother. Rearing mother's trauma was associated with child internalizing and externalizing behaviors in both AM-AC and BM-BC dyads, and this association was mediated by rearing mothers' depressive symptoms, with the exception of BC externalizing behavior where BM trauma had a direct influence only. The presence of significant associations between maternal trauma and child behavior in dyads that only share environment (i.e., AM-AC dyads) lends support to an environmental mechanism of influence for maternal trauma. Significant associations were also observed between maternal depressive symptoms and child internalizing and externalizing behavior in dyads that were only genetically related with no shared environment (i.e., BM-AC dyads), suggesting a heritable pathway of influence via maternal depressive symptoms. In reducing the intergenerational effects of maternal trauma, prevention efforts should focus on addressing mental health needs of mothers who have been victims of trauma, and identifying children who may be at greater risk for problem behaviors due to environmental and hereditary influences.

Taraban, L., Shaw, D. S., Leve, L. D., Wilson, M. N., Dishion, T. J., Natsuaki, M., Neiderhiser, J. M., & Reiss, D. (2017). Maternal depression and parenting in early childhood: Contextual influence of marital quality and social support in two samples. *Developmental Psychology*, 53, 436-449.

**Abstract:** In the current study, we explored the contextual influence of marital quality and social support satisfaction on the association between depressive symptoms and parenting during early childhood. Using two large, divergent, longitudinal samples (n = 526; n = 570), we tested the independent moderating effects of marital quality and social support satisfaction among partnered and single women. Unexpectedly, in both samples the association between maternal depressive symptoms and reduced parenting quality was strongest in the context of high marital quality and high social support satisfaction, and largely non-significant in the context of low marital quality and low social support satisfaction. Social support satisfaction played a stronger moderating

role among single, compared to partnered, women. Possible explanations for these surprising findings are discussed. Results point to the importance of accounting for larger family context in predicting the impact depression may have on maternal parenting.

Waller, R., Shaw, D. S., Neiderhiser, J. M., Ganiban, J. M., Natsuaki, M. N., Reiss, D., Trentacosta, C. J., Leve, L. D., & Hyde, L. W. (2017). Towards an understanding of the role of the environment in the development of early callous behavior. *Journal of Personality, 85*, 90-103. doi: 10.1111/jopy.12221

**Abstract:** Key to understanding the long-term impact of social inequalities is identifying early behaviors that may signal higher risk for later poor psychosocial outcomes, such as psychopathology. A set of early-emerging characteristics that may signal risk for later externalizing psychopathology is Callous-Unemotional (CU) behavior. CU behavior predict severe and chronic trajectories of externalizing behaviors in youth. However, much research on CU behavior has focused on late childhood and adolescence, with little attention paid to early childhood when preventative interventions may be most effective. In this paper, we summarize our recent work showing that: (1) CU behavior can be identified in early childhood using items from common behavior checklists; (2) CU behavior predicts worse outcomes across early childhood; (3) CU behavior exhibits a distinct nomological network from other early externalizing behaviors; and (4) malleable environmental factors, particularly parenting, may play a role in the development of early CU behaviors. We discuss the challenges of studying contextual contributors to the development of CU behavior in terms of gene-environment correlations and present initial results from work examining CU behavior in an adoption study in which gene-environment correlations are examined in early childhood. We find that parenting is a predictor of early CU behavior even in a sample in which parents are not genetically related to the children.

Waller, R., Trentacosta, C. J., Shaw, D. S., Neiderhiser, J. M., Ganiban, J. M., Reiss, D., Leve, L. D., Hyde, L. W. (2017). Heritable and non-heritable pathways to early callous unemotional behaviors. *British Journal of Psychiatry, 85*, 90-103.

**Abstract:** Early callous-unemotional behaviors identify children at risk for antisocial behavior. Recent work suggests that the high heritability of callous-unemotional behaviors is qualified by interactions with positive parenting.

**Aims:** Examine whether heritable temperamental dimensions of fearlessness and low affiliative behavior, are associated with early callous-unemotional behaviors and whether parenting moderates these associations.

**Method:** Using an adoption sample ( $N=561$ ), we examined pathways from biological mother self-reported fearlessness and low affiliative behavior to child callous-unemotional behaviors via observed child fearlessness and affiliative behavior, and whether adoptive parent observed positive parenting moderated pathways.

**Results:** Biological mother fearlessness predicted child callous-unemotional behaviors via earlier child fearlessness. Biological mother low affiliative behavior predicted child callous-unemotional behaviors, although not via child affiliative behaviors. Adoptive



mother positive parenting moderated the fearlessness to callous-unemotional behavior pathway.

*Conclusions:* Heritable fearlessness and low interpersonal affiliation traits contribute to the development of callous-unemotional behaviors. Positive parenting can buffer these risky pathways.

## 2018

Bridgett, D. J., Ganiban, J. M., Neiderhiser, J. M., Natsuaki, M. N., Shaw, D. S., Reiss, D., & Leve, L. D. (2018). Contributions of mother's and father's parenting to children's self-regulation: Evidence from an Adoption Study. *Developmental Science*, 21, e12692. doi: 0.1111/desc.12692

**Abstract:** The origins of top-down self-regulation are attributed to genetic and socialization factors as evidenced by high heritability estimates from twin studies and the influential role of parenting. However, recent evidence suggests that parenting behavior itself is affected by parents' own top-down self-regulation. Because children's top-down self-regulation is influenced by genetic factors and parenting is influenced by top-down self-regulation, the effects of parenting on children's top-down self-regulation identified in prior studies may partially reflect passive gene-environment correlation. The goal of this study was to examine parenting influences on children's top-down self-regulation using a longitudinal, adoption-at-birth design, a method of identifying parenting influences that are independent of the role of shared genetic influences on children's behaviors because adoptive parents are genetically unrelated to their adopted child. Participants (N = 361) included adoptive families and biological mothers of adopted children. Adoptive mothers' and fathers' harsh/negative parenting were assessed when children were 27 months of age and biological mothers' top-down self-regulation was assessed when children were 54 months of age. Adopted children's top-down self-regulation was assessed when they were 54 and 72 months of age. Results, accounting for child gender, biological mother top-down self-regulation, and the potential evocative effects of adopted child anger, provide evidence that inherited influences and socialization processes uniquely contribute to children's top-down self-regulation. Furthermore, findings demonstrate the importance of both mother's and father's parenting behavior as an influence on young children's top-down self-regulation. The implications of these findings for understanding the complex mechanisms that influence children's top-down self-regulation are discussed.

Leve, L. D., Neiderhiser, J. M., Harold, G. T., Natsuaki, M. N., Bohannon, B. J. M., & Cresko, W. A. (2018). Naturalistic experimental designs as tools for understanding the role of genes and the environment in prevention research. *Prevention Science*, 19, 68-78.

**Abstract:** Before genetic approaches were applied in experimental studies with human populations, they were used by animal and plant breeders to observe, and experimentally manipulate, the role of genes and environment on specific phenotypic or behavioral outcomes. For obvious ethical reasons, the same level of experimental control is not possible in human populations. Nonetheless, there are natural experimental designs in human populations that can serve as logical extensions of the rigorous quantitative genetic experimental designs used by animal and plant researchers. Applying concepts such as cross-fostering and common garden rearing

approaches from the life science discipline, we describe human designs that can serve as naturalistic proxies for the controlled quantitative genetic experiments facilitated in life sciences research. We present the prevention relevance of three such human designs: (1) children adopted at birth by parents to whom they are not genetically related (common garden approach); (2) sibling designs where one sibling is reared from birth with an unrelated adoptive family and the other sibling is reared from birth by the biological mother of the sibling pair (cross-fostering approach); and (3) in vitro fertilization designs, including egg donation, sperm donation, embryo donation, and surrogacy (prenatal cross-fostering approach). Each of these designs allows for differentiation of the effects of the prenatal and/or postnatal rearing environment from effects of genes shared between parent and child in naturalistic ways that can inform prevention efforts. Example findings from each design type are provided and conclusions drawn about the relevance of naturalistic genetic designs to prevention science.

Lipscomb, S., Becker, D. R., Laurent, H., Neiderhiser, J. M., Shaw, D. S., Natsuaki, M. N., Reiss, D., Fisher, P. A., & Leve, L. D. (2018). *Infant Child Development*, 27, e2083. doi: 10.1002/icd.2083

**Abstract:** This study examined children's morning HPA axis activation as a moderator of links between hostile, over-reactive parenting at age 4.5 years and children's skills for success in school (higher executive function and literacy, and less externalizing behavior) at age 6. Participants included 361 adoptive families. Parenting was self-reported. HPA axis activation was measured by basal levels in morning cortisol. Executive function and literacy were assessed via standardized tasks. Externalizing behavior was reported by teachers. Results indicated that hostile, over-reactive parenting predicted more externalizing behavior and lower executive functioning regardless of children's morning HPA axis activation. HPA axis activation moderated the effects of hostile, over-reactive parenting on literacy. Among children with moderate to high morning HPA axis activation (approximately 60% of the sample), harsh parenting was linked with lower literacy; children with low morning HPA axis activation exhibited better literacy in the context of more hostile, over-reactive parenting. Yet, across the sample, hostile, over-reactive parenting remained in the low to moderate range, not in the high range. Findings are discussed in the context of considering not only whether children's stress system activation moderates' responses to their environments, but also how these processes operate for different developmental outcomes.

Liu, C., Moore, G. A., Beekman, C., Perez-Edgar, K. E., Leve, L. D., Shaw, D. S., Ganiban, J. M., Natsuaki, M. N., Reiss, D., & Neiderhiser, J. M. (2018). Developmental patterns of anger from infancy to middle childhood predict problem behaviors at age 8. *Developmental Psychology*, 54, 2090-2100.

**Abstract:** Anger is a central characteristic of negative affect and is relatively stable from infancy and into middle childhood and beyond. Absolute levels of anger typically peak in early childhood and diminish as children become socialized and better able to manage their emotions. From infancy to school-age, however, there are individual differences in

rank-order levels of anger. Little is known about variations in developmental patterns of anger and how they may be related to children's school-age behavioral adjustment. The current study (N = 361) examined how distinct patterns of parent-reported child anger from 9 months to age 7 were related to externalizing and internalizing problems at age 8. Group-based trajectory analysis identified six groups: Low/Stable, Average/Stable, Average/Decreasing, Average/Increasing, High/Decreasing and High/Stable. Most children (65.1%) were in low to average anger groups. However, 34.9% of the children were in the Average/Increasing and High/Stable groups. Children in the High/Stable groups (6.7%) showed elevated levels of externalizing and internalizing problems at age 8. Findings contribute to the literature seeking to distinguish normative, age-related anger development from potentially problematic anger development across childhood.

Massey, S.H., Mroczek, D.K., Reiss, D., Miller, E.S., Jakubowski, J.A., Graham, E.K., Shisler, S.M., McCallum, M., Huestis, M.A., Ganiban, J.M., Shaw, D.S., Leve, L.D., Eiden, R.D., Stroud, L.R., Neiderhiser, J.M. (2018). Additive drug-specific and sex-specific risks associated with co-use of marijuana and tobacco during pregnancy: Evidence from 3 recent developmental cohorts (2003–2015). *Neurotoxicology and Teratology*, 68, 97-106. doi: 0.1016/j.ntt.2018.06.002

**Abstract:** Background: Methodologic challenges related to the concomitant use (co-use) of substances and changes in policy and potency of marijuana contribute to ongoing uncertainty about risks to fetal neurodevelopment associated with prenatal marijuana use. In this study, we examined two biomarkers of fetal neurodevelopmental risk—birth weight and length of gestation—associated with prenatal marijuana use, independent of tobacco (TOB), alcohol (ALC), other drug use (OTH), and socioeconomic risk (SES), in a pooled sample (N=1191) derived from 3 recent developmental cohorts (2003-2015) with state-of-the-art substance use measures. We examined differential associations by infant sex, and multiplicative effects associated with co-use of MJ and TOB. Methods: Participants were mother-infant dyads with complete data on all study variables derived from Growing Up Healthy (n=251), Behavior and Mood in Babies and Mothers (Cohorts 1 and 2; n=315), and the Early Growth and Development Study (N=625). We estimated direct effects on birth weight and length of gestation associated with MJ, TOB, and co-use (MJ x TOB), using linear regression analysis in the full sample, and in male (n=654) and female (n=537) infants, separately. Results: Mean birth weight and length of gestation were 3,277 grams (SD = 543) and 37.8 weeks (SD = 2.0), respectively. Rates of prenatal use were as follows: any use, n = 748 (62.8%); MJ use, n = 273 (22.9%); TOB use, n = 608 (51.0%); co-use of MJ and TOB, n = 230 (19.3%); ALC use, n= 464 (39.0%); and OTH use n=115 (9.7%.) For all infants, unique effects on birth weight were observed for any MJ use [B(SE) = -84.367(38.271), 95% C.I. -159.453 to -9.281, p = 0.28], any TOB use [B(SE) = -.99.416(34.418), 95% C.I. -166.942 to -31.889, p = .004], and each cigarette/day in mean TOB use [B(SE) = -12.233(3.427), 95% C.I. -18.995 to -5.510, p <.001]. Additional effects of co-use on birth weight, beyond these drug-specific effects, were not supported. In analyses stratified by sex, while TOB use was associated with lower birth weight in both sexes, MJ use during pregnancy was associated with lower birth weight of male infants [B(SE) = -153.1 (54.20); 95% C.I. -259.5 to -46.7, p = .005], but not

female infants [B(SE) = 8.3(53.1), 95% C.I. -96.024 to 112.551,  $p = .876$ ]. TOB, MJ, and their co-use were not associated with length of gestation. Conclusions: In this sample, intrauterine co-exposure to MJ and TOB was associated with an estimated 18% reduction in birth weight not attributable to earlier delivery, exposure to ALC or OTH drugs, nor to maternal SES. We found evidence for greater susceptibility of male fetuses to any prenatal MJ exposure. Examination of dose-dependence in relationships found in this study, using continuous measures of exposure, is an important next step. Finally, we underscore the need to consider (a) the potential moderating influence of fetal sex on exposure-related neurodevelopmental risks; and (b) the importance of quantifying expressions of risk through subtle alterations, rather than dichotomous outcomes.

## 2019

Ahmadzadeh, Y. I., Eley, T. C., Leve, L. D., Shaw, D. S., Natsuaki, M. N., Reiss, D., Neiderhiser, J. M., & McAdams, T. A. (2019). Anxiety in the family: A genetically informed analysis of transactional associations between mother, father and child anxiety symptoms. *Journal of Child Psychology and Psychiatry*, 60, 1269-1277. doi:10.1111/jcpp.13068

**Background:** Anxiety in parents is associated with anxiety in offspring, although little is known about the mechanisms underpinning these intergenerational associations. We conducted the first genetically sensitive study to simultaneously examine the effects of mother, father and child anxiety symptoms on each other over time.

**Method:** Adoptive parent and child symptoms were measured at child ages 6, 7 and 8 years from 305 families involved in the Early Growth and Development Study, using a prospective adoption design. Children were adopted at birth to nonrelatives and composite data on internalizing problems within birth families were used as a proxy measure of offspring inherited risk for anxiety. Structural equation models were fitted to the data to examine prospective associations between adoptive mother, father and child symptoms, whilst accounting for individuals' symptom stability over time.

**Results:** Child anxiety symptoms at age 7 predicted adoptive mothers' anxiety symptoms at age 8. No mother-to-child or child-to-father effects were observed. These results were consistent in sensitivity analyses using only paternal offspring reports and using a second measure of child anxiety symptoms. Fathers' anxiety symptoms at child age 6 prospectively predicted child symptoms, but only when paternal offspring reports were included in the model. Composite data on birth family internalizing problems were not associated with child anxiety symptoms.

**Conclusions:** Results show environmentally mediated associations between parent and child anxiety symptoms. Results support developmental theories suggesting that child anxiety symptoms can exert influence on caregivers, and mothers and fathers may play unique roles during the development of child symptoms. Further research is needed on the role of genetic transmission associated with anxiety symptoms in biologically related families. In the meantime, researchers and clinicians should strive to include fathers in assessments and consider the effects of child symptoms on caregivers.

Blackwell, C. K., Elliott, A. J., Ganiban, J., Herbstman, J., Hunt, K., Forrest, C. B., Camargo, C. A., and ECHO collaborators (2019) General health and life satisfaction in children with chronic illness. *Pediatrics*, 143, e20182988; DOI: <https://doi.org/10.1542/peds.2018-2988>

**Abstract:** OBJECTIVES: To investigate children's general health and life satisfaction in the context of chronic abstract illness. METHODS: Caregivers (n = 1113) from 3 concurrent cohort studies completed the Patient-Reported Outcomes Measurement Information System Parent-Proxy Global Health measure, which is used to assess a child's overall physical, mental, and social health, as well as the Patient-Reported Outcomes Measurement Information System Parent-Proxy Life Satisfaction measure between March 2017 and December 2017 for 1253 children aged 5 to 9 years. We

harmonized demographic factors and family environmental stressors (single parent, maternal mental health, and income) to common metrics across the cohorts. To examine associations between chronic illness and children's general health and life satisfaction, we fit linear regression models with cohort fixed effects and accounted for the multilevel data structure of multiple children nested within the same family (ie, twins and other siblings) with generalized estimating equations. **RESULTS:** Children with chronic illness had worse general health than those without illness (adjusted  $b = 21.20$ ; 95% confidence interval: 22.49 to 0.09). By contrast, children with chronic illness had similar levels of life satisfaction (adjusted  $b = 2.19$ ; 95% confidence interval: 21.25 to 0.87). Additionally, children's psychological stress had the strongest negative association with both outcomes, even after adjusting for demographics and family environmental stressors. **CONCLUSIONS:** Although children with chronic illness have lower parent-reported general health, their life satisfaction appears comparable with that of peers without chronic illness. With this study, we provide evidence that chronic illnesses do not preclude children from leading happy and satisfying lives.

Conradt, E., Flannery, T., Aschner, J. L., Annett, R. D., Croen, L. A., Duarte, C. S., ... & Jones, M. R. (2019). Prenatal opioid exposure: Neurodevelopmental consequences and future research priorities. *Pediatrics*, *144*(3), e20190128.

**Abstract:** Neonatal opioid withdrawal syndrome (NOWS) has risen in prevalence from 1.2 per 1000 births in 2000 to 5.8 per 1000 births in 2012. Symptoms in neonates may include high-pitched cry, tremors, feeding difficulty, hypertonia, watery stools, and breathing problems. However, little is known about the neurodevelopmental consequences of prenatal opioid exposure in infancy, early childhood, and middle childhood. Even less is known about the cognitive, behavioral, and academic outcomes of children who develop NOWS. We review the state of the literature on the neurodevelopmental consequences of prenatal opioid exposure with a particular focus on studies in which NOWS outcomes were examined. Aiming to reduce the incidence of prenatal opioid exposure in the near future, we highlight the need for large studies with prospectively recruited participants and longitudinal designs, taking into account confounding factors such as socioeconomic status, institutional variations in care, and maternal use of other substances, to independently assess the full impact of NOWS. As a more immediate solution, we provide an agenda for future research that leverages the National Institutes of Health Environmental Influences on Child Health Outcomes program to address many of the serious methodologic gaps in the literature, and we answer key questions regarding the short- and long-term neurodevelopmental health of children with prenatal opioid exposure.

Hails, K. A., Shaw, D. S., Leve, L. D., Ganiban, J. M., Reiss, D., Natsuaki, M. N., & Neiderhiser, M. N. (2019). Interaction between adoptive mothers' and fathers' depressive symptoms in risk for children's emerging problem behavior. *Social Development*, *28*, 725–742. DOI: 10.1111/sode.12352

**Abstract:** The effect of parental depression on children's adjustment has been well documented, with exposure during early childhood particularly detrimental. Most studies that examine links between parental depression and child behavior are confounded methodologically because they focus on parents raising children who are genetically related to them. Another limitation of most prior research is a tendency to focus only on the effects of maternal depression while ignoring the influence of fathers' depression. The purpose of this study was to examine whether infants' exposure to both parents' depressive symptoms, and inherited risk from birth mother internalizing symptoms, was related to school-age children's externalizing and internalizing problems. Study data come from a longitudinal adoption study of 561 adoptive parents, biological mothers, and adopted children. Adoptive fathers' depressive symptoms during infancy contributed independent variance to the prediction of children's internalizing symptoms and also moderated associations between adoptive mothers' depressive symptoms and child externalizing symptoms.

Leve, L. D., Griffin, A. M., Natsuaki, M. N., Harold, G. T., Neiderhiser, J. M., Ganiban, J. M., Shaw, D. S., & Reiss, D. (2019). Longitudinal examination of pathways to peer problems in middle childhood: A siblings-reared-apart design. *Development and Psychopathology, 31*, 1633-1674.

**Abstract:** To advance research from Dishion and others on associations between parenting and peer problems across childhood, we used a sample of 173 sibling pairs reared apart since birth (because of adoption of one of the siblings) to examine associations between parental hostility and children's peer problems when children were ages 7 and 9.5 years ( $n = 326$  children). We extended conventional cross-lagged parent-peer models by incorporating child inhibitory control as an additional predictor and examining genetic contributions via birth mother psychopathology. Path models indicated a cross-lagged association from parental hostility to later peer problems. When child inhibitory control was included, birth mother internalizing symptoms were associated with poorer child inhibitory control, which was associated with more parental hostility and peer problems. The cross-lagged paths from parental hostility to peer problems were no longer significant in the full model. Multigroup analyses revealed that the path from birth mother internalizing symptoms to child inhibitory control was significantly higher for birth parent-reared children, indicating the possible contribution of passive gene-environment correlation to this association. Exploratory analyses suggested that each child's unique rearing context contributed to their inhibitory control and peer behavior. Implications for the development of evidence-based interventions are discussed.

Leve, L. D., Neiderhiser, J. M., Ganiban, J. M., Natsuaki, M. N., Shaw, D. S., & Reiss, D. (2019). The Early Growth and Development Study: A dual-family adoption study from birth through adolescence. *Twin Research and Human Genetics, 22*, 716-727.

**Abstract:** The Early Growth and Development Study (EGDS) is a prospective adoption study of birth parents, adoptive parents, and adopted children ( $n = 561$  adoptees). The



original sample has been expanded to include siblings of the EGDS adoptees who were reared by the birth mother and assessed beginning at age 7 (n = 217 biological children), and additional siblings in both the birth and adoptive family homes, recruited when the adoptees were 8 - 15 years old (n = 823). The overall study aims are to examine how family, peer, and contextual processes affect child and adolescent adjustment, and to examine their interplay (mediation, moderation) with genetic influences. Adoptive and birth parents were originally recruited through adoption agencies located throughout the United States following the birth of a child. Assessments are ongoing and occurred in 9-month intervals until the adoptees turned 3 years of age, and in one- to two-year intervals thereafter through age 15. Data collection includes the following primary constructs: child temperament, behavior problems and mental health, peer relations, executive functioning and school performance, and health; birth and adoptive parent personality characteristics, mental health, health, context, substance use, parenting, and marital relations; and the prenatal environment. Findings highlight the power of the adoption design to detect environmental influences on child development and provide evidence of complex interactions and correlations between genetic, prenatal, and environmental influences on a range of child outcomes. The study sample, procedures, and an overview of findings are summarized and ongoing assessment activities are described.

Marceau, K., Abel, E., Duncan, R.J., Moore, P.J., Leve, L.D., Reiss, D., Shaw, D.S., Natsuaki, M., Neiderhiser, J.M., & Ganiban, J.M. (2019). Longitudinal associations of sleep duration, morning and evening cortisol, and body mass index during childhood. *Obesity, 27*, 645-652. doi:10.1002/oby.22420

**Abstract:** The primary objective of this paper was to examine associations between sleep duration, body mass index (BMI), and cortisol levels across childhood.

**Methods.** Participants included 361 children adopted domestically in the United States. Random-intercept cross-lagged panel models tested for between- and bi-directional within-person associations of sleep duration, BMI, and morning and evening cortisol from age 4.5 to 9 years.

**Results.** Sleep duration and BMI were stable during childhood, inversely associated at the between-person level, and unrelated to morning or evening cortisol. BMI at 6 years predicted longer sleep duration and lower evening cortisol at 7 years, and lower morning cortisol at 7 years predicted higher BMI at 9 years, within individuals.

**Conclusions.** The association between sleep and BMI is more likely a stable between-person phenomenon, rather than a unidirectional association that develops within-individuals over time.

Marceau, K., Rolan, E., Leve, L.D., Ganiban, J.M., Reiss, D., Shaw, D.S., Natsuaki, M.N., & Neiderhiser, J.M. (2019). Parenting and prenatal risk as moderators of genetic influences on conduct problems during middle childhood. *Developmental Psychology, 55*, 1164-1181. doi: 10.1037/dev0000701

**Abstract:** This study examines interactions of heritable influences, prenatal substance use, and postnatal environmental influences on the development of conduct problems in

middle childhood for boys and girls. Participants are 561 linked families, collected in two cohorts, including birth parents, adoptive parents, and adopted children. Heritable influences on internalizing and externalizing (including substance use) problems were derived from birth mothers' and fathers' symptoms, diagnoses, and age of onset from diagnostic interviews and the proportion of first-degree relatives with the same type of problems. Smoking during pregnancy (SDP) and alcohol use during pregnancy were assessed retrospectively from birth mothers at 5 months post-partum. Earlier externalizing problems and parental warmth and hostility and were assessed at one assessment prior to the outcome (Cohort II: 4.5 years; Cohort I: 7 years). Conduct problems were symptoms from a diagnostic interview assessed at age 6 (Cohort II) or 8 (Cohort I). Findings from regression analyses suggest 1) SDP plays an important role for the development of conduct problems, 2) some relatively well-accepted effects (e.g., gene  $\times$  SDP interactions) were less important when considering a fuller picture of the development of conduct problems in this sample, and 3) there were sex differences in main effects and interactions among genetic, prenatal substance use, and postnatal (parenting) influences on conduct problems that may be important to consider in future work. Replication is needed, but the current results provide preliminary but empirically-grounded hypotheses for future research testing complex developmental models of conduct problems.

Natsuaki, M. N., Neiderhiser, J. M., Harold, G. T., Shaw, D. S., Reiss, D., & Leve, L. D. (2019). Siblings reared apart: A sibling comparison study of rearing environment differences *Developmental Psychology*, *55*, 1182-1190. doi: 10.1037/dev0000710

**Abstract:** Cross-fostering studies have been ethically impossible to implement in human populations. We introduce a novel approach to address this barrier: the siblings-reared-apart design. Supplementing the traditional adoption design with a sample of birth families who (a) are linked to adoptive families, and (b) raise their biological child(ren) (i.e., biological siblings of adoptees), this design provides opportunities to evaluate the role of specific rearing environments. Using data from 118 pairs of adoption-linked adoptive and birth families, we found that compared with families in the birth homes, (a) adoptive families had higher household incomes and maternal educational attainment; (b) adoptive mothers more often displayed guiding parenting, less harsh parenting, and less maternal depression; and (c) socioeconomic differences between the two homes did not account for the behavioral differences in mothers. We discuss the potential of the sibling-reared-apart design to advance developmental science.

Taraban, L., Shaw, D. S., Leve, L. D., Natsuaki, M. N., Ganiban, J., M., Reiss, D., and Neiderhiser, J. M. (2019). Parental depression, overreactive parenting, and early childhood externalizing problems: Moderation by social support. *Child Development*, *90*, e468-485. doi: 10.1111/cdev.13027

**Abstract:** This study used a large (N = 519), longitudinal sample of adoptive families to test over-reactive parenting as a mediator of associations between parental depressive

symptoms and early childhood externalizing, and parents' social support satisfaction as a moderator. Maternal parenting (18 months) mediated the association between maternal depressive symptoms (9 months) and child externalizing problems (27 months). Paternal parenting was not a significant mediator. Unexpectedly, we found a cross-over effect for the moderating role of social support satisfaction, such that partners' social support satisfaction reduced the strength of the association between each parent's own depressive symptoms and over-reactive parenting. Results point to the importance of accounting for broader family context in predicting early childhood parenting and child outcomes.

Sellers, R., Harold, G. T., Smith, A. F., Neiderhiser, J. M., Reiss, D., Shaw, D., Natsuaki, M. N., Thaper, A., & Leve, L. D. (2019). Disentangling nature from nurture in examining the interplay between parent-child relationships, ADHD, and early academic attainment. *Psychological Medicine* 1-8.  
<https://doi.org/10.1017/S0033291719003593>

**Abstract: Background:** Attention deficit hyperactivity disorder (ADHD) is highly heritable and is associated with lower educational attainment. ADHD is linked to family adversity, including hostile parenting. Questions remain regarding the role of genetic and environmental factors underlying processes through which ADHD symptoms develop and influence academic attainment.

**Method:** This study employed a parent-offspring adoption design ( $N = 345$ ) to examine the interplay between genetic susceptibility to child attention problems (birth mother ADHD symptoms) and adoptive parent (mother and father) hostility on child lower academic outcomes, via child ADHD symptoms. Questionnaires assessed birth mother ADHD symptoms, adoptive parent (mother and father) hostility to child, early child impulsivity/activation, and child ADHD symptoms. The Woodcock-Johnson test was used to examine child reading and math aptitude.

**Results:** Building on a previous study (Harold et al., 2013, *Journal of Child Psychology and Psychiatry*, 54(10), 1038-1046), heritable influences were found: birth mother ADHD symptoms predicted child impulsivity/activation. In turn, child impulsivity/activation (4.5 years) evoked maternal and paternal hostility, which was associated with children's ADHD continuity (6 years). Both maternal and paternal hostility (4.5 years) contributed to impairments in math but not reading (7 years), via impacts on ADHD symptoms (6 years).

**Conclusion:** Findings highlight the importance of early child behavior dysregulation evoking parent hostility in both mothers and fathers, with maternal and paternal hostility contributing to the continuation of ADHD symptoms and lower levels of later math ability. Early interventions may be important for the promotion of child math skills in those with ADHD symptoms, especially where children have high levels of early behavior dysregulation.

Sellers, R., Smith, A., Leve, L. D., Nixon, E., Cassell, J., & Harold, G.T. (2019). Utilizing genetically designs to better understand family processes and child development: Implications for adoption and foster care focused interventions. *Adoption & Fostering*, 43, 351-371.

**Abstract:** Understanding the interplay between genetic factors and family environmental processes (e.g. interparental relationship quality, positive vs negative parenting practices) and children’s mental health (e.g. anxiety, depression, conduct problems, ADHD) in the contexts of adoption and foster care research and practice is critical for effective prevention and intervention programme development. While evidence highlights the importance of family relationship processes (e.g. interparental relationship quality, parent–child relationship quality) for the mental health and well-being of children in adoption and foster care, there is relatively limited evidence of effective interventions specifically for these families. Additionally, family-based interventions not specific to the context of adoption and foster care typically show small to medium effects, and even where interventions are efficacious, not all children benefit. One explanation for why interventions may not work well for some is that responses to an intervention may be influenced by an individual’s genetic make-up. Alternatively, the targets of family relationship level interventions (e.g. parenting processes) may not always affect the specific environment ‘trigger’ deemed salient to specific child/adolescent outcomes. This article summarizes how genetically informed research designs can help disentangle genetic from environmental processes underlying psychopathology outcomes for children, and how this evidence can provide improved insights into the development of more effective preventive intervention targets for adoptive and foster families. We discuss current difficulties in translating behavioral genetics research to prevention science and provide recommendations to bridge the gap between behavioral genetics research and prevention science, with lessons for adoption and foster care research and practice.

Trentacosta, C. J., Waller, R., Neiderhiser, J. M., Shaw, D. S., Natsuaki, M. N., Ganiban, J. M., Reiss, D., Leve, L. D., & Hyde, L. W. (2019). Callous-unemotional behaviors and harsh parenting: Reciprocal association across early childhood and moderation by inherited risk. *Journal of Abnormal Child Psychology*, 47, 811-823. doi: 10.1007/s10802-018-0482-y

**Abstract:** Callous-unemotional (CU) behaviors increase children’s risk for subsequent antisocial behavior. This risk process may begin in early childhood with reciprocal pathways between CU behaviors and harsh parenting. In a sample of 561 linked triads of biological mothers, adoptive parents, and adopted children, the present study examined bidirectional links between CU behaviors and harsh parenting across three time points from 18 to 54 months and investigated moderation by inherited risk for psychopathic traits. Findings support reciprocal associations between harsh parenting and CU behaviors during early childhood, especially during the transition from toddlerhood (27 months) to preschool (54 months). Moreover, inherited risk moderated these associations such that links between harsh parenting and CU behaviors were stronger among children at higher inherited risk for psychopathic traits. The findings illustrate the dynamic interplay between parenting, CU behaviors, and heritable risk.

2020

Borriello, G. A., Ramos, A. M., Natsuaki, M. N., Reiss, D., Shaw, D. S., Leve, L. D., & Neiderhiser, J. M. (2020). The intergenerational transmission of mathematics achievement in middle childhood: A prospective adoption design. *Developmental Science*, e12974, doi:10.1111/desc.12974.

**Abstract:** The present study uses a parent-offspring adoption design to examine the dual roles of heritable and environmental influences on children's mathematics achievement. Linked sets (N = 195) of adopted children, adoptive parents, and birth parents each completed a measure of mathematics fluency (i.e., simple computational operations). Birth parent mathematics achievement and adoptive father mathematics achievement positively correlated with child achievement scores at age 7, whereas adoptive mother and adopted child mathematics achievement scores were not significantly associated with one another. Additionally, findings demonstrated no significant effects of gene-environment (GxE) interactions on child mathematics achievement at age 7. These results indicate that both heritable and rearing environmental factors contribute to children's mathematics achievement and identify unique influences of the paternal rearing environment on mathematics achievement in middle childhood.

Bray, B. A., Liu, C., Roben, C. K., Leve, L. D., Shaw, D. S., Ganiban, J. M., ... & Neiderhiser, J. M. (2020). Inherited and Environmental Moderators of Mother-Child Behavioral Contingency and Contingent Negativity at 27 Months. *Infant Behavior and Development*, 61, 101478.

**Abstract:**

Previous research has shown that as depressive symptomology increases, mothers tend to show withdrawn or harsh interaction patterns with their children, and the quality of these interaction patterns have subsequently been linked to child behavior problems. However, little research has examined bidirectional influences between mothers and their children, and how these moment-to-moment contingencies differ based on heritable and environmental characteristics. We used data from the Early Growth and Development Study a prospective adoption study to examine how adoptive mothers' depressive symptoms and children's heritable tendencies for negative affectivity interact to predict the quality of mother-child interactions at child age 27-months. Results detected two distinct dyadic interaction patterns. The first was a withdrawn interaction style and was observed in children with a high heritable tendency for negative affect. In that style, mother and child interactions were not contingent upon each other, suggesting a lack of joint engagement. The second was a volatile interaction style, observed in children with a low heritable tendency for negative affect. In these cases, mother and child interactions were highly contingent but negative. Our findings demonstrate essential differences in how dyadic interaction patterns vary according to level of depressive symptomology and heritable tendency for negative affect.

Bush, L., Wakschlag, L. S., Winn, K., Hertz-Picciotto, I., Nozadi, S., Lewis, J. ... Posner, J. (2020). Environmental children's health outcomes (ECHOS): Looking back and moving forward. *Frontiers in Psychiatry, 11*, article 547, doi: 10.3389/fpsyt.2020.0054.

**Abstract:** The family environment, with all its complexity and diverse components, plays a critical role in shaping neurodevelopmental outcomes in children. Herein we review several domains of the family environment (family socioeconomic status, family composition and home environment, parenting behaviors and interaction styles, parental mental health and functioning, and parental substance use) and discuss how these domains influence neurodevelopment, with particular emphasis on mental health outcomes. We also highlight a new initiative launched by the National Institutes of Health, the Environmental influences on Child Health Outcomes (ECHO) program. We discuss the role that ECHO will play in advancing our understanding of the impact of the family environment on children's risk for psychiatric outcomes. Lastly, we conclude with important unanswered questions and controversies in this area of research, highlighting how ECHO will contribute to resolving these gaps in our understanding, clarifying relationships between the family environment and children's mental health.

Cioffi, C. C., Leve, L. D., Natsuaki, M. N., Shaw, D. S., Reiss, D., & Neiderhiser, J. N. (2020). Does parental warmth moderate longitudinal associations between infant attention control and children's inhibitory control? *Infant and Child Development, 29*, e2147.

**Abstract:** Attention control (AC) plays an important role in the development of inhibitory control (IC) in children, yet there are few longitudinal studies of this association. This research tested whether maternal warmth at child age 27 months moderated the link between AC during infancy and IC during childhood. Associations were examined within a prospective adoption design ( $n = 361$  children). Tobit regression analyses indicated low levels of infant AC at 9 months predicted low levels of IC at 6 years, controlling for birth parent IC, prenatal risk, infant temperament, child sex, and openness of adoption. Adoptive mother warmth at 27 months moderated this association. In the context of low levels of maternal warmth, low levels of infant AC predicted low IC.

Field, A., Lester, K. J., Cartwright-Hatton, S., Harold, G. T., Shaw, D. S., Natsuaki, M. N., Ganiban, J. M., Reiss, D., Neiderhiser, J. M. & Leve, L. D. (2020). *Maternal and paternal influences on the developmental trajectories of childhood anxiety symptoms: A genetically sensitive comparison. Journal of Applied Developmental Psychology, 68*, 101123.

**Abstract:** One theory suggests that anxious fathers may pose a greater environmental influence on childhood anxiety than anxious mothers. This study uses the Early Growth and Development Study (EGDS) to test rearing parent anxiety influences from mothers and fathers on child anxiety symptoms between 18 months and 4.5, while considering inherited influences. The EGDS is a longitudinal, multisite study of adopted children

recruited through US adoption agencies, and their adoptive and birth parents. Bayesian latent growth models of the trajectory of child anxiety symptoms over 3 years predicted from inherited (birth parent anxiety) and adoptive parent anxiety influences were compared for maternal and paternal measures. Parameter estimates and their HPD intervals provided evidence that the slope for anxiety symptoms between 18 and 54 months is trivially affected by both rearing parent anxiety and inherited influences from both mothers and fathers. Similarly, rearing parental anxiety and inherited influence from both mothers and fathers had only a very small effect on the intercept for growth (anxiety symptoms at 18 months old). The evidence for differences between mothers and fathers for any of these parameters was, at best, weak. Contrary to theoretical predictions, anxiety in the rearing father is unlikely to have a more important role in fostering child anxiety symptoms than that in the rearing mother.

Halpern-Manners, A., Marahrens, H., Neiderhiser, J. M., Natsuaki, M. N., Shaw, D. S., Reiss, D., & Leve, L. D. (2020). The intergenerational transmission of early educational advantages: New results based on an adoption study. *Research in Social Stratification and Mobility*, 67, 100486.

**Abstract:** Sociological research has traditionally emphasized the importance of post-birth factors (i.e., social, economic, and cultural capital) in the intergenerational transmission of educational advantages, to the neglect of potentially consequential pre-birth endowments (e.g., heritable traits) that are passed from parent to child. In this study, we leverage an experiment of nurture--children who were adopted at birth into nonrelative families--in an effort to simultaneously model the effects associated with both pathways. To do so, we fit a series of simple linear regression models that relate the academic achievement of adopted children to the educational attainments of their adoptive and biological parents, using data from a recent nationwide sample of birth and adoptive families. Because our dataset includes both "genetic" and "environmental" relatives, but not "genetic-and-environmental" relatives, the separate contributions of each pathway can be identified, as well as possible interactions between the two. Our results show that children's early achievements are influenced not only by the attainments of their adoptive parents, but also the attainments of their birth parents, suggesting the presence of genetically mediated effects. Supplementary analyses provide little evidence of effect moderation, using both distal and proximate measures of the childhood environment to model gene-by-environment interactions. These findings are robust to a variety of parameterizations, withstand a series of auxiliary checks, and remain intact even after controlling for intrauterine exposures and other measurable variables that could compromise our design. The implications of our results for theory and research in the stratification literature, and for those interested in educational mobility, are discussed.

Liu, C. Ji, L., Chow, S., Kang, B., Leve, L. D., Shaw, D. S., Ganiban, J. M., Natsuaki, M. N., Reiss, D., & Neiderhiser, J. M. (2020). Child effects on parental negativity: The role of heritable and prenatal factors. *Child Development*, 91, e1064-e1081.

**Abstract:** The current study examined two possible mechanisms, evocative gene-environment correlation and prenatal factors, in accounting for child effects on parental negativity. Participants included 561 children adopted at birth, their adoptive parents and birth parents within a prospective longitudinal adoption study. Findings indicated child effects on parental negativity, such that toddlers' negative reactivity at 18 months was positively associated with adoptive parents' over-reactive and hostile parenting at 27 months. Furthermore, we found that child effects on parental negativity are partially due to heritable (e.g., birth mother internalizing problems and substance use) and prenatal factors (e.g., birth mother illicit drug use during pregnancy) that influence children's negative reactivity at 18 months. The current study provides critical evidence for "child on parent" effects.

Sellers, R., Harold, G. T., Thapar, A., Neiderhiser, J. M., Ganiban, J. M., Reiss, D., Shaw, D. S., Natsuaki, M N., & Leve, L. D. (2020). Examining the role of genetic risk and longitudinal transmission processes underlying maternal parenting and psychopathology and children's ADHD symptoms and aggression: Utilizing the advantages of a prospective adoption design. *Behavior Genetics*.

**Abstract:** Although genetic factors may contribute to initial liability for ADHD onset, there is growing evidence of the potential importance of the rearing environment on the developmental course of ADHD symptomatology. However, associations between family-level variables (maternal hostility, maternal depressive symptoms) and child behaviors (developmental course of ADHD and aggression) may be explained by genes that are shared by biologically related parents and children. Furthermore, ADHD symptoms and aggression commonly co-occur: it is important to consider both simultaneously to have a better understanding of processes underlying the developmental course of ADHD and aggression. To address these issues, we employed a longitudinal genetically sensitive parent-offspring adoption design. Analyses were conducted using Cohort I (n = 340) of the Early Growth and Development Study with cross-validation analyses conducted with Cohort II (n = 178). Adoptive mother hostility, but not depression, was associated with later child ADHD symptoms and aggression. Mothers and their adopted children were genetically unrelated, removing passive rGE as a possible explanation. Early child impulsivity/activation was associated with later ADHD symptoms and aggression. Child impulsivity/activation was also associated with maternal hostility, with some evidence for evocative gene-environment correlation processes on adoptive mother depressive symptoms. This study provides novel insights into family-based environmental influences on child ADHD and aggression symptoms, independent of shared parental genetic factors, implications of which are further explicated in the discussion.

Tavalire, H. F., Budd, E. L., Natsuaki, M. N., Neiderhiser, J. M., Reiss, D., Shaw, D. S., Ganiban, J. M., & Leve, L. D. (2020). Using a sibling adoption design to parse genetic and environmental influences on children's body mass index (BMI). *PLOS ONE*. 15(7): e023626

**Abstract:** Risk for obesity and associated lifelong health consequences begins early in life. Previous research highlights the importance of genetic and environmental



contributions to obesity risk; however, most studies involve related children reared together.

**Objective:** Here we utilize a novel sibling adoption design to independently estimate genetic and environmental contributions to obesity in childhood and describe how these influences vary with age.

**Methods:** As part of a prospective adoption study, we assessed biological siblings reared apart or together, and nonbiological siblings reared together, using a variance partitioning model to estimate the contributions of genetics and environment to BMI in a large cohort (N = 711) during middle childhood and adolescence.

**Results:** Sixty-three and 31% of total variance in BMI was attributed to genetics and common environment, respectively, in middle childhood sibling pairs (age 5-11.99;  $p < 0.01$ ). We detected no influence of genetics or common environment in older sibling pairs (12-18) or pairs spanning age groups, but home type (adoptive versus birth) was an important predictor of BMI in adolescence.

**Conclusions:** We observed a strong influence of genetics and common environment on BMI in middle childhood, supporting existing evidence that early interventions at the family level could effectively mitigate childhood obesity risk.

Whitesel, A. L., Dismukes, A., White, D., Guyer, S., Ganiban, J. M., Leve, L. D., & Neiderhiser, J. M. (2020). The Early Growth & Development Study: Using an Adoption Design to *Understand Family Influences and Child Development* (Chapter 7). In G. Wrobel, E. Helder, & E. Marr (Eds). *The Routledge Handbook of Adoption*.

**Abstract:** The Early Growth and Development Study (EGDS) is a longitudinal study of birth parents and adoptive families recruited from domestic U.S. adoption agencies across the United States beginning in 2002. The EGDS demonstrates many benefits of the adoption design, including the ability to study heritable and environmental contributions to health and behavior within families, and adoption specific outcomes such as openness between members of the adoption kinship network. Birth parents have been historically neglected in adoption research, and this chapter presents information on their characteristics and their experiences with making an adoption plan. Adoptive family characteristics are also described, as are key findings resulting from the overarching study aims of the EGDS. Finally, future directions and implications for adoption designs in general and EGDS in particular are considered.

## Electronic Publication Ahead of Print

Cree, R. A., Gueorguieva, R., Neiderhiser, J. M., Leve, L. D., Connell, C. M., Shaw, D. S., Natsuaki, M. N., Ganiban, J. M., Beekman, C., Smith, M. V., & Reiss, D. (in press). Using an adoption design to test genetically based differences in risk for child behavior problems in response to home environmental influences. *Development and Psychopathology*.

**Abstract:** Differential susceptibility theory (DST) posits that individuals differ in their developmental plasticity: some children are highly responsive to both environmental adversity and support, while others are less affected. According to this theory, “plasticity” genes that confer risk for psychopathology in adverse environments may promote superior functioning in supportive environments. We tested DST using a broad measure of child genetic liability (based on birth parent psychopathology), adoptive home environmental variables (e.g., marital warmth, parenting stress, and internalizing symptoms), and measures of child externalizing problems ( $n = 337$ ) and social competence ( $n = 330$ ) in 54-month-old adopted children from the Early Growth and Development Study. This adoption design is useful for examining DST because children are placed at birth or shortly thereafter with nongenetically related adoptive parents, naturally disentangling heritable and postnatal environmental effects. We conducted a series of multivariable regression analyses that included Gene  $\times$  Environment interaction terms and found little evidence of DST; rather, interactions varied depending on the environmental factor of interest, in both significance and shape. Our mixed findings suggest further investigation of DST is warranted before tailoring screening and intervention recommendations to children based on their genetic liability or “sensitivity.”

Ramos, A.M., Marceau, K., Neiderhiser, J. M., Araujo-Greecher, M., Natsuaki, M. N., & Leve, L. D. (in press). Maternal consistency in recalling prenatal experiences at 6-months and 8-years postnatal. *Journal of Developmental & Behavioral Pediatrics*.

**Abstract:** Objective: Mothers are known to be reliable reporters of smoking during pregnancy, type of delivery, and birth weight when compared to medical records. Few studies have considered whether the timing of retrospective collection impacts the mother’s retrospective self-report. We examined the consistency of maternal retrospective recall of prenatal experiences, behaviors, and basic birth outcomes between 6-months and 8-years postpartum. Method: We examined 117 mothers (62% Caucasian, 44% living in a committed relationship, median high school education) from the Early Growth and Development Study (EGDS). EGDS is a longitudinal adoption study that includes birth mothers of children born between 2003 and 2009 who were involved in a domestic adoption. Using the Modified Life History Calendar and a pregnancy screener, mothers reported on their prenatal health behaviors, prenatal substance use, and labor and delivery at 6-months and 8-years postpartum. Cohen’s kappa was calculated to examine consistency and chi-square tests were used to test differences by parity and maternal education. Results: Mothers recall was very good for recall of type of delivery, and good for smoking during pregnancy, medicine used for

labor induction, and specific medical problems (i.e., pre-eclampsia, STIs, and kidney infections). Recall consistency was poor for illicit drug use, specific prenatal tests performed (i.e., amniocentesis, ER visits), and using drugs other than an epidural during delivery. Conclusion: This study provides support for using retrospective collection of maternal self-report on some prenatal experiences up to 8-years postpartum and offers a potential way to more accurately collect self-reported prenatal experiences.

## In Print

Cioffi, C. C., Tavalire, H. F., Neiderhiser, J. M., Bohannon, B., & Level L. D. (in press). History of breastfeeding but not model of delivery shapes the gut microbiome in childhood. *PLOS ONE*.

**Abstract:** Background. The naïve neonatal gut is sensitive to early life experiences. Events during this critical developmental window may have life-long impacts on the gut microbiota. Two experiences that have been associated with variation in the gut microbiome in infancy are mode of delivery and feeding practices (e.g., breastfeeding). It remains unclear whether these early experiences are responsible for microbial differences beyond toddlerhood. Our study examined whether mode of delivery and infant feeding practices are associated with differences in the child and adolescent microbiome. To determine the impacts of these early experiences on the gut microbiome later in childhood, we used an adoption-sibling design to compare genetically related siblings who were reared together or apart. Methods. Gut microbiome samples were collected from 73 children (M = 11 years, SD = 3 years, range = 3-18 years). Parents reported on child breastfeeding history, age, sex, height, and weight. Mode of delivery was collected through medical records and phone interviews. Results. Negative binomial mixture models were conducted to identify whether mode of delivery and feeding practices were related to differences in phylum and genus-level abundance of bacteria found in the gut of child participants. Covariates included age, sex, and body mass index. Genetic relatedness and rearing environment were accounted for as random effects. We observed a significant association between lack of breastfeeding during infancy and a greater number of the genus *Bacteroides* in stool in childhood and adolescence. Conclusion. Early formula feeding may impart lasting effects on the gut microbiome well into childhood.

Wang, J., Natsuaki, M. N., Neiderhiser, J. M., Shaw, D. S., Ganiban, J. M., Reiss, D., & Leve, L. D. (2020). Fertility problems and parenting daily hassles in childhood: A 7-year longitudinal study of adoptive parents. *Adoption Quarterly*.

**Abstract:** While fertility problems have a negative impact on psychological health, infertile couples often view adoption as a positive healing experience. Yet, a dearth of work has examined the long-term impact that fertility problems have on adoptive parents and their childrearing stress. Here, we investigated how fertility problems related to parenting daily hassle (PDH) trajectories among adoptive mothers and fathers in the Early Growth and Development Study (N = 333). At adopted child age 9 months, adoptive parents reported whether they had fertility problems prior to their decision to adopt and rated their PDH frequency and intensity on six occasions over the next 7 years. Multilevel models revealed inverse U-shaped curves for PDH among both fertile and infertile parents, such that PDH increased from child age nine months until about five to six years and decreased thereafter. Mothers with fertility problems exhibited a steeper PDH incline from 9 months to the peak at child age 5 to 6, but also incurred a swifter subsequent decline. There were no significant differences in fathers'

PDH trajectories based on fertility problems. We discuss why fertility problems appear to impact PDH trajectories for mothers rather than fathers.

Liu, C., Moore, G. A., Roben, C. K., Ganiban, J. M., Leve, L. D., Shaw, D. S., Natsuaki, M. N., Reiss, D., & Neiderhiser, J. M. (in press). Examining Research Domain Criteria (RDoc) constructs for anger expression and regulation in toddlers. Manuscript under review.

**Abstract:** The present study is focused on anger expression and regulation within the National Institute of Mental Health (NIMH) Research Domain Criteria (RDoC) construct of Frustrative Nonreward. Although previous studies have examined associations between child anger regulation and expression, these studies do not directly address the dynamic processes involved in Frustrative Nonreward using micro-longitudinal methods. The current study used 561 adopted children, their adoptive parents, and birth parents and aimed to address gaps in the literature by examining: (1) temporal associations between anger expression during a frustrating situation, and behaviors thought to regulate emotions (e.g., attempt-to-escape, support-seeking, distraction, and focus-on-restraint) on a micro-longitudinal scale during an arm restraint task assessed at 27 months; (2) birth parent externalizing problems and overreactive parenting by adoptive parents as predictors of child anger expression and moderators of the moment-to-moment associations estimated in step 1; and (3) longitudinal associations (linear vs. quadratic) between anger expressions and externalizing behaviors at 4.5 years. Findings indicated that children's attempt-to-escape and support-seeking predicted an increase in anger expression in the following 3-second interval, whereas distraction and focus-on-restraint were not associated with changes in anger expression. Furthermore, we found that birth parents' externalizing problems were significantly associated with child anger expression, suggesting heritable influences. Interestingly, anger expression showed a U-shaped longitudinal association with externalizing behaviors at 4.5 years. Taken together, the findings emphasize the significance of integrating micro-longitudinal analysis approaches into the RDoC framework, helping to advance our understanding of dynamic processes underlying reactions to Frustrative Nonreward.

## Pre-Press

Beekman, C., Neiderhiser, J. M., Loken, E., Buss, K. A., Moore, G. A., Leve, L. D., Shaw, D. S., & Ganiban, J. M. (2015). *A single genetic liability for psychopathology? A stringent test of parent-to-child transmission in an adoption sample*. Manuscript submitted for publication.

**Abstract:** *Objective:* To use a prospective adoption study to stringently test for the intergenerational transmission of general psychopathology using disorder diagnoses from birth mothers, internalizing and externalizing problems in their adopted children, and reports of overreactive parenting by adoptive mothers. *Methods:* This study used a prospective adoption design with 561 yoked family units including birth mothers, their adopted children, and adoptive mothers. Structural equation modeling was used to extract a general psychopathology factor from birth mother disorder diagnoses. This factor was then associated with child behavior problems and moderation by adoptive mother overreactive parenting was subsequently tested using ordinary least squares regression. *Results:* Birth mother general psychopathology and adoptive mother overreactive parenting were significantly positively associated with both child internalizing and externalizing problems. For child externalizing, adoptive mother overreactive parenting moderated the genetic risk conferred by general psychopathology from birth mothers.

*Conclusions:* Findings provide preliminary evidence for the genetic transmission of general psychopathology by linking birth mother disorder diagnoses to their adopted child's behavior problems. The moderation of the positive association between general psychopathology and child externalizing by adoptive mother overreactive parenting highlights the importance of parenting when children are at low genetic risk. Implications for the study of comorbidity and child behavior problems are discussed.

Nagpal, N., Hajal, N., Massey, S., Leve, L. D., Shaw, D., Ganiban, J., Reiss, D., & Neiderhiser, J. (Under review, 2019). *Antisocial behavior is associated with prenatal health practices in pregnant smokers*. Manuscript submitted for publication.

**Abstract:** *Introduction:* This report examined pregnant smokers and nonsmokers to develop a better understanding of factors that contribute to variations in prenatal health-related behaviors.

*Methods:* Data were obtained from 913 women in a prospective, longitudinal adoption study who reported approximately 3 months postpartum on pregnancy smoking, prenatal vitamin (PNV) use, antisocial behaviors, depression and anxiety symptoms, and attendance at prenatal visits. *Results:* 40% of participants reported smoking during pregnancy, and 24% reported smoking more than 6 cigarettes per day for one or more trimesters. On average women attended 10.2 prenatal visits and took PNVs 1–2 times per week. Pregnancy smoking was correlated with poorer adherence to PNVs, though the relationship with number of prenatal visits was not significant after controlling for timing of pregnancy recognition. Maternal antisocial behavior was correlated with both

cigarette smoking (any smoking  $r = .19, p < .01$ ; heavy smoking  $r = .18, p < .01$ ), and inversely with frequency of PNV intake ( $r = -.17, p < .01$ ). A trend toward partial mediation by maternal antisocial behavior in the relationship between cigarette smoking and poor adherence to PNVs, controlling for maternal age, depressive symptoms, and adequacy of prenatal care, was detected,  $F(5,363) = 7.55, p < .0001$ ; adjusted  $R^2 = .08$ ; CI  $(-.14, -.03)$ . *Conclusions:* In this study we found an association between prenatal smoking and poor adherence to PNV intake. Maternal antisocial behaviors during pregnancy appeared to be a marker for poor adherence to recommendations for dietary supplementation among pregnant smokers, independent of adequacy of prenatal care.

Natsuaki, M. N., Harold, G. T., Neiderhiser, J. M., Shaw, D., Reiss, D., & Leve, L. D. (2015). *(Dis)connected in the peer context: Disentangling the effects of family influences on heterogeneity in play behavior in preschool children using an adoption study*. Manuscript submitted for publication.

**Abstract:** Using a longitudinal adoption design, we aimed to (a) capture the heterogeneity of children's peer play behavior, and (b) examine genetic and parenting factors that contribute to profiles of peer play behavior. The sample consisted of 178 children age 4.5 years. Preschool teachers reported on children's play behavior. Four distinct profiles of peer play behaviors were identified: socially competent children who were well connected with peers (the socially connected profile: SC), children who were slightly disruptive yet socially interactive (the connected-slightly disruptive profile: CD), children who were shy and socially marginalized (the withdrawn profile: WD), and children who were highly disruptive and socially disconnected (the disconnected-disruptive profile: DD). Children in the DD profile had adoptive mothers who were more overreactive than did those in the SC profile. Children in the WD profile had adoptive fathers who were more overreactive than did the SC profile children. Compared with the CD children, the DD profile children received less positive reinforcement from adoptive mothers. Children in the DD profile had birth mothers with lower sociability than did the SC children (i.e., SC and CD profiles). The results suggest that different profiles of play behaviors in preschool children may have distinct clusters of environmental and genetic correlates.

Neiderhiser, J. M., Trentacosta, C. J., Wakschlag, L. S., Leve, L. D., Ganiban, J. M., Shaw, D. S., Natsuaki, M. N., & Reiss, D. (2015). *Disentangling the influence of prenatal exposure to cigarettes and postnatal rearing environment on young children's externalizing trajectories*. Manuscript submitted for publication.

**Abstract: Importance:** This study addresses the controversy in the field about whether or not maternal smoking during pregnancy has a direct teratogenic effect on emergent psychopathology in children. Clarifying the mechanisms that promote externalizing problems early in development is critical for designing early life preventions. **Objective:** To disentangle genetic risk, prenatal exposure to maternal smoking, and postnatal rearing environment on trajectories of externalizing problems in children from 18 to 54 months.

*Design:* Data from the Early Growth and Development Study, a longitudinal adoption study of parents and offspring, were used. All adoptions were domestic, nonrelative, infant placements (average age at placement = 7 days). *Setting:* Population of birth parents and adoptive families completing domestic adoption of infants at birth throughout the United States.

*Participants:* 561 sets of birth parents, adopted children, and their adoptive parents participated.

*Exposures:* Maternal smoking during pregnancy was assessed from birth mothers at 4 months postpartum using the Life History Calendar method. Birth mother externalizing psychopathology was assessed at 18 months postpartum using the CIDI and a shortened version of the DIS. Marital hostility was assessed using adoptive parent reports (combined across both parents) at child age 18 months. *Main Outcome*

*Measures:* Child externalizing trajectories were assessed using combined parent reports on the Child Behavior Checklist at child ages 18, 27, and 54 months. *Results:* We found no main effects of maternal smoking during pregnancy on child externalizing problems intercept or slope. Marital hostility showed a significant interaction with smoking during pregnancy for growth in child externalizing problems, but not intercept. Specifically, SDP × Family Environment on Trajectories of EXT when marital hostility was high, exposed children were more likely to show an increasing trajectory of externalizing problems.

*Conclusions and Relevance:* The findings from this study indicate that the rearing environment is a critical factor in understanding the impact of maternal smoking during pregnancy on the behavioral outcomes of offspring.

Reece, B. J., Leve, L. D., Shaw, D. S., Neiderhiser, J. M., Reiss, D., & Ganiban, J. (Under review, 2020). *Are racial attitudes associated with decisions to place infants with same-sex couples?* Manuscript submitted for publication.

**Abstract:** This study examined the association between racial ideologies and birth mothers' decision to voluntarily place their children with same-sex couples ( $n = 36$ ) or other family types ( $n = 429$ ) during the adoption process. Results indicated that birth mothers who evidenced an overall ideology that tends to legitimate or deny racism and those who indicated unawareness of the existence of overt racist discrimination were significantly less likely to place their children with same-sex couples. The need for more research about interactions among various forms of prejudice in the adoption process and the impact of potential interactions between homophobia and racism are discussed. Suggestions for adoption professionals wishing to minimize homophobic and racist prejudice are provided.

Cree, R. A., Leve, L. D., Neiderhiser, J. M., Connell, C. M., Ganiban, J., Smith, M. V., Shaw, D., Gueorguieva, R., Natsuaki, M. N., Reiss, D. (2017). *Interviewer ratings and self-reports of parenting in infancy: a cross method comparison.* Manuscript submitted for publication.

**Abstract:** Studies of parenting of infants use varying methods. We report a comparison of parenting measures in a large set of adoptive parents of infants from three sources:



coded observation, interviewer ratings, and parental self-reports. We give special attention to the latter two because they are practical for large scale studies and clarify their utility for characterizing unique dimensions of parenting. We used exploratory and confirmatory factor analyses to delineate three dimensions of parenting: vexed, hostile, and supportive/engaged using self-reported and interviewer ratings of parenting. Results were consistent with the broader parenting literature, and although dimensions were source-specific, structural equation models validating domains against correlates of parenting including parent and child problematic functioning and observationally-coded ratings of parenting revealed cross-source correlations. This evidence suggests that self-reported and interviewer ratings of parenting capture important but distinguishable aspects of parenting, and supports the use of these easily obtainable measures.

Stepanyan, S. T., Natsuaki, M. N., Neiderhiser, J. M., Shaw, D. S., Reiss, D., & Leve, L. D. (Under review, 2019). Linking early signs of puberty and parenting via environmental pathways. Manuscript submitted for publication.

**Abstract:** Puberty has been associated with increased parent-child conflict and disagreements. However, most research has considered adolescents in the midst or end of pubertal development, leaving potential links between early pubertal development and parent-child relationships relatively understudied. Moreover, studies have most often examined biologically related families where separation of underlying genetic and environmental effects on the associations between puberty and parent-child relationships is impossible. The current study addresses these gaps by investigating the aforementioned association in a sample of 11-year-old adolescents and their adoptive parents ( $N = 259$  families). Results from cross-sectional analyses revealed significant associations between early pubertal maturation and paternal hostility, such that adolescents with early onset of puberty tended to experience increased levels of hostility with their adoptive fathers. With the utility of a genetically sensitive adoption-at-birth design, current findings demonstrate that the association between early pubertal maturation and family relationships in early adolescence could be partially explained by environmental factors.

Shewark, E., Ramos, A., Liu, C., Jody, G., Fosco, G., Shaw, D. S., Reiss, D., Natsuaki, M. N., Leve, L. D., & Neiderhiser, J. M. (2020, under review). The role of child negative emotionality in parenting and child adjustment: Gene-environment interplay. Manuscript submitted for publication.

**Abstract:** Background: Few studies have considered children's heritable characteristics when examining the effect children have on their parents. We examined how heritable contributions of child negative emotionality is related to parenting and child outcomes. Method: Using data from the Early Growth and Development Study, we examined associations among adoptive parent (AP) reports on child anger and sadness at 4.5 years, AP hostile and warm parenting at 6 years, and child behavioral problems and social competence at age 7. Birth parent temperament was included to test whether the child's effects on parents could reflect evocative gene-environment correlation (rGE).

Results: The results showed that child anger at 4.5 years evoked hostile parenting from APs at 6 years, which was subsequently related to child problem behaviors at 7 years. Evocative rGE effects were identified for adoptive parents' hostile parenting. Conclusions: By employing a genetically informed design, we found that parents were sensitive to the child's heritable negative emotionality and this sensitivity was linked to the child's later adjustment outcomes.

Cioffi, C., Griffin, A. M., Natsuaki, M. N., Shaw, D. S., Reiss, D., Ganiban, J. M., & Neiderhiser, J. M. (under review, 2020). The role of negative emotionality in the development of child executive function and language abilities from toddlerhood to age 7: An adoption study. A manuscript submitted for publication.

**Abstract:** Understanding the role of negative emotionality in the development of executive functioning (EF) and language skills can help identify developmental windows that may provide promising opportunities for intervention. In addition, because EF and language are both heritable, intergenerational transmission patterns are important to consider. The prospective parent-offspring adoption design used in the Early Growth and Development Study (EGDS) provides a unique opportunity to examine the intergenerational transmission of EF and language skills. Using data from EGDS ( $n = 561$  children adopted around the time of birth), we examined the role of heritable influences and negative emotionality in toddlerhood (age 9 to 27 months) and childhood (age 4.5 to 7 years) on child EF and language skills at age 7. There was continuity in EF from age 27 months to 7 years, and in language ability from age 27 months to 7 years, with no cross-lagged effects between child EF and language ability. Negative emotionality at age 9 months predicted lower EF and lower language abilities at age 7, and growth in negative emotionality from age 4.5 years to 7 years predicted lower child EF at age 7. Overall, findings suggest that lower negative emotionality at age 9 months is associated with higher toddler and child EF and language skills, and that preventing growth in negative emotionality from age 4.5 years to 7 years may lead to improvements in child EF.

Natsuaki, M. N., Stepanyan, S. T., Neiderhiser, J. M., Shaw, D. S., Ganiban, J. M., Reiss, D., & Leve, L. D. (under review, 2020). Do I look gawky? The association between pubertal asynchrony and peer victimization. A manuscript submitted for publication.

**Abstract:** Using data from the Early Growth and Development Study ( $N = 289$ ), this study examined the effect of pubertal asynchrony on peer victimization. Results revealed that at age 11, asynchronously maturing boys experienced a growth spurt, but other parts of the body were underdeveloped. Asynchronous girls also experienced a growth spurt with some signs of maturation in other bodily parts, but without menarche. Pubertal asynchrony was associated with a lower risk of peer victimization for boys but a higher risk for girls. The adverse effect of pubertal asynchrony at age 11 in girls was moderated by positive parent-child engagement at age 7. These results highlight

puberty as a unique transition when biology intersects with multiple layers of the social context.

Wechsler, D. L., Neiderhiser, J. M., Leve, L. D., Shaw, D. S., Natsuaki, M. N., Ganiban, J. M., Reiss, D., Rijdsdijk, F. V., & McAdams, T. A. (under review, 2020). Do parental hostility and warmth mediate associations between early symptoms of ADHD and later ODD and anxiety? A longitudinal adoption-at-birth investigation. Manuscript submitted for publication.

**Abstract:** The high rates of comorbid disorders in ADHD may be influenced by evoked negative parenting behaviors, which have been shown to increase risk for externalizing and internalizing psychopathology in children. Most family research on comorbidity in ADHD is cross-sectional and does not account for genetic confounds, precluding the assessment of the independent environmental influence of specific risk factors. We used a longitudinal adoption-at-birth design to investigate whether parental hostility and warmth in mid-childhood mediated relationships between children's early ADHD symptoms and subsequent ODD and anxiety symptoms in early adolescence, after accounting for genetic confounds.

*Methods:* Phenotypic data on 294 adopted children, their adoptive parents and their birth parents were drawn from the Early Growth and Development Study (EGDS), a prospective adoption-at-birth cohort. A cross-rater approach was used to assess reciprocal relationships between adoptive mother and father self-reports of parental hostility and warmth, and partner ratings of children's ADHD, ODD and anxiety symptoms at ages 6, 8 and 11. Birth mother ADHD symptoms were also included as predictors of all child and adoptive parent measures to assess evocative gene-environment correlation.

*Results:* Children's ADHD symptoms did not evoke parental hostility nor warmth, and these in turn did not predict children's subsequent ODD and anxiety symptoms. However, we found that parental hostility and warmth in early childhood did prospectively predict child ADHD symptoms up to several years later, in early adolescence.

*Conclusions:* While we did not find evidence that parental hostility or warmth mediated comorbidity between symptoms of ADHD, ODD and anxiety, our findings suggest that early parental warmth and hostility may have a long-term influence on core ADHD symptoms.

Leve, L. D., Harold, G. T., Neiderhiser, J. M., Natsuaki, M. N., Shaw, D. S., Ganiban, J. M., & Reiss, D. (under review, 2020). The potential of children's rearing environment to overcome genetic propensity for low academic achievement. Manuscript submitted for publication.

**Abstract:** Past research suggests that children's academic achievement is heritable (de Zeeuw, Geus, Boomsma, 2015; Lee et al., 2018; Okbay et al., 2016, with both genetic studies and intervention studies also showing that it is malleable and subject to environmental influences (Mullender-Wijnsma et al., 2016; Sasser et al., 2017). We used a parent-offspring adoption study to examine heritable and environmental

influences on academic achievement in a sample of 344 seven-year old adopted children and their biological and adoptive parents. Results indicated that adoptees' achievement scores were correlated with their biological parents' achievement scores but not with their adoptive parents' achievement scores, suggesting genetic influences. However, examination of mean achievement scores indicated that adoptees' scores were not significantly different than adoptive parents' ( $p's > .05$ ) but were significantly greater than their biological parents' ( $p's < .05$ ), suggesting promotive effects of the rearing environment. The positive effect of the rearing environment was present even when biological parents scored  $> 1$  standard deviations below the mean. Education practice and policy implications are discussed.

Burt, S. A., Johnson, W., Leve, L. D., **Natsuaki, M. N.**, Reiss, D., Shaw, D. S., Ganiban, J. M., & Neiderhiser, J. M. (under review, July 2020). Our understanding of environmental influences on academic achievement may not correct. Manuscript submitted for publication.

**Abstract:** Adoption studies cleverly leverage a naturally occurring disjoining of parents' genetic and environmental influences to make causal inferences regarding their effects. Unfortunately, extant studies are typically restricted to examinations of rank-order (dis)similarity between reared-apart and reared-together relatives, ignoring the well-documented presence of mean differences in outcomes across family members. We sought to fill this gap, jointly examining both mean differences and indices of similarity in 424 linked adoptive families participating in the Early Growth and Development Study (EGDS) using multilevel models. Results indicated that although adopted children's achievement was modestly correlated with that of their reared-apart biological relatives, they scored 3.01 to 15.09 points (0.20 to 1.00 standard deviations) higher than those relatives. What's more, these differences were partially attributable to rearing-home literary opportunities. We conclude that, by omitting considerations of mean differences between reared-apart relatives, behavioral geneticists may have inadvertently failed to detect and consider key environmental effect.

