Prospective associations between parenting and attention deficit hyperactivity problems: A sibling comparison analysis

Lara Khalifeh (✉ larakh@umich.edu)

University of Michigan <https://orcid.org/0000-0001-9840-6735>

Jackson

University of Dayton

Research Article

Keywords: Attention-Deficit Hyperactivity, parental responsiveness, parental harshness, learning stimulation, genetically informative

Posted Date: January 26th, 2022

DOI: <https://doi.org/10.21203/rs.3.rs-1285101/v1>

License: This work is licensed under a Creative Commons Attribution 4.0 International License. [Read Full License](#)

Abstract

Research suggests that parental factors like responsiveness, learning stimulation, and harshness plays a role in the development and maintenance of Attention-Deficit Hyperactivity Problems (ADHP). However, existing research utilizes a correlational, one-child-per-family approach that is unable to control for many confounding variables that might be accounting for links between parenting and ADHP. Consequently, it is crucial to understand whether previously unraveled associations still stand after accounting for a wide range of possible confounds. Using data from the mothers of the National Longitudinal Survey of Youth and their offspring ($N=11,521$ participants), we employed a longitudinal, sibling comparison design to examine associations from parental responsiveness, learning stimulation, and harshness at ages 4-5, to ADHP at ages 6-9. In addition to using a sibling comparison to reduce confounding, we also controlled for maternal smoking or drinking during pregnancy, maternal age at childbirth, maternal delinquency and IQ, child gender, and birth order. At the population and sibling analysis levels, children with higher levels of learning stimulation at ages 4-5 had lower levels of ADHP at ages 6-9. Parental responsiveness and harshness at ages 4-5 did not predict child ADHP at ages 6-9. Our results highlight the significance of early learning stimulation in the development of ADHP and suggest that intervention and prevention efforts could benefit from encouraging parents to engage in cognitively stimulating activities.

Highlights

- We followed a population-representative cohort of children (ages 4 to 9).
- We employed a sibling comparison to disentangle links from parenting behaviors to subsequent ADHP.
- Child cognitive stimulation was associated with lower subsequent ADHP, beyond shared familial factors and key confounds.
- Programs targeting increasing learning stimulation might improve developmental outcomes for children with ADHP.

Main

The Significance of Attention-Deficit Hyperactivity Problems (ADHP)

ADHD (Attention-Deficit Hyperactivity Disorder) affects millions of children in the US and foretells wide-ranging negative outcomes over an individual's lifespan (American Psychiatric Association, 2013) such as lower levels of education, poorer social functioning, and worse occupational outcomes (Ramos-Olazagasti et al., 2018). Additionally, children with ADHD are at risk for comorbid mental health problems including defiant, disruptive, and antisocial behaviors, emotional problems, self-harm, and substance abuse (Sayal et al., 2018). These comorbid conditions extend through the lifespans of children with ADHD, putting them at a higher risk of criminal activity, drug abuse, and increased mortality rates (Dalsgaard et al., 2015). Thus, it is important to better understand and disentangle the roles of genetic and psychosocial factors in the development, maintenance, and prevention of attention deficit hyperactivity problems (ADHP).

It is well-established that a multi-factor risk model, accounting for both genetic and environmental contributors, best explains the development of ADHP, as no single risk factor stands alone to explain their etiology. For example, Thapar and Colleagues (2013) found four particular risk factors that consistently contribute to ADHP. Those factors include having a relative with ADHD, having rare chromosomal structural variants, being exposed to extreme early adversity, and prenatal and postnatal exposure to lead. Other risk factors include pregnancy complications, low socioeconomic status, and psychosocial adversity (Sagiv et al., 2013). In addition, many parental practices have been linked to ADHP, including warmth, involvement, responsiveness, harshness (e.g., corporal punishment), and learning stimulation (e.g., Alizadeh et al., 2007; Einziger et al., 2019). Consequently, it is important to understand how such factors influence the development of ADHP. This study examines associations between ADHP and three parental factors: responsiveness, learning stimulation, and harshness.

Parental Responsiveness

Parents often have difficulty interacting with their children diagnosed with ADHD (Johnston & Mash, 2001; Barkley, 1998). Such problems in parent-child interactions are associated with the maintenance or exacerbation of ADHD symptoms (Barkley, 1998). Longitudinal studies have shown that child externalizing symptoms and parenting behaviors are associated bidirectionally, in a

transactional manner, over time (Campbell, 1994). This can take the form of lower compliance levels in children with ADHP when engaging with parents, paired with more demanding and negative communication and less praise exhibited by parents (Campbell, 1994).

Parental responsiveness (measured in terms of synchrony, guidance, and approval) is one parenting practice that stands out in meta-analyses examining family variables that correlate with externalizing behaviors like aggression, hostility, and noncompliance (Rothbaum & Weisz, 1994). Caregivers demonstrate responsiveness when responding consistently to their children either verbally (e.g., speaking to their child), through physical affection (e.g., hugging), through monitoring (e.g., keeping the child in view), or through providing either toys or activities (Bardley et al., 2001). Responsiveness is a predictor of various positive child outcomes (Thompson & Meyer, 2007). For instance, Pauli-Pott et al., (2018) found that maternal responsiveness at 4 years predicted higher levels of reward-related control and lower levels of ADHD symptom development and maintenance at 5 years.

Maternal responsiveness is also conceptually related to warmth and sensitivity, and studies have revealed that such constructs are predictive of ADHP (Keown, 2012). More specifically, maternal sensitivity at age 3 seems to be associated with lower ADHP at age 8 (Choenni et al., 2019), and maternal sensitivity during structured play for preschool-aged children predicts better attentional control at age 6 (Belsky et al., 2007). Thus, it appears that maternal responsiveness and related constructs are predictors of the symptomology of ADHP, suggesting that they may exert a protective effect against the development of ADHP.

Learning stimulation

Learning stimulation, also referred to as cognitive stimulation, relates to the general concept of enriched home environments as reflected in access to materials and experiences that promote learning (i.e., characterized by the presence of adequate toys, books, and activities; Bradley & Caldwell, 1979). Learning stimulation also encompasses parental behaviors that encourage the child to learn new skills (e.g., coloring, solving puzzles; Bradley & Caldwell, 1979).

Studies have linked home-learning environments in early childhood to ADHD symptoms at elementary-school-age (Schmiedeler et al., 2014). For example, Jester and colleagues found that a less-cognitively-stimulating home environment in early school years predicted later ADHD symptoms (Jester et al., 2005). They also suggested that a cognitively stimulating home environment might improve children's self-regulation, which in turn might enhance their ability to be attentive, especially in school settings. The inverse association between learning stimulation and ADHP is still found after controlling for parental ADHD symptoms, other aspects of the home environment, as well as other environmental risk factors like socioeconomic status, birth weight, and alcohol/cigarette exposure (Einziger et al., 2019; Jester et al., 2005; Mulligan et al., 2013). Additionally, it appears that the influence of an enriched home environment on later ADHP might be specific to the cognitive rather than the emotional or physical aspects of the environment (Einziger et al., 2019; Schmiedeler et al., 2014).

Parental Harshness

Studies have examined differences in harsh parenting behaviors directed towards ADHD vs non-ADHD children (e.g., Gerdes et al., 2003). Overall, research has found that mothers of children with ADHD are more punitive (Danforth et al., 1991) and exhibit higher levels of angry parenting (Demmer et al., 2018). To our knowledge, less research has investigated the effects of such parental differences on the development and maintenance of ADHP; however, the general trend suggests that harshness may be harmful. For instance, a study by Woodward and colleagues (1998) revealed that poor parental coping and disciplinary aggression were significantly associated with higher levels of hyperactivity in children with ADHD.

Other studies have suggested that corporal punishment (a component of parental harshness) is not just a predictor/outcome of ADHP, but it might help explain intergenerational continuity of ADHD (Tung, et al., 2014). However, the literature linking harshness to later ADHP is somewhat inconsistent. Lifford and colleagues (2008) did not find a significant prospective association between harshness and ADHP, and some authors have suggested that harshness is more influential for other externalizing behaviors (e.g., defiance and conduct problems) than for ADHP (Burke et al., 2008).

Limitations of previous research

Efforts to understand the role of parents in socialization are constrained severely by the unavoidably nonexperimental design of this work (Collins et al., 2000). That is, much of the research on parenting and its effects on children's development has not attended to

the potentially confounding effects of factors like genetics and shared environmental factors (Collins et al., 2000). Some gains in addressing confounding are achieved by examining prospective associations between parenting and later ADHP (e.g., Campbell, 1994; Schmiedeler et al., 2014). Nevertheless, even prospective studies are limited in their ability to address confounding, as the effectiveness of this design in ruling out confounding is dependent on the degree to which covariates are measured without error and all relevant covariates are included in the analysis (Lahey & D’Onofrio, 2010).

In contrast, genetically informative designs, like biometric models and sibling comparisons, have the potential to control unmeasured sources of confounding originating from both environmental and genetic sources. In the area of ADHD research, genetically informative designs have been applied when examining topics like family conflict and externalizing problems (Burt et al., 2005) and when assessing risk for ADHD in offspring of parents with ADHD (Uchida et al., 2020). However, to our knowledge, the risks associated with exposure to harshness, responsiveness, and learning stimulation have not been parsed out using such designs.

Current Study

This study examines the relationship between parental responsiveness, learning stimulation, and harshness and childhood ADHP while controlling for genetic factors and shared-familial environments. Employing a longitudinal, sibling-comparison design, along with accounting for covariates that might confound associations (e.g., family income, maternal smoking and drinking during pregnancy, birth order, maternal age at time of birth, child sex, child ethnicity, maternal highest level of school completed, maternal IQ, maternal delinquency, and ADHP at ages 4-5), the study attempts to disentangle the links from different parenting behaviors to ADHP.

A longitudinal research design is employed to better identify how social processes relate to the development of ADHP by helping to rule out child effects (e.g., by controlling baseline ADHP). Such a design helps establish the direction of effect between risk factors and outcome, ruling out child and selection effects by controlling baseline levels of the outcome. Additionally, the sibling comparison design is employed to take a step towards identifying environmentally mediated effects (Lahey & D’Onofrio, 2010). This is important because the relation between parenting factors and child ADHP may in fact be due in part or in whole to underlying genetic factors contributing to both the parents’ and the child’s behavior. When an experimental study cannot be conducted, a quasi-experimental design such as a sibling comparison design can provide highly informative tests of causal environmental hypotheses (Lahey & D’Onofrio, 2010). To illustrate, it might be the case that maternal history of ADHP contributes to low levels of learning stimulation while simultaneously predisposing children to exhibit ADHP. The sibling comparison designs account for such possibilities (i.e., maternal history of ADHP) by comparing individuals who share mothers and many other aspects of their family backgrounds. Therefore, a prospective sibling comparison design helps to achieve a clearer understanding of the directionality and magnitude of links between parenting and ADHP.

Using this design, the study addresses sources of confounding at the family level by testing within-family associations between parental factors and child outcomes. Taking into account the existing literature and the study design, this study predicted that lower levels of parental responsiveness, lower levels of cognitive stimulation, and higher levels of parental harshness would be associated with higher levels of ADHD symptoms. We also predicted that these effects would be greatly attenuated after genetic and environmental confounds are addressed through the sibling comparison design.

Methods

Participants

This study analyzed data from the Children of the National Longitudinal Survey of Youths (CNLSY), a study of the biological offspring of a large, nationally representative sample of women who had previously participated in the National Longitudinal Survey of Youth (NLSY79). Interviews for the CNLSY have been conducted biennially since 1986. Data collection for the CNLSY began in 1986 and offers data on children from birth through adulthood. The present study analyzed data collected between 1986 and 2014, which includes 11,521 total offspring participants (Bureau of Labor Statistics, 2017). Moreover, the CNLSY provides kinship data, allowing for a sibling comparison design. With the use of sampling weights, the NLSY sample is representative of the U.S. population. In the present study, 19.2% of the participants were Hispanic, 27.7% African American, and 53% white, non-Hispanic; 51%

male. The average annual household income (in 1986 dollars) was \$32,386, ranging from \$14 to \$977,585 (Bureau of Labor Statistics, 2017).

Measures

Predictors. Parenting factors were assessed with the short form HOME Inventory at ages 4 and 5. The short form HOME Inventory is a combination of observer ratings and mother's report on aspects of the environment (Bradley et al., 2001). The HOME Inventory was used to evaluate multiple parenting factors like parental harshness (e.g., instances of spanking over a period of time), learning stimulation (e.g., how often the mother reads to the child), and parental responsiveness (e.g., how often the mother hugs her child). Refer to Bradley et al. (2001) for a detailed account of how the different predictors in our study were constructed. The three predictors examined in this study, utilizing the HOME inventory are:

Responsiveness. Components of this measure of responsiveness included an observational component composed of items as follows: how much the Mother/Guardian: (1) spontaneously spoke to child twice or more (excluding scaffolding); (2) responded verbally to child's speech; (3) caressed, kissed, or hugged child at least once; (4) provided toy or interesting activities for child; (5) kept child in view/could see child/ looked at child often. These items were coded in a dichotomous fashion (Bradley et al., 2001). Items were averaged together to create a maternal responsiveness scale, which was then z-score standardized. The maternal responsiveness scale had a Cronbach's alpha of .54.

Learning stimulation. This measure consisted of observational items (e.g., About how many children's books does your child have of his/her own? Response options were: None, 1 or 2 books, 3-9 books, or 10 or > books) and interview items (e.g., How often do you get a chance to read stories to your child? Response options were: Never, several/year, several/month, 1/week, or 3/week. Interview items also extended to inquiring about activities like taking the child to any type of museum, and musical and theatrical performances). Items were z-score standardized and averaged together. The learning stimulation scale had an alpha of .60.

Harshness. This measure was also based on observational items (e.g., whether the parent/guardian has slapped or spanked the child at least once) and interview items (e.g., Sometimes kids mind pretty well and sometimes they don't. About how many times have you had to spank your child in the past week?) Response options were presented as: none, 1 or 2 times, 3 to 7 times, 8 or > times. The two items were z-score standardized, averaged together. The harshness scale had an alpha of .39. The internal consistency of this scale is likely affected by the use of only two items, and by the low frequency with which physical harshness would have been observed during the HOME interview.

Outcome measure. ADHP were assessed using the Behavior Problems Index (BPI). This measure was completed by the child's mother, where responses were scored 3 (*often true*), 2 (*sometimes true*) or 1 (*not true*). The ADHP measure included items around whether the child has: (a) difficulty concentrating, (b) is impulsive or acts without thinking, and (c) is restless or overly active, cannot sit still (D'Onofrio et al., 2008). ADHP items were averaged across the ages of 4-5 and 6-9 years old. The Cronbach's Alpha coefficients over ages 4-13 years of age for items operationalizing inattention and hyperactivity/impulsivity ranged between .67 and .74 (Lahey et al., 2006).

Additionally, several child and maternal covariates that might confound the association between parenting and ADHP were included in the analysis. Child-specific covariates included maternal self-reported smoking and drinking during pregnancy, the child's birth order, maternal age at each child's birth, sex of the child, and ADHP measured concurrently with the assessment of parenting (ages 4-5). Maternal alcohol use in the 12 months prior to giving birth was coded as a binary (yes/no) variable. Maternal smoking during pregnancy was coded to reflect three levels: (1) less than 1 pack/day, (2) more than 1 pack but less than 2 packs/day, and (3) 2 or more packs a day. Other maternal covariates include family income when the mother was 30 years of age, her highest level of school completed, age at the birth of her first child, IQ, delinquency, and race/ethnicity, coded as Hispanic, African American, or European American.

Analyses

The hypotheses were tested using multilevel path analysis in Mplus. For each hypothesis, we estimated the within-family (sibling comparison) and between-family (population estimates) effects simultaneously. This approach to data analysis allowed for the comparison of siblings who have different parenting factors and ADHP histories while accommodating non-independence of data

points. This approach controls for all familial genetic and environmental factors that are shared by siblings that might otherwise confound the association between the different parenting measures and ADHP. Measured covariates, such as maternal age at childbirth, child gender, and birth order, were also included in the model to reduce confounding due to sources of influence that siblings do not share in common. Robust standard errors were estimated in all models.

Sampling weights were used so that estimates from analyses could be generalized to the original nationally representative NLSY79 sample. Missing data were addressed using full information maximum likelihood (FIML) estimation, as it allows the inclusion of all participant data, whether complete or partial, thereby producing less biased estimates than those produced when using listwise deletion (Schafer & Graham, 2002). We also investigated potential for bias in the missingness of data using both t-tests (for continuously distributed demographic variables) and chi-square tests (for categorical demographic variables).

Results

Preliminary analyses

Preliminary analyses were conducted to assess for possible confounds. Based on the literature, childbirth order, child sex, maternal age at childbirth, maternal highest grade, family income (log-transformed), and maternal cigarette smoking and alcohol consumption were considered potential confounding variables based on their potential relationship with parenting and child ADHP. The means, standard deviations, and ranges of all variables are summarized in Table 1. Zero-order correlations were calculated between these variables, ADHP, and our three parental factors. The results shown in Table 2, along with the literature, are in support of the potential confounding effect of these key demographic factors, as all these key factors correlated with our predictors and outcomes.

As for missing data, t-tests did not reveal a significant difference in the missingness of data on outcome measures based on maternal age, maternal delinquency, and income ($p > .05$); however, there was a significant difference based on maternal IQ, where younger mothers had more missing data. The chi-square test did not reveal significant differences in terms of child sex. Based on race/ethnicity, there were significant differences in the missingness of data, where European Americans had more missing data points (approximately 24% missing data pertaining to their outcomes measures) compared to Hispanic (approximately 4%) and Black Americans (approximately 6%).

Path Analysis Results

The results for the multivariate model in which the three parenting factors were tested as predictors of ADHP yielded varying results. Between-family comparisons revealed that earlier ADHP (ages 4-5) and lower levels of parental learning stimulation were significant predictors of later ADHP, with $b = 0.49, p < .0011$ and $b = -0.08, p < .001$ respectively. Parental responsiveness did not predict ADHP at ages 6-9 ($b = -0.03, p = .112$), and neither did parental harshness ($b = -0.01, p = .404$). Within-family comparisons revealed a similar pattern, where ADHP at ages 4-5 and parental learning stimulation were significant predictors of later ADHP, $b = 0.43, p < .0011$ and $b = -0.07, p = .045$ respectively. Neither parental responsiveness ($b = -0.04, p = .121$) nor parental harshness ($b = 0.00, p = .866$) predicted later ADHP. Refer to Table 3 for standardized coefficients.

Discussion

The goal of this study was to unravel the links from three parenting factors (responsiveness, learning stimulation, and harshness) to ADHP, using a longitudinal design and a sibling comparison design to address limitations of past research. This study improves on our understanding of factors relating to ADHP by comparing biological siblings, thus controlling for environmental and genetic factors that might confound the associations of responsiveness, harshness, learning stimulation with ADHP.

Summary of Findings

Results from population and sibling-comparison analyses were consistent in showing that higher levels of learning stimulation at ages 4-5 were significantly associated with lower levels of ADHP at ages 6-9. Although this effect was found in both the population and sibling comparison analyses, the effect was smaller in the sibling comparisons, suggesting that part of the population-level association was confounded by family background characteristics. Parental responsiveness and harshness at ages 4-5 did not

significantly predict ADHP at ages 6-9 at either the population or sibling-comparison level. These findings suggest that increased learning stimulation directed toward children at ages 4-5 may have the potential to reduce the risk of ADHP at ages 6-9.

To put our results in the context of the literature, the role of parental responsiveness and harshness in the development and maintenance of ADHP is unclear. For example, there are studies that bolster the link between low maternal responsiveness and increased symptoms of ADHD over a 12-month period (Pauli-Pott et al., 2018) and others that support the role of corporal punishment in maintaining intergenerational continuity of parent and offspring ADHD (Tung et al., 2014). On the contrary, other studies have found that parental behaviors related to responsiveness and harshness only predict conduct problems in offspring with ADHD (Anderson et al., 1994). For example, Wakschlag & Hans (1999) found that less responsiveness mothers during infancy predicted subsequent Oppositional Defiant Disorder or Conduct Disorder diagnoses for the child, but not ADHD symptoms.

As for learning stimulation (also referred to as cognitive stimulation), in our study, mothers who engaged in learning stimulation activities had children with lower levels of ADHP. This is in line with previous findings that have supported the role of learning stimulation in the development of ADHD. For example, Einziger et al. (2019) found that higher levels of cognitive stimulation at age 4 predicted lower risk for ADHD diagnoses in adolescence. The literature also supports the role of learning stimulation beyond the confounding influence of factors like low SES (e.g., Bradley et al., 1989; Mulligan et al., 2013; Schmiedeler et al., 2014), which is consistent with our findings. Overall, it appears that the link between learning stimulation and ADHP goes beyond familial confound factors like risk for ADHD and parental symptoms of ADHD, however, no study to our knowledge has attempted to disentangle environmental effects from possible genetic effects (Einziger et al., 2019).

Thus, our results add to the existing learning stimulation literature by suggesting that the link from early learning stimulation to later ADHP is free from confounding factors that are shared by biological siblings, and key factors like birth order, sex, ethnicity, baseline ADHP, prenatal maternal substance use, maternal delinquency, and maternal IQ, education, and income. Our results also suggest that the potential path from parental harshness and responsiveness to ADHP is not free from confounds, as the bivariate associations between these parenting behaviors and ADHPs subside in our more-controlled analysis.

Strengths

The current study has many strengths, including the use of a nationally representative sample of mothers and children, a large sample size, and a prospective, longitudinal design. Additionally, the primary strength of the quasi-experimental design is that it controls for various unmeasured genetic and environmental factors, ruling out a wide range of possible confounds. Furthermore, the measures of our study (derived from the HOME inventory) included both interviews (self-reports) and observation data and had adequate reliability (with the exception of the harshness variable). Finally, the availability of repeated measures of our ADHP outcome facilitated controlling for earlier levels of ADHP, which vary between siblings and therefore cannot be fully controlled by comparing siblings.

Limitations and Future Directions

One limitation of the design is that causality cannot be inferred because the study is not experimental. It is important to note that our study controlled for a myriad of potential confounds, however, it is unlikely that all confounds were controlled. Future studies can address such a limitation by providing the resources to create a cognitively stimulating environment, or introducing an intervention that facilitates early learning stimulation, and tracking possible changes in ADHP. It is important to note that there is research that supports the role of lower economic standing in limiting access to materials and opportunity for learning stimulation (Bradley et al., 2001). Researchers have also examined the benefits of enrichment programs, like Head Start, an intervention geared at providing social, educational, and health resources with a focus on parental involvement. However, there is no consensus on whether such enrichment programs are beneficial and further investigation is warranted (Ball et al., 2019).

Additionally, the ADHP measure of the current study consists of only 3 items, thus, future studies can benefit from the use of a more comprehensive ADHD screening tool that encompasses the full range of ADHD symptoms. The parental measures used in this study were also limited in detail and breadth. For example, there are many forms of learning stimulation, responsiveness, and harshness that are not captured in the HOME-inventory. Thus, a better measure might have revealed more robust effects.

Furthermore, it is worthwhile to examine potential mediators and moderators in the path from learning stimulation to ADHP. For example, Jester et al. (2005) suggested that individual factors like self-regulation, might be a key variable linking learning stimulation to reduced risk for ADHP. Finally, it is also important to note the racial demographics of our sample reflected the make-up of the United States in 1979, which no longer reflects the current racial demographics.

Conclusions

Per the DSM-5, ADHD is one of the most common neurodevelopmental disorders of childhood that forecasts various adult health outcomes (American Psychiatric Association, 2013). Research aimed at unraveling prospective associations between parental practices and ADHP might inform prevention and intervention efforts. Our study tackled this by exploring three parental factors: responsiveness, learning stimulation, and harshness. Our results from the population and sibling-comparison models revealed that only learning stimulation had a statistically significant association with future ADHP, suggesting the cognitive stimulation may have a small but important role to play in our understanding of the development of ADHP.

Declarations

Competing interests: The authors declare no competing interests.

The authors did not receive support from any organization for the submitted work

References

- Alizadeh, H., Applequist, K. F., & Coolidge, F. L. (2007). Parental self-confidence, parenting styles, and corporal punishment in families of ADHD children in Iran. *Child Abuse & Neglect*, 31(5), 567–572. <https://doi.org/10.1016/j.chiabu.2006.12.005>
- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). <https://doi.org/10.1176/appi.books.9780890425596>
- Anderson, C. A., Hinshaw, S. P., & Simmel, C. (1994). Mother-child interactions in ADHD and comparison boys: Relationships with overt and covert externalizing behavior. *Journal of Abnormal Child Psychology*, 22(2), 247–265. <https://doi.org/10.1007/BF02167903>
- Ball, N. J., Mercado, E., & Orduña, I. (2019). Enriched environments as a potential treatment for developmental disorders: A critical assessment. *Frontiers in Psychology*, 10. <https://doi.org/10.3389/fpsyg.2019.00466>
- Barkley, R. A. (1998). *Attention-deficit hyperactivity disorder: A handbook for diagnosis and treatment*, 2nd ed (pp. xii, 628). Guilford Press.
- Belsky, J., Pasco Fearon, R. M., & Bell, B. (2007). Parenting, attention and externalizing problems: Testing mediation longitudinally, repeatedly and reciprocally. *Journal of Child Psychology and Psychiatry, and Allied Disciplines*, 48(12), 1233–1242. <https://doi.org/10.1111/j.1469-7610.2007.01807.x>
- Bradley, R. H., & Caldwell, B. M. (1979). Home observation for measurement of the environment: A revision of the preschool scale. *American Journal of Mental Deficiency*, 84(3), 235–244.
- Bradley, R. H., Caldwell, B. M., Rock, S. L., Ramey, C. T., Barnard, K. E., Gray, C., Hammond, M. A., Mitchell, S., Gottfried, A. W., Siegel, L., & Johnson, D. L. (1989). Home environment and cognitive development in the first 3 years of life: A collaborative study involving six sites and three ethnic groups in North America. *Developmental Psychology*, 25(2), 217–235. <https://doi.org/10.1037/0012-1649.25.2.217>
- Bradley, R. H., Corwyn, R. F., McAdoo, H. P., & García Coll, C. (2001). The home environments of children in the United States Part I: Variations by age, ethnicity, and poverty status. *Child development*, 72(6), 1844–1867. <https://doi.org/10.1111/1467-8624.t01-1-00382>

- Burt, S. A., McGUE, M., Krueger, R. F., & Iacono, W. G. (2005). How are parent–child conflict and childhood externalizing symptoms related over time? Results from a genetically informative cross-lagged study. *Development and Psychopathology*, 17(1), 145–165. <https://doi.org/10.1017/S095457940505008X>
- Campbell, S. B. (1994). Hard-to-manage preschool boys: Externalizing behavior, social competence, and family context at two-year followup. *Journal of Abnormal Child Psychology*, 22(2), 147–166. <https://doi.org/10.1007/BF02167897>
- Choenni, V., Lambregtse-van den Berg, M. P., Verhulst, F. C., Tiemeier, H., & Kok, R. (2019). The Longitudinal Relation between Observed Maternal Parenting in the Preschool Period and the Occurrence of Child ADHD Symptoms in Middle Childhood. *Journal of Abnormal Child Psychology*, 47(5), 755–764. <https://doi.org/10.1007/s10802-018-0492-9>
- Collins, W. A., Maccoby, E. E., Steinberg, L., Hetherington, E. M., & Bornstein, M. H. (2000). Contemporary research on parenting. The case for nature and nurture. *The American Psychologist*, 55(2), 218–232.
- Dalsgaard, S., Østergaard, S. D., Leckman, J. F., Mortensen, P. B., & Pedersen, M. G. (2015). Mortality in children, adolescents, and adults with attention deficit hyperactivity disorder: A nationwide cohort study. *The Lancet*, 385(9983), 2190–2196. [https://doi.org/10.1016/S0140-6736\(14\)61684-6](https://doi.org/10.1016/S0140-6736(14)61684-6)
- Danforth, J. S., Anderson, L. P., Barkley, R. A., & Stokes, T. F. (1991). Observations of parent-child interactions with hyperactive children: Research and clinical implications. *Clinical Psychology Review*, 11(6), 703–727. [https://doi.org/10.1016/0272-7358\(91\)90127-G](https://doi.org/10.1016/0272-7358(91)90127-G)
- Demmer, D. H., Puccio, F., Stokes, M. A., McGillivray, J. A., & Hooley, M. (2018). The Influence of Child Gender on the Prospective Relationships between Parenting and Child ADHD. *Journal of Abnormal Child Psychology*, 46(1), 113–125. <https://doi.org/10.1007/s10802-017-0284-7>
- D’Onofrio, B. M., Van Hulle, C. A., Waldman, I. D., Rodgers, J. L., Harden, K. P., Rathouz, P. J., & Lahey, B. B. (2008). Smoking during pregnancy and offspring externalizing problems: An exploration of genetic and environmental confounds. *Development and Psychopathology*, 20(1), 139–164. <https://doi.org/10.1017/S0954579408000072>
- Einziger, T., Zilberman-Hayun, Y., Atzaba-Poria, N., Auerbach, J. G., & Berger, A. (2019). How Important Is Early Home Environment in the Prediction of Attention-Deficit Hyperactivity Disorder in Adolescence? The Protective Role of Early Cognitive Stimulation. *Infant and Child Development*, 28(5). <https://doi.org/10.1002/icd.2138>
- Gerdes, A. C., Hoza, B., & Pelham, W. E. (2003). Attention-deficit/hyperactivity disorder boys’ relationships with their mothers and fathers: Child, mother, and father perceptions. *Development and Psychopathology*, 15(2), 363–382. <https://doi.org/10.1017/S0954579403000208>
- Jester, J. M., Nigg, J. T., Adams, K., Fitzgerald, H. E., Puttler, L. I., Wong, M. M., & Zucker, R. A. (2005). Inattention/hyperactivity and aggression from early childhood to adolescence: Heterogeneity of trajectories and differential influence of family environment characteristics. *Development and Psychopathology*, 17(1), 99–125. <https://doi.org/10.1017/S0954579405050066>
- Johnston, C., & Mash, E. J. (2001). Families of children with attention-deficit/hyperactivity disorder: Review and recommendations for future research. *Clinical Child and Family Psychology Review*, 4(3), 183–207. <https://doi.org/10.1023/a:1017592030434>
- Keown, L. J. (2012). Predictors of boys’ ADHD symptoms from early to middle childhood: The role of father-child and mother-child interactions. *Journal of Abnormal Child Psychology*, 40(4), 569–581. <https://doi.org/10.1007/s10802-011-9586-3>
- Lahey, B. B., Van Hulle, C. A., Waldman, I. D., Rodgers, J. L., D’Onofrio, B. M., Pedlow, S., Rathouz, P., & Keenan, K. (2006). Testing Descriptive Hypotheses Regarding Sex Differences in the Development of Conduct Problems and Delinquency. *Journal of Abnormal Child Psychology*, 34(5), 730–748. <https://doi.org/10.1007/s10802-006-9064-5>
- Lahey, B. B., & D’Onofrio, B. M. (2010). All in the Family: Comparing Siblings to Test Causal Hypotheses Regarding Environmental Influences on Behavior. *Current Directions in Psychological Science*, 19(5), 319–323. <https://doi.org/10.1177/0963721410383977>

- Lifford, K. J., Harold, G. T., & Thapar, A. (2008). Parent-child relationships and ADHD symptoms: A longitudinal analysis. *Journal of Abnormal Child Psychology*, 36(2), 285–296. <https://doi.org/10.1007/s10802-007-9177-5>
- Mulligan, A., Anney, R., Butler, L., O'Regan, M., Richardson, T., Tulewicz, E. M., Fitzgerald, M., & Gill, M. (2013). Home environment: Association with hyperactivity/impulsivity in children with ADHD and their non-ADHD siblings. *Child: Care, Health and Development*, 39(2), 202–212. <https://doi.org/10.1111/j.1365-2214.2011.01345.x>
- NLSY79 Data Overview: U.S. Bureau of Labor Statistics. (2017). Retrieved July 24, 2021, from <https://www.bls.gov/nls/nlsy79.htm>
- Tung, I., Brammer, W. A., Li, J. J., & Lee, S. S. (2014). Parenting behavior mediates the intergenerational association of parent and child offspring ADHD symptoms. *Journal of Clinical Child & Adolescent Psychology*, 44(5), 787–799. <https://doi.org/10.1080/15374416.2014.913250>
- Pauli-Pott, U., Schloß, S., & Becker, K. (2018). Maternal responsiveness as a predictor of self-regulation development and attention-deficit/hyperactivity symptoms across preschool ages. *Child Psychiatry & Human Development*, 49(1), 42–52. <https://doi.org/10.1007/s10578-017-0726-z>
- Ramos-Olazagasti, M. A., Castellanos, F. X., Mannuzza, S., & Klein, R. G. (2018). Predicting the adult functional outcomes of boys with ADHD 33 years later. *Journal of the American Academy of Child and Adolescent Psychiatry*, 57(8), 571–582.e1. <https://doi.org/10.1016/j.jaac.2018.04.015>
- Burke, J. D., Pardini, D. A. & Loeber, R. (2008). Reciprocal relationships between parenting behavior and disruptive psychopathology from childhood through adolescence. *Journal of Abnormal Child Psychology*, 36(5), 679–692. <https://doi.org/10.1007/s10802-008-9219-7>
- Rothbaum, F., & Weisz, J. R. (1994). Parental caregiving and child externalizing behavior in nonclinical samples: A meta-analysis. *Psychological Bulletin*, 116(1), 55–74. <https://doi.org/10.1037/0033-2909.116.1.55>
- Sagiv, S. K., Epstein, J. N., Bellinger, D. C., & Korrick, S. A. (2013). Pre- and postnatal risk factors for ADHD in a nonclinical pediatric population. *Journal of Attention Disorders*, 17(1), 47–57. <https://doi.org/10.1177/1087054711427563>
- Sayal, K., Prasad, V., Daley, D., Ford, T., & Coghill, D. (2018). ADHD in children and young people: Prevalence, care pathways, and service provision. *The Lancet. Psychiatry*, 5(2), 175–186. [https://doi.org/10.1016/S2215-0366\(17\)30167-0](https://doi.org/10.1016/S2215-0366(17)30167-0)
- Schafer, J. L., & Graham, J. W. (2002). Missing data: Our view of the state of the art. *Psychological Methods*, 7(2), 147–177. <https://doi.org/10.1037/1082-989x.7.2.147>
- Schmiedeler, S., Niklas, F., & Schneider, W. (2014). Symptoms of attention-deficit hyperactivity disorder (ADHD) and home learning environment (HLE): Findings from a longitudinal study. *European Journal of Psychology of Education*, 29(3), 467–482. <https://doi.org/10.1007/s10212-013-0208-z>
- Thapar, A., Cooper, M., Eyre, O., & Langley, K. (2013). Practitioner Review: What have we learnt about the causes of ADHD? *Journal of Child Psychology and Psychiatry*, 54(1), 3–16. <https://doi.org/10.1111/j.1469-7610.2012.02611.x>
- Thompson, R. A., & Meyer, S. (2007). Socialization of emotion regulation in the family. *Handbook of emotion regulation* (pp. 249–268). The Guilford Press.
- Uchida, M., Driscoll, H., DiSalvo, M., Rajalakshmi, A., Maiello, M., Spera, V., & Biederman, J. (2020). Assessing the magnitude of risk for ADHD in offspring of parents with ADHD: A systematic literature review and meta-analysis. *Journal of Attention Disorders*, 1087054720950815. <https://doi.org/10.1177/1087054720950815>
- Wakschlag, L. S., & Hans, S. L. (1999). Relation of maternal responsiveness during infancy to the development of behavior problems in high-risk youths. *Developmental Psychology*, 35(2), 569–579. <https://doi.org/10.1037//0012-1649.35.2.569>
- Woodward, L., Taylor, E., & Dowdney, L. (1998). The parenting and family functioning of children with hyperactivity. *Journal of Child Psychology and Psychiatry, and Allied Disciplines*, 39(2), 161–169. <https://doi.org/10.1111/1469-7610.00310>

Tables

Table 1

Means, Standard Deviations, and Ranges for Demographic Variables, ADHP, Responsiveness, Learning Stimulation, and Harshness

Variable	<i>M</i>	<i>S.D.</i>	Minimum	Maximum	<i>n</i>
Birth Order of Child	1.96	1.15	1.00	11.00	11510
Maternal Age at Childbirth	25.22	5.94	10.00	50.00	11508
Maternal Highest Grade	13.02	3.23	1.00	95.00	11508
Maternal IQ	35.63	27.31	1.00	99.00	10887
Income	9.86	0.99	2.70	13.79	9530
Maternal Delinquency	0.00	1.46	-1.50	9.00	10816
ADHP (4-5)*	0.00	1.00	-1.16	2.94	6916
ADHP (6-9)*	0.01	0.93	-1.11	2.83	8274
Cigarettes Smoked	0.39	0.67	0.00	3.00	10250
Alcohol Consumed	0.43	0.50	0.00	1.00	10277
Family Income**	9.86	1.00	2.70	13.79	9530
Responsiveness*	0.00	1.00	0.00	1.00	4697
Learning Stimulation*	0.00	1.00	0.00	1.00	5283
Harshness*	0.00	1.00	0.00	1.00	5344

Note. *Variables were z-score standardized. **Variables were log-transformed. Maternal age is the

maternal age at birth of each child. Maternal IQ was assessed using the Armed Forces Qualification. Maternal delinquency is residualized on maternal age.

Table 2

Zero-order correlations among measures of ADHP, Responsiveness, Learning Stimulation, Harshness, and Demographics

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Birth Order	—												
2. Maternal Age at Birth	.39**	—											
3. Highest Grade	-.10**	.24**	—										
4. Maternal IQ	-.14**	.27**	.42**	—									
5. Maternal Delinquency	.00	-.06**	-.07**	-.09**	—								
6. ADHP (4-5)	-.05**	-.19**	-.15**	-.16**	.07**	—							
7. ADHP (6-9)	-.02	-.17**	-.10**	-.14**	.10**	.56**	—						
8. Cig. Smoked	.05**	-.13**	-.17**	-.12**	.19**	.14**	.16**	—					
9. Alc. Consumed	-.07**	.07**	.09**	.26**	.09**	-.03*	.00	.15**	—				
10. Fam. Income	-.11**	.22**	.28**	.45**	-.09**	-.16**	-.15**	-.17**	.09**	—			
11. Responsiveness	-.04**	.23**	.13**	.22**	-.06**	-.11**	-.10**	-.10**	.05**	.18**	—		
12. Learning Stim.	-.18**	.25**	.31**	.43**	-.04**	-.22**	-.23**	-.15**	.11**	.35**	.24**	—	
13. Harshness	.07**	.34**	.11**	.09**	-.03	-.12**	-.10*	-.04**	.03*	.09**	.06**	.11**	—

Note. * $p < .05$, ** $p < .01$.

Table 3

Standardized estimates of path coefficients as estimated in the population (top) and when comparing siblings (below)

	ADHP at ages 6-9	
Predictor variable	β (S.E.)	z
Estimated Associations between families (population estimates)		
ADHP (ages 4-5)	0.86 (0.02)	43.32***
Parental Responsiveness	-0.05 (0.03)	-1.58
Parental Learning Stimulation	-0.13 (0.03)	-4.83***
Parental Harshness	-0.03 (0.03)	-0.83
Birth order	-0.03 (0.02)	-1.67
Sex	-0.16 (0.02)	-6.58**
Maternal age at childbirth	-0.10 (0.03)	-3.27**
Maternal drinking during pregnancy	0.00 (0.03)	-0.09
Maternal smoking during pregnancy	0.09 (0.03)	3.26**
Maternal Delinquency	0.09 (0.03)	3.53**
Maternal IQ	0.01 (0.03)	0.15
Hispanic	-0.02 (0.02)	-1.41
Black	0.07 (0.02)	0.35
Income	-0.06 (0.03)	-2.411*
Highest grade earned by mother	0.00 (0.03)	-0.09
Estimated Associations within families (sibling comparison)		
ADHP (ages 4-5)	0.33 (0.02)	18.77***
Parental Responsiveness	-0.03 (0.02)	-1.55
Parental Learning Stimulation	-0.03 (0.02)	-2.00*
Parental Harshness	0.00 (0.02)	-0.17
Birth order	0.08 (0.02)	3.53**
Sex	-0.15 (0.01)	-12.72***
Maternal age at childbirth	-0.10 (0.03)	-3.77**
Maternal drinking during pregnancy	0.00 (0.01)	-0.06
Maternal smoking during pregnancy	0.02 (0.01)	1.23

Note. Sex: 0 = male, 1 = female. Maternal age is the maternal age at birth of each child. Maternal delinquency was residualized on maternal age. Maternal IQ was assessed using the Armed Forces Qualification Test. Hispanic Americans and African Americans were assessed in comparison to European Americans. Family income was log-transformed. * $p \leq .05$ ** $p \leq .01$ *** $p \leq .001$.