HHS Public Access

Author manuscript

J Fam Psychol. Author manuscript; available in PMC 2020 December 01.

Published in final edited form as:

J Fam Psychol. 2019 December ; 33(8): 975–981. doi:10.1037/fam0000535.

The association between home chaos and academic achievement: The moderating role of sleep

Rebecca H. Berger[1], **Anjolii Diaz**[2], **Carlos Valiente**[3], **Nancy Eisenberg**[4], **Tracy L. Spinrad**[3], **Leah D. Doane**[4], **Marilyn S. Thompson**[3], **Maciel M. Hernández**[5], **Sarah K. Johns**[4], **Jody Southworth**[4]

[1]College of Education, The University of Maryland, 4716 Pontiac St. Suite 1102, College Park, MD 20740 USA

[2]Department of Psychological Science, Ball State University, 2000 W University Avenue 109 North Quad Muncie, IN 47306, USA

[3]T. Denny Sanford School of Social and Family Dynamics, Arizona State University, 850 S. Cady Mall Tempe, AZ 85281-3701 USA

[4]Department of Psychology, Arizona State University, P.O. Box 871104, Tempe, AZ 85287-1104 USA

[5]Department of Psychology, Portland State University, 1721 SW Broadway, Portland, OR 07207 1104 USA

Abstract

The goal of this study was to understand the role young children's sleep plays in the association between their family environment and academic achievement (AA) by examining sleep as a moderator between home chaos (chaos) and children's AA. We examined this question in a sample of 103 kindergarteners and first graders. In the fall, parents reported on levels of chaos in their home. To measure sleep, early in the spring, children wore actigraphs for five consecutive school nights. Later in the spring, children completed standardized tests of achievement. Sleep duration, but not sleep efficiency, moderated relations between chaos and AA. Specifically, children with longer sleep durations (26% of the sample), as compared to children with average or lower sleep durations, had significant negative associations between chaos and achievement indicating that children in higher chaos homes had lower academic achievement. The findings enhance scholars' understanding of the relation between chaos and AA as well as highlight an important bioregulatory factor in the association between home family environment and children's academic outcomes.

Keywords

home environment; home chaos; academic achievement; sleep

Correspondence should be addressed to Dr. Rebecca H. Berger, College of Education, The University of Maryland, 4716 Pontiac St. Suite 1102, College Park, MD 20740 USA, rhberger@umd.edu. Phone: 248-345-8937.

Introduction

Children raised in a chaotic family environment are often theorized to experience negative academic outcomes (Berry et al., 2016; Brown & Low, 2008); however, not all children raised in chaotic environments experience such difficulties (Johnson, Martin, Brooks-Gunn, & Petrill, 2008). Recent scholarship identifies bioregulatory mechanisms, particularly sleep, as important constructs that might modify relations between the family environment and children's school experiences (El-Sheikh & Kelly, 2017). Indeed, sleep facilitates children's cognitive and social functioning (Vriend, Davidson, Rusak, & Corkum, 2015) and is associated with academic success (Gruber, Wiebe, Wells, Cassoff, & Monson, 2010). However, how sleep modifies the relations between family environments and children's school experiences remains unclear.

To bolster this growing line of research and offer some clarity on the relations in early elementary school, we modeled our study similarly to El-Sheikh, Tu, Erath, and Buckhalt's (2014) study involving sleep duration and efficiency as moderators of the relations between parenting and adolescents' cognitive capacities. Specifically, we examined whether sleep moderated the relations between elementary school children's home chaos (chaos) and academic achievement (AA). El-Sheikh et al. (2014) found that sleep efficiency, but not sleep duration, modified the association between parenting and cognition such that the negative association between parental control and cognition was found only for adolescents who experienced high sleep efficiency. Cognition and AA (Astill, Van der Heijden, Van Dzendoorn, & Van Someren, 2012) and parenting and chaos (Coldwell, Pike, & Dunn, 2006) are highly related constructs, but they are operationalized differently and each may provide insights into the role of home environments in children's outcomes. In addition, Luthar, Cicchetti, and Becker (2000) suggested that the home environment's effect on a child may depend on bioregulatory mechanisms. One of the models they postulated was a protective-reactive model in which a bioregulatory factor that generally provides an advantage (i.e., sleep) demonstrates less of an advantage in the context of high stress (i.e., chaos; Luthar et al., 2000). Thus, prior research and theory guided this study's utilization of chaos as an indicator of the family environment as well as the assessment of sleep as a potential moderator between chaos and early AA.

Chaos and AA

We focused on chaos as an indicator of the quality of children's family environment. There is large body of research on the relations between chaotic home environments and children's outcomes (for reviews, see Evans & Wachs, 2010). Chaos can include marital conflict, instability, and overcrowding. In this study, a chaotic home was characterized by high levels of noise, disorganization, and a lack of routines. Skills associated with children's AA, such as social abilities and self-regulation, are thought to develop inadequately in chaotic homes, thereby thwarting children's AA (Wachs, 1992). Studying chaos is important because it is part of the broader family environment that relates to children's outcomes (Evans & Wachs, 2009). Only a few researchers have examined the relation between chaos and children's AA in early childhood. However, findings suggest that chaos is either related to poorer reading and AA (Berry et al., 2016; Brown & Low, 2008; Garrett-Peters, Mokrova, Vernon-Feagans, Willoughby, & Pan, 2016) or has no association with early literacy and AA (Johnson et al., 2008). By including bioregulatory mechanisms as a moderator of the relation between chaos and AA, the present study may help explain the inconsistent evidence reported in previous studies.

The Moderating Role of Sleep

Sleep is thought to facilitate skills that are important for AA, such as cognition, memory, and self-regulation (Gruber et al., 2010; Vriend et al., 2015). A meta-analysis indicates that sleep duration, but not efficiency, is related to children's cognition (Astill et al., 2012). This may be because of low variability in children's sleep efficiency, but may also be due to the small number of studies that include sleep efficiency in children.

Thus, in the present study, we included sleep duration and efficiency. Sleep duration is the total time asleep minus waking periods between sleep onset (i.e., when in bed and movement is limited, indicating falling asleep) and offset (i.e., when awake and movement indicates no longer asleep). Sleep efficiency is the percentage of time actually asleep. Scholars theorize that more optimal sleep (e.g., longer time spent asleep) may enhance the effects of positive home environments on AA because longer sleep duration may promote regulatory capacities, memory, and motivation (Buckhalt, 2011; Gruber et al., 2010). Given that chaos interferes with the ability to master information (Evans, Gonnella, Marcynyszyn, Gentile, & Salpekar, 2005), it is not surprising that children in chaotic homes sometimes experience more sleep problems and a lack of persistence and withdrawal from academically challenging tasks (Boles et al., 2017; Brown & Low, 2008). Many children are living in chaotic homes and getting less sleep than recommended (Evans et al., 2005; Hirshkowitz et al., 2015); thus, it is important to examine if the interaction between chaos and sleep predicts early AA.

Some researchers found maternal sensitivity was positively related to toddlers' outcomes (e.g., executive function, theory of mind), but only when sleep duration was long (Bernier, Bélanger, Tarabulsy, Simard, & Carrier, 2014). There is also growing empirical evidence supporting the protective-reactive model (Luthar et al., 2000). El-Sheikh et al. (2014) found sleep efficiency, but not duration, interacted with parenting when predicting adolescents' cognition. Specifically, when sleep efficiency was high, there were stronger negative relations between adolescents' cognition and harsh parenting or psychological control (i.e., stressful environment), than when sleep efficiency was low (El-Sheikh et al., 2014). Results also suggest that adolescents with higher sleep efficiency and low harshness and control had the highest cognition. Therefore, sleep may predict academic outcomes, but other results show sleep does not significantly predict other indicators of child well-being, such as Body Mass Index (Miller et al., 2014). This study fills a gap in the literature by considering interactions of bioregulatory mechanisms and the home environment during early elementary school, a critical period when children develop skills that lay the foundation for later success (Entwisle & Alexander, 1993).

Present Study

We examined sleep as a moderator of the relations between chaos and AA because El-Sheikh et al. (e.g., El-Sheikh & Kelly, 2017), and Luthar et al. (2000) highlighted the importance of studying bioregulatory mechanisms in explaining the relations between stressful home environments (i.e., chaos) and children's outcomes (i.e., AA). We expected that low chaos and more optimal sleep (i.e., long sleep duration and high efficiency) would be associated with higher AA. We further hypothesized that chaos and sleep would interact, such that the negative association between chaos and AA would be strongest for children with more optimal sleep.

Method

Participants

Fifty kindergarteners and 53 first graders (51% girls, all percentages are rounded) were recruited from a larger study (see Hernández et al., 2016 for larger study demographics). All participants from the larger study were invited to participate in the present study. This study's sample was not statistically different from the larger study's sample except that mothers and fathers in the larger study were less educated than parents in the present study ($t_{mom\ education} = -3.16$, $p = .002$, $\Delta M = -.37$, 95% CI [−.59, −.14]; $M_{larger\ study} = 2.86$ ($SD = 1.06$), $M_{present\ study} = 3.23$ ($SD = .88$); $t_{father\ education} = -3.61$, $p < .001$, $\Delta M = -.46$, 95% CI [−.71, −.21]; $M_{larger\ study} = 2.65$ ($SD = 1.15$), $M_{present\ study} = 3.11$ ($SD = .96$). Children were predominantly Hispanic (50%). Non-Hispanic (45%) children were mostly White (83%; 4% Black, 2% Asian, 9% American Indian, 2% mixed race, 6% did not report). Children ranged in age from 5.65 to 7.51 years ($M = 6.47$ years, $SD = 0.30$).

Procedure

In the fall, parents reported on chaos in their home. In early spring, children wore actigraphs for five consecutive weekdays[1] and parents ensured children followed the actigraph protocol. Later in the spring, research assistants assessed children's AA using standardized tests. Children were given two small toys and parents were paid $50 for their participation. The study had IRB approval from Arizona State University. Parents provided consent and children provided assent.

Measures

Chaos—Parents reported on chaos (1 = *extremely false* to 5 = *extremely true)* using a modified version of the Chaos Order and Hubbub Scale (9 items; "We almost always seem to be rushed"; CHAOS; Matheny, Wachs, Ludwig, & Phillips, 1995). The CHAOS measure has demonstrated stability over time and construct validity with observed chaos (Matheny et al., 1995). In this sample, the scale was reliable ($\alpha = .77$); items were averaged into a composite.

[1]Thirteen children in this sample took one nap, and 3 took two naps during the week of data collection. Napping was unrelated to other study variables; thus, napping was not included in the final models.

Sleep duration—Sleep duration was assessed using an actigraph (Actiwatch 2; Philips Respironics Inc, Murrysville, PA), which children wore on their non-dominant wrist from Sunday to Thursday. Actigraphy has been validated against polysomnography and is a non-invasive tool for measuring sleep (Acebo et al., 1999). Sleep-wake cycles were estimated with a piezoelectric set to a low threshold of motion (40 counts per epoch and a range of 20–80 counts per epoch) and measured in 1-minute epochs based on at least 10 minutes of inactivity using the Phillips Actiware V5.7 algorithm, which has been validated in children (Meltzer et al., 2012). In a daily sleep diary (offered in Spanish and English), parents reported their children's sleep-wake times and these times were used to score and validate the actigraph data (Acebo & Carskadon, 2002). Most children had five nights of sleep data (89%); a few had four nights (10%), or three nights (1%). Missing nights are due to device malfunctions or forgetting to put the actigraph back on after an activity (e.g., showering). Average sleep duration and efficiency was calculated from a minimum of three nights of data ($M = 4.88$ nights, $SD = .35$ nights; Acebo et al., 1999).

AA—AA was assessed with the Applied Problems (AP) and Passage Comprehension (PC) subtests from the Woodcock Johnson Tests of Achievement (WJ-III). The subtests are reliable ($\alpha > .88$; Woodcock et al., 2001). W scores computed by the WJ-III software were used in the present study. These scores are norm-referenced and allow for intra-individual comparisons across time. AP and PC were related ($r = .58$, $p < .001$) and averaged into a composite.

Covariates

Initial academic knowledge: Children completed the Picture Vocabulary (PV) subtest from the WJ-III in the fall of their kindergarten year and the PV W score was used as a control for initial academic knowledge (Woodcock et al., 2001).

Family demographic information: Family annual income (Range = 1 ($0-$9,000) to 11 ($100,000 or over), $M = 7.29$, $SD = 3.34$), mothers' and fathers' education (Range = 1 (less than high school diploma) to 4 (college graduate or higher), $M_{mother} = 3.24$ [$SD_{mother} = .87$], $M_{father} = 3.12$ [$SD_{father} = .96$), were highly correlated (rs < .53, ps < .001); thus, they were converted into z-scores and averaged as a measure of SES. Finally, parents reported whether their child was Hispanic (0) or non-Hispanic (1) and on their child's sex (0 = female, 1 = male).

Medication use: Parents reported if their child took medication that could alter sleep (e.g., antihistamines, antibiotics) on nights that their child wore the actigraph. A 1 was scored for each night that a child took medication and an average was computed across weekdays of available sleep data, which was used as a control in statistical analyses.

Results

Prior to hypothesis testing, correlations between the study variables were examined and are presented in Table 1. Many of the covariates were related in the expected ways to key study variables. Chaos was unrelated to AA. Intra-class correlations indicated that similarities between children in the same classroom accounted for 4% of the total variance in sleep duration, 16% in sleep efficiency, and 33% in AA. As a result, all subsequent analyses were conducted using type=complex in MPlus 7 (Muthén & Muthén, 2012) with fall classroom as the cluster variable (33 classrooms, *M* = 3 students per classroom [*SD* = 2]). Full Information Maximum Likelihood estimator with robust standard errors was used to handle missing data. Chaos and sleep were grand mean centered.

Sleep Duration and Efficiency as Moderators between Chaos and AA

Two regressions evaluated the interactions between chaos and sleep (see Table 2). The interaction between chaos and sleep duration significantly predicted AA[2]. Simple slopes were tested by computing the regression coefficient for AA on chaos at one standard deviation above, at, and below the mean of sleep duration (Aiken & West, 1991). The negative relation between chaos and AA was only significant when sleep duration was long (see Table 2 and Figure 1). Regions of significance tests indicated that the negative relation between chaos and AA was significant at 0.57 *SD* above the mean of sleep duration (9.65 hours), which represents 26% of the sample. The interaction between chaos and sleep efficiency was not significant (see Table 2).

Discussion

The goal of this study was to examine sleep as a bioregulatory moderator of the relation between the home environment, specifically chaos, and children's AA. The interaction between chaos and sleep duration, but not efficiency, significantly predicted AA in late spring, even when controlling for a number of known correlates of sleep and AA. The relation between chaos and AA was negative at high levels of sleep duration, such that children low in chaos and high in sleep duration performed well, whereas those high in chaos and high in duration performed at lower levels. These findings support a key premise of the protective-reactive model; sleep duration provided an advantage at low levels of environmental stress (i.e., chaos) but not high levels of stress (Luthar et al., 2000). These results suggest that sleep duration may be a potentially important bioregulatory modifier of the relation between chaos and AA. Younger children's sleep was found to relate to family functioning and AA but not in the same ways as in adolescence (e.g., El-Sheikh et al., 2014), thus confirming the importance of studying both aspects of sleep (quality and quantity) across a range of development.

The negative relation between chaos and AA was only significant when sleep duration was long. Further probing suggested that lower chaos and more sleep was associated with higher AA supporting previous research (Bernier et al., 2014; El-Sheikh et al., 2014). Moreover, children with higher chaos and long sleep duration had low AA scores. It is plausible that children in chaotic homes use sleep to escape and help manage daily demands (Matheny et al., 1995). Indeed, sleep is thought to provide respite from stressful thoughts, personal interactions, and contexts in adults (Ohayon, 2008). The characteristics of our sample may also explain this result. Chaos was assessed on a scale from 1 to 5, but in our sample, the

---

[2]When WJ-III AP and PC were analyzed as separate outcomes, the interaction between chaos and sleep duration and chaos and sleep efficiency were the same as the results with the AA composite. For parsimony, we only report the regression results with the AA composite as the outcome.

mean was 2.15. This is discrepant from a previous study with a larger sample that reported a larger range and a mean closer to 3 (i.e., Johnson et al., 2008). Therefore, "high" chaos in our sample may not be representative of a highly chaotic environment. Also, according to the National Sleep Foundation, normally developing three- to five-year-olds should get 10 to 13 hours and six- to 13-year-olds should get nine to 11 hours of sleep (Hirshkowitz et al., 2015). Thus, the children in our sample with long sleep duration (~9 hrs 54 mins) were either not getting enough sleep (3- to 5-year-olds) or getting *just* enough sleep (6- to 13-year-olds) whereas the short sleepers were getting less than the recommended amount of sleep. In the future, scholars should identify samples with a wider range of chaos and sleep duration.

The present study has several strengths. First, we utilized an objective measure of children's sleep. Parents may overestimate their children's sleep duration by 30 to 60 minutes (Dayyat, Spruyt, Molfese, & Gozal, 2011), potentially biasing results (Fallone, Acebo, Seifer, & Carskadon, 2005). Second, we included measures of sleep quality and quantity, which scholars recommend in order to understand associations more clearly (e.g., Gregory & Sadeh, 2012). Given that quantity but not quality explained the relation between chaos and AA, future researchers should continue to examine sleep quantity and quality, which includes sleep regularity (i.e., consistency of bed and wake times). Third, this is a short-term longitudinal study as measures were collected in the Fall and Spring of the participants' school year. We also used an objective measure of children's AA. Finally, to our knowledge, this is the only study to empirically examine sleep as a potential moderator of the relations between chaos and AA.

Despite these strengths, the study is not without its limitations. For example, the families in our sample were mostly middle-class. Although chaos is often cited as being part of the environment in low SES homes, chaos still contributes to children's outcomes in middle-SES homes (e.g., Coldwell et al., 2006). Thus, it is important to continue studying chaos in a variety of families. We also used subjective measures of chaos. Objective measures, such as dosimeters (measures noise) and independent observations, should also be explored. Additionally, we controlled for previous AA using PV W scores. Although other researchers have used similar methods (e.g., Valiente, Lemery-Chalfant, & Swanson, 2010), a more optimal method would have been to measure AA at two time points and control for the earlier time point. Finally, the sample size was somewhat small so we may have been underpowered to detect some effects. Collecting objective sleep assessments from a large number of young participants can be challenging due to the high cost of the assessment tools (e.g., actigraphs, polysomnography) as well as the need to collect multiple days of sleep data. Nevertheless, future scholars should consider studying these constructs in larger samples.

In conclusion, we found that chaos and AA were only negatively related when children experienced longer sleep duration. Children who experienced lower chaos and longer sleep duration had higher AA. Children who had higher chaos and longer sleep had lower AA. Our results support calls by El-Sheikh and Kelly (2017) to examine sleep as an important bioregulatory moderator between family functioning and children's outcomes. This study provides some evidence for the premise that children's success and development may be a function of *both* environmental and individual factors (Luthar et al., 2000), but additional research is needed and especially studies involving younger children's home environment, bioregulatory functioning, and their outcomes.

Acknowledgments

Funding

Research reported in this publication was supported by the Eunice Kennedy Shriver National Institute of Child Health & Human Development of the National Institutes of Health under Award Number R01HD068522, awarded to Carlos Valiente and Nancy Eisenberg. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

References

Acebo C, & Carskadon MA (2002). Influence of irregular sleep/wake patterns on waking behavior In Carskadon MA (Ed.), Adolescent Sleep Patterns: Biological, Social, and Psychological Influences (pp. 220–235). Cambridge, UK: Cambridge University Press.

Acebo C, Sadeh A, Seifer R, Tzischinsky O, Wolfson AR, Hafer A, & Carskadon MA (1999). Estimating sleep patterns with activity monitoring in children and adolescents: How many nights are necessary for reliable measures? Sleep, 22(1), 95–103. 10.1093/sleep/22.L95 [PubMed: 9989370]

Aiken LS, & West SG (1991). Multiple regression: Testing and interpreting interactions. Thousand Oaks, CA: SAGE Publications, Inc.

Astill RG, Van der Heijden KB, Van IJzendoorn MH, & Van Someren EJW (2012). Sleep, cognition, and behavioral problems in school-age children: A century of research meta-analyzed. Psychological Bulletin, 138(6), 1109–1138. 10.1037/a0028204 [PubMed: 22545685]

Bernier A, Bélanger M-È, Tarabulsy GM, Simard V, & Carrier J (2014). My mother is sensitive, but I am too tired to know: Infant sleep as a moderator of prospective relations between maternal sensitivity and infant outcomes. Infant Behavior & Development, 37(4), 682–694. 10.1016/j.infbeh.2014.08.011 [PubMed: 25243613]

Berry D, Blair C, Willoughby M, Garrett-Peters P, Vernon-Feagans L, & Mills-Koonce WR (2016). Household chaos and children's cognitive and socio-emotional development in early childhood: Does childcare play a buffering role? Early Childhood Research Quarterly, 34, 115–127. 10.1016/j.ecresq.2015.09.003 [PubMed: 29720785]

Boles RE, Halbower AC, Daniels S, Gunnarsdottir T, Whitesell N, & Johnson SL (2017). Family chaos and child functioning in relation to sleep problems among children at risk for obesity. Behavioral Sleep Medicine, 15(2), 114–128. 10.1080/15402002.2015.1104687 [PubMed: 26745822]

Brown ED, & Low CM (2008). Chaotic living conditions and sleep problems associated with children's responses to academic challenge. Journal of Family Psychology, 22(6), 920–923. http://dx.doi.org.ezproxy1.lib.asu.edu/10.1037/a0013652 [PubMed: 19102613]

Buckhalt JA (2011). Insufficient sleep and the socioeconomic status achievement gap: Sleep and achievement. Child Development Perspectives, 5(1), 59–65. 10.1111/j.1750-8606.2010.00151.x

Coldwell J, Pike A, & Dunn J (2006). Household chaos - links with parenting and child behaviour. Journal of Child Psychology and Psychiatry, 47(11), 1116–1122. 10.1111/j.1469-7610.2006.01655.x [PubMed: 17076750]

Dayyat EA, Spruyt K, Molfese DL, & Gozal D (2011). Sleep estimates in children: Parental versus actigraphic assessments. Nature and Science of Sleep, 3, 115–123. 10.2147/NSS.S25676

El-Sheikh M, & Kelly RJ (2017). Family functioning and children's sleep. Child Development Perspectives, 0(0), 1–6. 10.1111/cdep.12243

El-Sheikh M, Tu KM, Erath SA, & Buckhalt JA (2014). Family stress and adolescents' cognitive functioning: Sleep as a protective factor. Journal of Family Psychology, 28(6), 887–896. 10.1037/fam0000031 [PubMed: 25329625]

Entwisle DR, & Alexander KL (1993). Entry into school: The beginning school transition and educational stratification in the United States. Annual Review of Sociology, 19, 401–423. 10.2307/2083394

Evans GW, Gonnella C, Marcynyszyn LA, Gentile L, & Salpekar N (2005). The role of chaos in poverty and children's socioemotional adjustment. Psychological Science, 16(7), 560–565. 10.1111/j.0956-7976.2005.01575.x [PubMed: 16008790]

Evans GW, & Wachs TD (2009). Chaos and children's development: Levels of analysis and mechanisms. Washington, D.C: American Psychological Association.

Evans GW, & Wachs TD (Eds.). (2010). Chaos and its influence on children's development: An ecological perspective. Washington, DC, US: American Psychological Association 10.1037/12057-000

Fallone G, Acebo C, Seifer R, & Carskadon MA (2005). Experimental restriction of sleep opportunity in children: Effects on teacher ratings. Sleep, 25(12), 1561–1567. 10.1093/sleep/28.12.1561

Garrett-Peters PT, Mokrova I, Vernon-Feagans L, Willoughby M, & Pan Y (2016). The role of household chaos in understanding relations between early poverty and children's academic achievement. Early Childhood Research Quarterly, 37(Supplement C), 16–25. https://doi.org/10.1016Zj.ecresq.2016.02.004 [PubMed: 27330247]

Gregory AM, & Sadeh A (2012). Sleep, emotional and behavioral difficulties in children and adolescents. Sleep Medicine Reviews, 16(2), 129–136. 10.1016/j.smrv.2011.03.007 [PubMed: 21676633]

Gruber R, Wiebe ST, Wells SA, Cassoff J, & Monson E (2010). Sleep and academic success: mechanisms, empirical evidence, and interventional strategies. Adolescent Medicine: State of the Art Reviews, 21(3), 522–541, x. [PubMed: 21302859]

Hernández MM, Eisenberg N, Valiente C, VanSchyndel SK, Spinrad TL, Silva KM, ... Southworth J (2016). Emotional expression in school context, social relationships, and academic adjustment in kindergarten. Emotion, 16(4), 553–566. 10.1037/emo0000147 [PubMed: 26751629]

Hirshkowitz M, Whiton K, Albert SM, Alessi C, Bruni O, DonCarlos L, ... Hillard PJA (2015). National Sleep Foundation's sleep time duration recommendations: methodology and results summary. Sleep Health: Journal of the National Sleep Foundation, 1(1), 40–43. https://doi.org/10.1016Zj.sleh.2014.12.010

Johnson AD, Martin A, Brooks-Gunn J, & Petrill SA (2008). Order in the house! Associations among household chaos, the home literacy environment, maternal reading ability, and children's early reading. Merrill-Palmer Quarterly, 54(4), 445–472. [PubMed: 19526070]

Luthar SS, Cicchetti D, & Becker B (2000). The construct of resilience: A critical evaluation and guidelines for future work. Child Development, 71(3), 543–562. 10.1111/1467-8624.00164 [PubMed: 10953923]

Matheny AP Jr., Wachs TD, Ludwig JL, & Phillips K (1995). Bringing order out of chaos: Psychometric characteristics of the confusion, hubbub, and order scale. Journal of Applied Developmental Psychology, 16(3), 429–444. 10.1016/0193-3973(95)90028-4

Meltzer LJ, Walsh CM, Traylor J, & Westin AML (2012). Direct comparison of two new actigraphs and polysomnography in children and adolescents. Sleep, 35(1), 159–166. 10.5665/sleep.1608 [PubMed: 22215930]

Miller AL, Kaciroti N, LeBourgeois MK, Chen YP, Sturza J, & Lumeng JC (2014). Sleep timing moderates the concurrent sleep duration-body mass index association in low-income preschool-age children. Academic Pediatrics, 14(2), 207–213. 10.1016/_j.acap.2013.12.003 [PubMed: 24602585]

Muthén LK, & Muthén BO (2012). MPlus user's guide. (7th ed.). Los Angeles, CA: Muthén & Muthén.

Ohayon MM (2008). From wakefulness to excessive sleepiness: what we know and still need to know. Sleep Medicine Reviews, 12(2), 129–141. 10.1016/j.smrv.2008.01.001 [PubMed: 18342261]

Valiente C, Lemery-Chalfant K, & Swanson J (2010). Prediction of kindergartners' academic achievement from their effortful control and emotionality: Evidence for direct and moderated relations. Journal of Educational Psychology, 102(3), 550–560. 10.1037/a0018992

Author Manuscript
Author Manuscript
Author Manuscript

Vriend JL, Davidson F, Rusak B, & Corkum P (2015). Emotional and cognitive impact of sleep restriction in children. Sleep Medicine Clinics, 10(2), 107–115. 10.1016/j.jsmc.2015.02.009 [PubMed: 26055858]

Wachs TD (1992). The Nature of Nurture. Newbury Park, CA: SAGE Publications.

Woodcock RW, Mather N, & McGrew KS (2001). Woodcock-Johnson III Tests of Achievement (WJ-III). Riverside Pub.

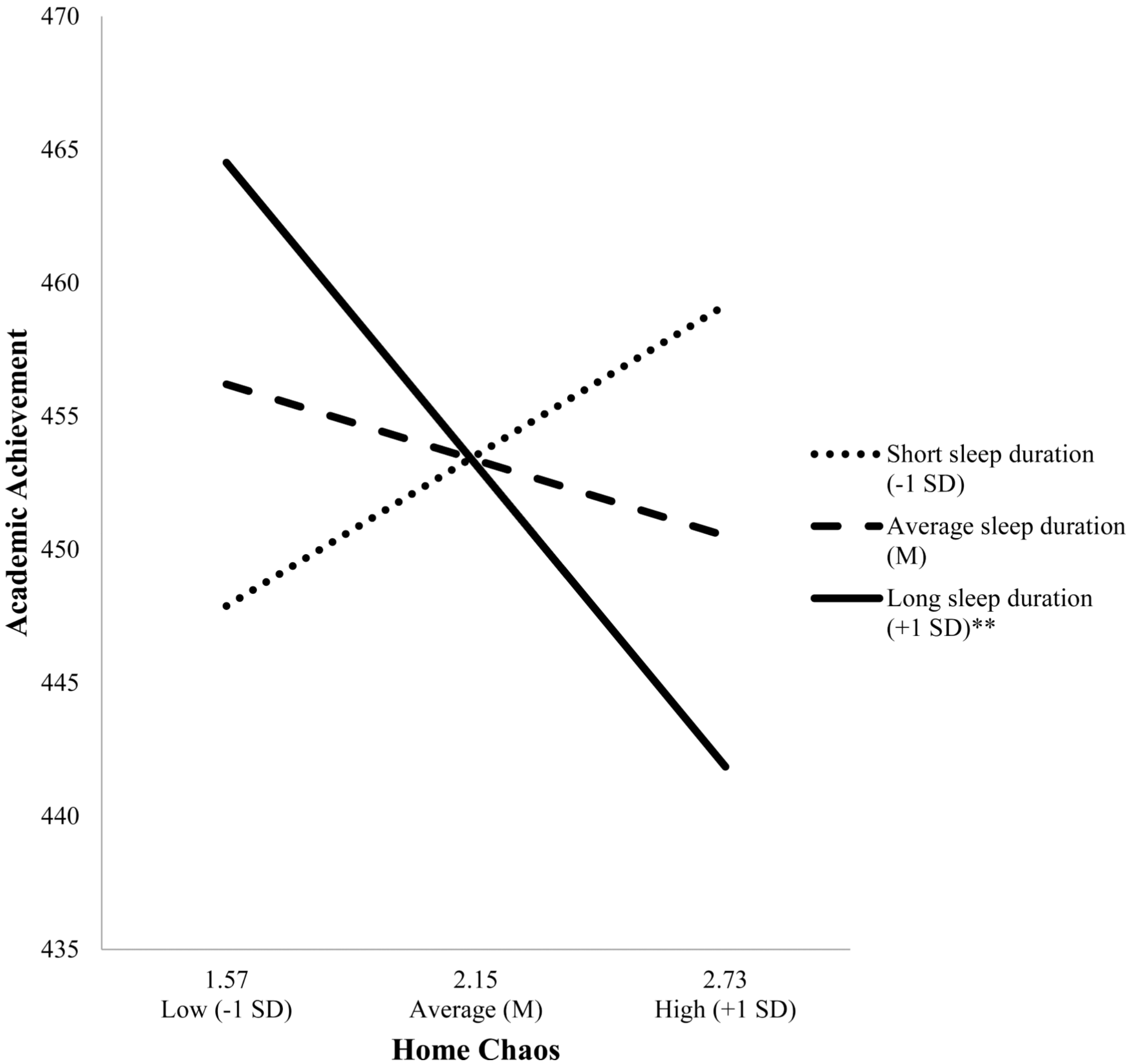

Figure 1.

Home chaos predicting academic achievement as moderated by sleep duration. Twenty-six percent of the sample fell into the region of significance (.57 *SD* above the mean of sleep duration [M = 9.65 hours]). Short duration = one standard deviation below the sample mean. Average duration = sample mean. Long duration = one standard deviation above the sample mean. Low chaos = one standard deviation below the sample mean. High chaos = one standard deviation above the sample mean. Academic achievement = average of Woodcock Johnson III Applied Problems and Passage Comprehension subtests. **$p < .01$.

Table 1

Descriptive Statistics and Correlations for Study Variables

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1. SES	-									
2. Age	−0.09	-								
3. WJ-III PV	0.59**	−0.03	-							
4. Hispanic	−0.36**	−0.02	−0.44**	-						
5. Medication	0.20*	0.04	0.20*	−0.10	-					
6. Male	0.20*	−0.02	0.23*	−0.26*	0.31**	-				
7. Home chaos	−0.09	0.13	−0.07	0.09	0.17	−0.03	-			
8. Sleep duration	0.29**	−0.24*	0.17	0.01	−0.02	−0.05	−0.13	-		
9. Sleep efficiency	−0.06	−0.17	−0.21*	0.20*	−0.11	−0.18	0.08	0.26**	-	
10. AA	0.32**	0.01	0.50**	−0.23*	0.06	0.12	−0.07	0.07	0.08	-
Min	−2.09	5.65	444.00	-	0.00	-	1.00	477.80	63.87	415.00
Max	1.02	7.51	513.00	-	1.00	-	3.56	631.00	91.45	503.50
Mean	−0.01	6.47	472.04	0.53	0.12	0.50	2.15	561.82	81.01	454.14
SD	0.88	0.30	10.72	0.50	0.27	0.50	0.58	30.65	4.25	17.88

Note. N = 103. Child’s age is in years. Male is coded as 0=female, 1=male; Hispanic is coded as 0=non-Hispanic, 1=Hispanic. SES=Socioeconomic status; WJ-III PV=Woodcock Johnson III Picture Vocabulary; AA = Academic Achievement, which is a composite of Woodcock Johnson III Applied Problems and Passage Comprehension subtests. SES was calculated as a composite of standardized family income and parent education. Sleep duration is in minutes.

* $p < .05$.

** $p < .01$.

Table 2

Home Chaos Predicting AA as Moderated by Sleep

	Model 1	Model 2
	B (SE)	***B (SE)***
SES	0.82 (2.84)	0.12 (2.96)
Age	0.86 (4.24)	4.05 (4.47)
WJ-III PV	0.86 (0.18) ***	0.90 (0.18) ***
Hispanic	0.43 (3.81)	−1.55 (3.49)
Medication	−2.76 (4.98)	−2.12 (5.44)
Male	−1.11 (3.11)	0.20 (2.97)
Home chaos	−2.08 (2.35)	−2.29 (2.49)
Sleep duration	−0.01 (0.06)	
Sleep efficiency		0.83 (0.43)
Interaction	−0.20 (0.09) *	−0.10 (0.80)
Simple slopes for significant interactions		
Short sleep duration	4.11 (3.72)	
Medium sleep duration	−2.08 (2.35)	
Long sleep duration	−8.26 (3.30) *	
Low sleep efficiency		N/A
Average sleep efficiency		N/A
High sleep efficiency		N/A

Note. Child's age is in years. Male is coded as 0=female, 1=male; Hispanic is coded as 0=non- Hispanic, 1=Hispanic. SES=Socioeconomic status; WJ-III PV=Woodcock Johnson III Picture Vocabulary; AA = Academic Achievement, which is a composite of Woodcock Johnson III Applied Problems and Passage Comprehension subtests. SES was calculated as a composite of standardized family income and parent education. Sleep duration is in minutes. All coefficients are unstandardized.

* $p < .05$.

** $p < .01$.

*** $p < .001$.