The State of Chaos

DISSERTATION

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By

Pamela Sechrist Vincent

Graduate Program in Human Ecology

The Ohio State University

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Dissertation Committee:

Stephen Petrill, Advisor

Xin Feng

Claire Kamp-Dush

Sarah Schoppe-Sullivan
Abstract

Chapter 1: Getting the chaos out of chaos

The goal of this review was to explore and organize current theoretical foundations, definitions, and methodologies associated with chaos. It demonstrated that there were two main groups of research; that which intentionally studied the effects of chaos in the home (such as noise and distraction), and that which studied some form of instability (such as partner changes or relocation). This review argued that measures of instability may actually be operationalized as dimensions of chaos. It also illustrated that many of the outcomes associated with these measures were similar. Therefore, future research should compare additional measures of instability and chaos to either create a unified construct or demonstrate the differences between the two.

Chapter 2: Chaos and attention

The goal of this study was to explore the relationship between chaos in the home and children’s attention scores at approximately age 11. The current study utilized established measures of chaos, inattention, and hyperactivity in a sample from the Western Reserve Reading and Math Project (WRRMP). Evidence suggested that mothers’ reports of chaos (N=157) were significantly correlated with inattention and hyperactivity, but children’s reports of chaos (N=309) were not. Additionally, hierarchical regression models were estimated to address whether the relationship
between chaos and attention was moderated by SES or family size. A significant interaction was found between chaos and family size when estimating variance in inattention, suggesting that the relationship between chaos and inattention was stronger in small families. While it was hypothesized that home literacy environment and parental involvement would mediate the relationship between chaos and attention, no mediating effects were found. Finally, the unique results for mother- and child- ratings of chaos suggested that there may be differences in the way that chaos was perceived, leading to variable effects for different members of the family.

Chapter 3: Attention, chaos, and academic performance.

This study used 157 mothers and 309 of their children at age 11, drawn from the Western Reserve Reading and Math Project (WRRMP), to examine the relationship between perceptions of chaos (noise, distraction, lack of routine) and children’s inattention and hyperactivity scores, as well as their associations with math and reading performance measures. Results demonstrated that child- and mother- reported chaos scores were correlated with the math performance measures taken from the Woodcock Johnson III (WJIII) and with the reading performance measures taken from the Woodcock Reading Mastery Test (WRMT). The inattention and hyperactivity measures were significantly related to the math scores, but not the reading scores. Additionally, hierarchical regression models were estimated to address whether the relationship between attention and academic performance was moderated by chaos. There were no significant interactions with chaos when accounting for variance in math or reading performance.
Chapter 4: Discussion

This summary demonstrated the importance of each of the previous chapters in the current manuscript. Additionally, it organized the findings into a clear and concise review in order to illustrate the connections between Chapters 1-3. Limitations of the current studies were then outlined so that the reader would appropriately interpret the results. Finally, implications for research and practice were established in order to illustrate future directions for this research.
To Emelia Rae; may you find enough chaos in your life to make it remarkable.
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Vita

June 2004 ........................................ Loyalsock Township Sr. High School

2008 ............................................... B.A. Psychology, Ohio Northern University

2009 ............................................... M.S. Human Ecology, The Ohio State University

2009 to present ................................ Graduate Teaching Associate, Department of Human Development and Family Science, The Ohio State University

Publications


Fields of Study

Major Field: Human Ecology
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Chapter 1: Getting the Chaos out of Chaos

Introduction

Chaos has been described in many ways. Our fast-paced society combined with high expectations can leave even the most levelheaded person feeling overwhelmed, confused, and generally out of sorts. In everyday speech, chaos is used to indicate that something is in a state of disorder or lacking organization. For instance, a working parent runs out of the office after a stressful day, picks up the children from school, drops one off at ballet, another off at soccer practice, and brings a third home to work on homework while reheating leftovers for the family dinner and catching up on the latest breaking news. Many would consider this chaotic (although not necessarily uncommon).

Stability and predictability of events within in the family, relationships among family members, and establishing routines for children are all concepts which have been examined and discussed in the context of family and home environment (Baldridge, 2011). The link between family characteristics and children’s developmental outcomes has been studied extensively, specifically as it relates to behavioral adjustment and academic success in adolescence (Repetti, Taylor, & Seeman, 2002). However, there is still much that is unknown about these relationships.

The purpose of this review is to organize and explain one particular aspect of the home environment which may influence development, the construct of chaos. Research has demonstrated that chaos is significantly related to children’s behavioral problems.
above and beyond that attributed to other environmental measures, such as parenting (Coldwell et al., 2006). Brody and Flor (1997) noted a correlation between chaos and internalizing behavior and suggested that moderators such as race, ethnicity, parenting styles, SES, and age are all significant factors in examining the effects of chaos. In order to better understand such a pervasive force in our environment, this synopsis will examine its operational definition, measurement, outcomes, and limitations of previous research. It aims to analyze the current body of literature on this topic and its impact on child behavioral and academic outcomes by exploring and organizing current theoretical foundations, definitions, and previous methodologies associated with chaos.

**Defining chaos**

The definitions used by researchers to describe chaotic environments are less rooted in “busy-ness” and more in complex levels of instability within a family or home environment. Families function as systems rooted in well-organized, routine, and orderly exchanges between people and the environment (Sameroff, 2010). Matheny, Wachs, Ludwig, and Phillips (1995) considered chaos to be potentially stressful ambient background noise and crowding. Wachs and Evans (2010) added that chaos described environments of instability in temporal or physical structure, such as lack of routine and regularity. Evans and Wachs (2010) edited a collection of scientific writings examining the definitions of chaos from an ecological perspective, and a common theme throughout these definitions and others was that chaos produced some aspect of stress within one’s environment.
Wachs and Evans (2010) also addressed whether or not chaos was associated with negative developmental outcomes. They pointed to research stating that delayed development was attributed to a lack of stimulation or enrichment from the environment. This implies that some amount of noise or distraction in the environment may be necessary in order to promote healthy growth. The authors argued, however, that there can also be too much stimulation (i.e. noise and distraction) in the environment, which may inhibit growth. Therefore, Wachs and Evans (2010) turned to a model of stimulation called the optimal stimulation hypothesis (Uzgiris, 1977). This showed the impact of stimulation on development as an inverted U-curve in which too little or too much stimulation may be associated with lower levels of growth, while a moderate amount of stimulation promoted healthy development.

A large number of researchers who focus on chaos do so from the framework of Bronfenbrenner’s Bioecological model (Ackerman & Brown, 2010). This is because one of the foundations of this theory is the attention given to the interactions between context (i.e. environment) and person (i.e. developmental outcomes). This theory suggests that a person’s environmental context is the driving force of development through both direct and indirect interactions between process, person, context, and time (Bronfenbrenner & Morris, 1998). Process is the core of this model, referring to the proximal interactions between person, context, and time, and is the driving mechanism of development. Additionally, there are biopsychological characteristics within a person which influence these interactions, contexts, and time periods (Bronfenbrenner & Morris, 1998). For instance, one’s personality interacts with the people and places he or she comes into
contact with, therefore reciprocally influencing his or her developmental trajectory. Each of these elements functions to promote or hinder interactions which change the course of development. Chaos fits concisely into this model as a contributor to proximal environmental contexts and its correlation with developmental outcomes such as cognitive ability (Ackerman & Brown, 2010). Because chaos is experienced in one’s spatial context, it both directly and indirectly interacts with one’s routine and daily activities. This interaction, whether or not it is overtly perceived, will contribute to the overall developmental course for each person.

**Characterization of chaos in previous literature**

Table 1.1 organizes the previous literature collected for this review by listing the studies which have incorporated elements of chaos in their methodology. It summarizes both the specific operationalization of chaos and the outcomes associated with it in each study. Notably, it is organized by those articles which intentionally measured some aspect of chaos versus those whose intention was to capture another facet of the home environment but shares some or all parts of its definition with chaos as defined by Evans and Wachs (2010). Each row represents a specific article by listing the authors and year of publication. Each column specifies a unique measure which has been classified as a dimension of chaos in previous literature. Three general categories of outcomes are represented in order to specify which articles and measures have been associated with particular outcomes. Academic performance/achievement has been denoted with the abbreviation Ac, Behavioral outcomes with Be, and Socioemotional/Psychosocial with Em.
There are numerous issues surrounding the operationalization of chaos. As mentioned, the first is the difference between those studies intending to measure chaos versus those whose intention is to measure another facet of the environment (which happens to overlap with the definition of chaos). A researcher who is “inadvertently” measuring chaos is likely not looking for issues related to its measurement or proposed outcomes. This may be diversifying the construct of chaos. A second issue is that several facets of the environment can and have been characterized as chaos in some literature, but have also been studied as predictors, outcomes, or factors which are simply related to chaos. For example, instability (either physical location or familial) has been studied both as a measure of chaos and as a separate measure which is associated with chaos (Evans, Eckenrode, & Marcynyszyn, 2009). Parsing out the true indicators of chaos from those which are merely associated should be a goal of future family research.

Aside from the conceptual issues, measurement is another factor which diversifies the study of chaos. Some studies operationalize chaos as one or two specific factors, such as residential density (Evans, Maxwell, & Hart, 1999) or degree of noise and order (Johnson, Martin, Brooks-Gunn, & Petrill, 2008). Conversely, other studies have utilized a more unitary measure of chaos, called the Confusion, Hubbub, and Order Scale (CHAOS; Matheny et al., 1995). CHAOS, a short questionnaire composed of items representing the conceptual domain of environmental confusion or disorder, has been often utilized as a research tool in studies of environmental influences on child development. Of particular interest are the predicted and observed relations between scores from the CHAOS questionnaire and direct observations of existing environmental
conditions, such as noise, crowding, and home traffic pattern. CHAOS scores correlate with parent-child interactions linking direct observations of noise and confusion with mothers’ behaviors with their children, which offers additional evidence that CHAOS is a valid measure (Matheny et al., 1995). Thus, it appears that the CHAOS questionnaire measures at least some of the aspects of the latent construct of chaos.

Another measure which has been noted as a component of chaos in previous research is crowding, or residential density (Matheny et al., 1995). This construct is the physical manifestation of the number of people living in the home per number of rooms in the home (or some similar measurement of home size). However, there is still disagreement as to, methodologically speaking, what ratio an environment is considered “chaotic” or whether it should be assessed as a threshold or a linear statistic (Matheny et al., 1995). Even further, density is sometimes illustrated as the number of homes per square block when studying chaos as a geographic construct (Brooks-Gunn et al., 2010). A final element is noise and confusion, which correlates very highly with crowding (Brooks-Gunn et al., 2010), suggesting that when there is more crowding, levels of noise and confusion are inevitably greater, as well.

Thus far, much of the research in the area of chaos and instability has been collected via questionnaire and observer-report data. For example, the CHAOS measure can be completed by each member of the family. Johnson and colleagues (2008) based their research on mothers’ reports of the chaos in their own homes. Measures of instability, including relocation and changing family members, is typically completed in a questionnaire by one or both parents. A measure of crowding may be collected by asking
the family how many people live in the home and how many rooms are in the home, and then having the observer calculate the actual crowding measure. New methodologies, such as calculating a mean family score of chaos and then creating an individual difference score for each person in the family (subtracted from the family mean), would lend insight regarding the varying perceptions of chaos in one home, and provide evidence for differential susceptibility to chaos due to innate factors. This would be an important step forward in family research.

**Outcomes associated with chaos**

There are two different ways in which chaos has been linked to developmental outcomes (Hertzman, 2010). The first is through daily disturbances accumulating over time. From an ecological perspective, this day-to-day “buildup” of overstimulation due to chaos slowly changes the way that a child is able to interact with his or her environment, and therefore the biological process between person and context is innately changed, altering the developmental trajectory and outcome. This is referred to as temporal-spatial instability (Hertzman, 2010). On the other hand, there are more directly impactful forms of chaos, such as variability of residents living in the household (Brooks-Gunn et al., 2010). These are short, but major disturbances which interrupt routine in a more abrupt fashion (Hertzman, 2010). This type of chaos highlights the disturbances created by having unstable relationships with other people who come into and out of the home (more frequent in single-parent homes) and alter the environment by either their presence or absence (Brooks-Gunn et al., 2010).
Based on Evans’ body of work, it is believed that these chaotic environments create a compounding risk factor for developing children, and the construct of chaos may also be related to multiple physical and socioemotional factors that lead to poor academic achievement (Evans & Wachs, 2010). Specifically, household chaos is associated with higher levels of stress within the developing child’s home (Evans & Kim, 2007; Evans & Stecker, 2004; Taylor, Eisenberger, Saxbe, Lehman, & Lieberman, 2006). This stress can have actual physical ramifications. Studies investigating the relationship between stress and the developing brain have shown that elevated cortisol levels can damage the hippocampus and prefrontal cortex in young children (Anda et al., 2006). When a child experiences chronic stress, the increased levels of cortisol in the body circulate back to the hippocampus and can physically decrease the volume of the hippocampus (McEwen & Sapolsky, 1995). Damage to the hippocampus and pre-frontal cortex results in decreased declarative memory and executive functioning, both of which are related to learning (Anda et al., 2006).

Outcomes related to instability from inconsistent parenting

First is a summary of research associating chaos or similar measures of instability with the influences of inconsistent parenting strategies. Cavanaugh and Huston (2006) hypothesized that when key aspects of child rearing and parenting were not consistent or predictable, the child was more likely to engage in problematic behaviors; possibly due to feelings of unease or insecurity. For instance, one study utilized number of changes in family structure to measure inconsistency or instability and found that these changes hindered children’s behavioral and emotional outcomes (Ram & Hou, 2003). Chaos and
instability within the family significantly predicts internalization of behaviors as early as 5 or 6 years old, both at home and in school environments. This instability is also a predictor of children’s inability to adjust to new environments throughout their childhood and into adulthood ($b = -30.9, p < .001$; Cavanagh & Huston, 2006). Instability within the home from birth has a significant impact on many different aspects of childhood problematic behavior, often manifesting when the child transitions to elementary school (Ackerman, Brown, D’Eramo, & Izard, 2002; Cavanagh & Huston, 2006). Forman and Davies (2003) suggest that this is due to a general distrust of the family environment, which goes unnoticed at home, but can easily be seen in settings outside of the home environment, such as in school.

Chaos has also been linked to poor socioemotional development through an association with specific parenting strategies, as suggested in Table 1.1. Research has demonstrated that chaos is associated with poorer parenting, which then leads to negative child outcomes (Baldridge, 2011). Family chaos is increasingly identified as a correlate of both parenting and children’s social functioning (Evans, Maxwell, & Hart, 1999; Wachs, 2000). Children raised in chaotic environments tend to be more difficult, low in cognitive competence, have lower language development, lower motivation, and are more likely to engage in risky behaviors (Valiente et al., 2007; Wachs, 2000). These findings suggest a relationship between children’s chaotic home environment and their social functioning, including their problem behaviors.

According to this view, a highly chaotic family environment may be influenced by parenting for several reasons. First, continued exposure to noise, crowding and a lack
of organization may increase parents’ fatigue or tension, which would increase their
tendency to respond to others in more negative ways (Evans et al., 1999). Secondly, if
parents view the chaos as beyond their ability to control, they may not be motivated to
utilize appropriate parenting techniques which promote children’s effortful control and
social functioning (Cohen, Evans, Krantz, & Stokols, 1980). The notion that parenting
and family environment are related is consistent with findings that parents in chaotic
homes tend not to use parenting practices that promote the children’s emotional and
social development (Evans et al., 1999; Matheny et al., 1995; Wachs, 1989, 2000). These
findings are important given the hypothesized role that parenting plays in creating
positive outcomes for children.

*Outcomes related to marital instability*

Furthermore, multiple disruptions within a family structure (parent figures
changing more than once) may also be an indicator of antisocial, aggressive, drug-related,
and other negative or harmful behavioral outcomes (Baldrige, 2011; Osborne &
McLanahan, 2007). A significant focus is placed on families in which the father figure is
either non-existent or inconsistent. Serious behavioral and emotional issues have been
demonstrated in children in those families (Carlson, 2006). For example, the number of
relationship changes by the primary caregiver is a significant indicator of negative
behavioral consequences (Table 1.1; Osborne & McLanahan, 2007). While changing
partners only once moderately predicts behavioral outcomes, several partner changes by a
primary caregiver significantly predicts outcomes such as depression and aggressive
behaviors in young children (Osborne & McLanahan, 2007).
Finally, research has demonstrated that higher levels of maladjustment can be expected in families in which there are higher levels of instability (Milan & Pinderhughes, 2006). Additionally, the amount of instability that occurs within one calendar year, such as the number of relocations or the number of partners the primary caregiver has allowed into the family environment, significantly influences the level of behavioral maladjustment in children (Baldridge, 2011).

*Outcomes related to instability of location*

Other, more concrete, changes in a child’s family have also been studied. Specifically, frequent relocation has been tied to behavioral outcomes (Adam & Chase-Lansdale, 2002), as shown in Table 1.1. This study found that school-age children struggle more with moving, possibly due to the inability to build and maintain consistent friendships in the short time they are in one location. Hoglund and Leadbeater (2004) found that frequent relocations had greater behavioral ramifications for students who were temperamentally shy or socially withdrawn. This is important to note because it demonstrates the interactions between child temperament (or risk factors) and instability. As it relates to Bronfenbrenner’s Bioecological theory, these findings demonstrate that risk factors in the home have implications for how chaos can tangibly influence the course of development based on interactions between individuals and their environments (Evans & Wachs, 2010).

*Outcomes related to instability due to poverty*

Measures of chaos and instability have also been studied in relation to socioeconomic status (SES), specifically those families considered to be in poverty.
Research also indicates that children from poor families exhibit more behavioral problems than those from more affluent families (Carlson & Corcoran, 2001; Ackerman et al., 2004). Continual poverty (as opposed to short-term situational poverty) is a likely predictor for externalization of problematic behaviors (Ackerman et al., 2004). However, it is important to note that lack of financial resources alone is not necessarily related to other aspects of family instability (Ackerman et al., 1999). Although involved in the construct of family instability, low SES cannot stand alone as a single indicator of instability within a family (Milan & Pinderhughes, 2006). Therefore, other interactions have been posited.

Stress may be one process through which SES is associated with chaos, ultimately producing negative outcomes. Gyamfi (2004) pointed out that caring for a child with a behavioral disorder added stress to the overall dynamic of family interactions, which compounded the effect of behavioral outcomes. Conversely, families with a higher SES could possibly have more or better resources to obtain medication/treatment for the disorders, minimizing the stress at home and leading to positive behavioral outcomes. On the other hand, families with lower SES may not have the ability or knowledge (due to lack of access to resources) to obtain help for the child in question.

Outcomes related to family structure

Family structure is another factor which has been associated with chaos and related measures in previous research. For the purposes of this review, Table 1.1 demonstrates family structure as a separate measure from family instability, as instability infers some amount of change, while structure implies that there is something chaotic
about the general makeup of the family. A commonly accepted model for children is to live in a stable household consisting of a traditional nuclear family with both a stable mother and father figure (Baldridge, 2011; Hetherington, Bridges, & Insabella, 1998).

Additionally, as is demonstrated in Table 1.1, studies indicate that a child in a single-mother family, or in a family without one stable father figure throughout the key developmental years of that child, is more likely to suffer from behavioral difficulties (Carlson, 2006; Carlson & Corcoran, 2001). The differences between child behavioral outcomes measured across time between one and two parent families is very stable (Teachman, Day, Paasch, Carver, & Call, 1998). Father involvement significantly reduces almost all statistically significant family structure effects on negative adolescent behavioral outcomes (Carlson, 2006).

Another aspect of family that has been examined is the idea that the amount and/or quality of time spent with families can impact development. One way to address the measurement of time spent with family is through the analysis of cohesion or disengagement of family members. Although it does not appear to be linked to chaos on the surface, family cohesion can be interpreted as a measure of how much stability (i.e. lack of chaos) a child perceives from the family (Olson, 2000). Family cohesion can be explained as the closeness that family members feel to one another or as the emotional trust that is formed between parents and their children (Baldridge, 2011). Research demonstrates that family cohesion has a strong influence on possible adolescent delinquent behavior (Cashwell & Vacc, 1996). Adolescents who report higher levels of family cohesion have demonstrated fewer internalizing behavior problems and attention-
related problems compared to those who self-reported as more disengaged from their parents or caregivers (Lucia & Breslau, 2006). Cooper, Grotevant, and Condon (1983) found that perception of family cohesion lead to an appropriate level of self-esteem in children. On the other end of that spectrum, children who were disengaged from their families or those who do not feel trust or closeness with a parent or caregiver figure had a much higher risk of developing negative behaviors.

However, Olson (2000) warned against both extremes of engagement or cohesion. He stated that families who become too enmeshed were also in danger of developing inappropriate boundaries. The development of inappropriate boundaries or the complete lack of boundaries within a family is easily transferable into other aspects of a child’s life, such as relationships with peers or future relationships in that child’s life as he or she matures. It is this lack of boundaries that children perceive as chaos in their own environment.

*Outcomes related to instability from lack of routine and structure*

Family rituals can be defined as habits or behaviors that families engage in together. Table 1.1 illustrates the outcomes related to a lack of routines and rituals. Participation in customary family rituals leads to a healthy development of identity and positive behaviors (Eaker & Walters, 2002). Family rituals also assist in developing a sense of belonging for family members (Viere, 2001). These rituals or routines can be daily (such as meals together), or they can be special traditions that occur on a predictable, but not daily, basis (such as birthday celebrations or holidays at grandparents’ homes). Referring to Table 1.1, research suggests that when parents create
and implement constant and predictable routines or rituals within a family, children have better social and emotional outcomes (Eaker & Walters, 2002). Families who take part in joint activities, or “quality time,” together create a much more stable environment in which the child can develop his or her social and emotional skills. Furthermore, families who engage in these predictable routines tend to have higher levels of functioning and lower levels of problematic behaviors (Kiser, Bennett, Heston, & Paavola, 2005).

Chaotic environments are characterized as low on structure and routine and high on unpredictability, activity and background stimulation (Asbury, Wachs, & Plomin, 2005). Increasing the amount of chaos and stress in children’s lives prohibits the child from fully experiencing other aspects of his or her environment, what Bronfenbrenner termed as proximal processes (Bronfenbrenner & Evans, 2000; Bronfenbrenner & Morris, 1998). Chaotic environments may affect development of the child by interfering with the duration and consistency of proximal processes, making the interaction between the child and his or her environment unpredictable and decreasing the time the child is able to fully engage in exploring their own environment (Bronfenbrenner & Evans, 2000).

Studies on the link between chaos and academic achievement have found that children in households with more structure and routines have better academic achievement (Brody & Flor, 1997; Fiese et al., 2002). Furthermore, young children in more chaotic homes reveal cross-sectional and longitudinal deficits in cognitive development (Hart, Petrill, Deckard, & Thompson, 2007; Petrill, Pike, Price, & Plomin, 2004). Both of these points are illustrated in Table 1.1. Routine, or family management,
is positively associated with academic self-concept and school engagement (Seaton & Taylor, 2003). Children living in chaotic environments experience both stress and neglect due to high levels of noise, crowding, and a lack of routine and higher levels of unpredictability in the home. A question that remains to be investigated is how the confusion and unpredictability of highly chaotic childhood home environments translates into poor academic outcomes. This research ultimately introduces a hypothesis that the effects of anything from stress to unpredictability in the home can have long-term negative consequences on academic performance (parallel with many of the results shown in Table 1.1).

**Current limitations**

One of the major limitations to the findings discussed in this review is the lack of agreement about how to define and measure chaos. As previously stated, chaos is agreed upon conceptually, but researchers operationalize it in many unique ways, as evidenced by the large and unwieldy chaos literature. Most studies examining variables which “define” chaos have conceptualized it as a lack of routine or order, or a high level of noise or distraction. However, chaos can be operationalized as any number of variables; including frequent changes in parenting makeup (marital/family instability), crowding, unpredictable living situations, frequency of relocation, level of background noise, and more (Ackerman et al., 1999; Cavanagh & Huston, 2006). This is where the disparities in measurement of chaos become apparent. Furthermore, some studies suggest that instability may be related to chaos (Baldridge, 2011), while others argue that is actually a dimension of chaos (Brooks-Gunn et al., 2010).
Not only are there inconsistencies in how chaos is defined, there are elements missing in which attributes of chaos have not yet been addressed in the literature. Specifically, neither definition fully addresses perception of chaos. Matheny and colleagues (1995) described chaos as “ambient”, suggesting that this stressor is not overtly perceived. However, Wachs and Evans’ (2010) definition gave more tangible stressors, such as lack of routine. Therefore, we cannot assume whether or not chaos is a perceivable risk factor in the environment. Additionally, whether chaos is measured at an individual or family level, it has yet to be addressed that different people within a single environment are theoretically experiencing the same chaos and yet, may be having quite dissimilar experiences. Future research should address these within-family differences to better understand the implications of individual susceptibility to chaos.

Another limitation of chaos is possible comorbidity with other factors such as SES. While research has demonstrated that SES and chaos are distinct factors, there is still some disagreement about whether the two can really be separated into distinct measures which uniquely influence outcomes such as behavior and academic performance. As stated previously, the lack of financial resources alone is not necessarily related to other aspects of family instability (Ackerman et al., 1999). There are several reasons why SES and chaos have demonstrated such high correlations. For instance, parents in low-income households have fewer resources to provide a dependable routine for their children (Marcynyszyn, Evans, & Eckenrode, 2008). This may be evident by the inability to consistently provide transportation, child-care, or even a stable home for their children to live in. Parents living in poverty are less likely to be in a stable
relationship and have higher rates of relocations, upsetting both the home and school environments for the children (Evans et al., 2010). Additionally, the population of low-income families has been underrepresented in literature on chaos and child developmental outcomes. This is due to factors including difficulty recruiting these families, retention due to relocation, and self-selection on the part of the researcher (Evans et al., 2010). The lack of low-income representation in the literature gives a less realistic view of the actual nature of the relationship between chaos and SES.

**Implications**

Despite this large corpus of knowledge on chaos and its effects on human development, there are still many unknowns. This can be attributed not only to the need for more research on the effects of chaos, but to the need for a better understanding of the definition of chaos and how to appropriately operationalize this concept. Furthermore, chaos could also prove to be a mediator or moderator of the relationship between temperamental or environmental factors and similar child outcomes. Understanding how other factors interact with chaos to promote or hinder development can aid not only in explaining outcomes, but provide more appropriate interventions.

As briefly mentioned in the limitations, another feature that has not yet been explored in detail is the notion that some people may be more susceptible to (or sensitive toward) chaos. Through now, research has compared the levels of chaos in different homes/environments and then addressed how those chaotic environments lead to poorer developmental outcomes for children. However, there is yet to be research which looks at individual differences within families to show the degree to which some children are
affected by chaos than others. If it is found that there are unique sensitivities to chaos within families, research can begin to explore not only why that may be, but whether or not that acts in relation to individual differences in academic performance and behavioral outcomes.
Chapter 2: Chaos and Attention

**Introduction**

A growing body of literature has begun to associate chaos (e.g., noise, distraction, lack of family routines) with children’s and adolescents’ socioemotional and academic outcomes (Fiese et al., 2002). Overall, children from more organized homes with less reported chaos tend to display fewer behavioral problems (Coldwell, Pike, & Dunn, 2006; Valiente, Lemery-Chalfant, & Reiser, 2007). Routine and structure in the home are also associated with psychological adjustment and school achievement in children and adolescents (Repetti, Taylor, & Seeman, 2002). Additionally, Deater-Deckard, Mullineaux, Beekman, Petrill, and Schatschneider (2009) found parent-rated chaos to be a valid and independent predictor of both childhood cognition and longitudinal behavioral outcomes. Studies have found that children in households with more structure and routines have better academic achievement (Fiese et al., 2002) and young children in more chaotic homes are significantly more likely to exhibit longitudinal deficits in cognitive development (Hart, Petrill, Deater-Deckard, & Thompson, 2007; Petrill, Pike, Price, & Plomin, 2004). Routines in the home are also positively associated with academic self-concept and school engagement (Seaton & Taylor, 2003).

However, the link between chaos and children's behavior must be understood in the context of other family circumstances. Indeed, as emphasized by Bronfenbrenner’s Bioecological paradigm (Bronfenbrenner & Morris, 1998), context matters. The physical
and mental resources in the family may exacerbate or ameliorate the stresses induced by family transitions, so children's experiences of family instability are likely to vary depending on the overall family environment in which they live (Booth & Amato, 2001). Therefore, it is essential to understand not just how chaos is associated with child behavior, but how it interacts with other constructs in the home environment to explain these behaviors.

Higher levels of chaos negatively impact children in several domains of social, emotional, and behavioral development. Even when associations with known psychosocial and environmental risk factors (such as parental education and SES) are taken into account, chaos predicts individual differences in cognitive ability and conduct problems (Hart et al., 2007; Seaton & Taylor, 2003). This establishes both the validity and reliability of this construct. Specifically, Ackerman and colleagues (1999) demonstrated evidence supporting the link between chaos and children’s socioemotional outcomes. Research has also demonstrated that chaos can significantly predict children’s behavioral problems above and beyond that attributed to other environmental measures, such as parenting (Coldwell et al., 2006). Brody and Flor (1997) noted a correlation between chaos and internalizing behavior. Their findings suggest that moderators such as race, ethnicity, parenting styles, SES, and age are all significant factors in examining the effects of chaos.

Despite the large number of studies examining chaos and behavior, research has not yet attempted to explore the relationship between chaos and attention, or how this relationship may impact other developmental outcomes. Although Bronfenbrenner &
Morris (1998) alluded to the implications of attention in developmental processes, little information was known about how symptoms of poor attention were associated with chaos. There is a vast body of literature on the subject of attention parallel to that of chaos. Both constructs demonstrate a relationship with behavioral, social, and academic outcomes in children and adolescents (Breslau et al., 2009). Historically, attention disorders are one of the most prevalent types of clinical diagnoses in childhood and adolescence with 2.5 to 5% of children meeting the diagnostic criteria at any given age (Rapee, Schniering, & Hudson, 2009). Research also shows that childhood attention disorders have been reported to continue throughout development (Grills-Taquechel & Ollendick, 2007). Long-term effects of these attention disorders have implications for both academic and social domains of functioning, which extend even into adulthood (Rapee et al., 2009). Attention appears to be a driving force of our interactions and subsequent development over time, so understanding how it can be affected is essential (Polderman, Derks, Hudziak, Verhulst, & Posthuma, 2007).

Due to a lack of research which explicitly links chaos and attention, it is necessary to extrapolate to known relationships with similar developmental concepts. For instance, Toner, O’Donoghue, and Houghton (2006) argued that attention problems contributed to higher levels of stress or distraction in the home regarding anything from finances to relationships. However, the amount of stress and distraction caused by attention problems depends highly on how well-equipped other members of the family are to handle it (Toner et al., 2006). According to Evans and Wachs (2010), stress and distraction are elements of chaos, suggesting that what Toner and colleagues (2006) may
actually have been studying was the relationship between attention problems and chaos in the home.

A second goal of this study was to better understand the indirect pathways between chaos and attention. One study, by Valiente, Lemery-Chalfant, and Reiser (2007) illustrated pathways through which chaos could lead to children’s externalizing behaviors through parent reactions (both positive and negative) as well as effortful control. Literature suggests that parents in chaotic homes lack appropriate parenting attitudes which promote healthy emotional and social development (Evans et al., 1999). The findings by Valiente and colleagues (2007) showed support for this statement by demonstrating a significant pathway which highlighted the role of chaos in parenting and eventually leads to children’s externalizing behaviors.

Also of interest is the difference in perceptions of chaos both between and within families. As previously noted, chaos and attention have not yet been directly associated in research. However, based on the findings presented, a hypothesis was drawn that the ability to focus on a task despite disturbances in the background would be highly influenced by the amount of disturbance that one is exposed to on a consistent basis. In other words, some children and parents reported less chaos than their equally chaotic counterparts because they are desensitized to the perception of chaos by its constant presence. Given what is known about chaos and its influence on child development (Valiente et al., 2007), it is important not only to understand chaos as a family-level factor, but individually for different family members. Previous literature has not yet
addressed how both mothers and children perceive chaos and how those individual ratings correspond with specific outcomes.

Given these findings and the limitations of previous research, the overarching goal of this study was to explore the relationship between chaos and attention in regards to children’s development. This was accomplished by addressing two specific aims. First, the relationship between chaos and attention in childhood was established. It was hypothesized that there would be a moderate to high positive correlation between chaos and attention based on previous research demonstrating that perception of chaos was detrimental to development and that attention is necessary for perception. Specifically, the findings by Anda and colleagues (2006) that the damage to the hippocampus and pre-frontal cortex due to chaos resulted in decreased declarative memory and executive functioning, informed this hypothesis. Additionally, due to the availability of multiple ratings of chaos in the same home environment, it was possible examine which raters were correlated with specific outcomes. It was hypothesized that the individual ratings of chaos will yield information demonstrating that two or more people in the same home can perceive chaos differently, therefore producing unique results.

Secondly, this research addressed whether the relationship between attention and chaos was moderated or mediated by other influences in the environment. For example, the interaction between family size and chaos to account for variance in attention was examined. It was expected that factors such as SES and family size moderate the relationship between chaos and attention due to the complex relationships that chaos has demonstrated with these constructs (Evans et al., 2010). Furthermore, it was
hypothesized that developmentally positive factors in the home environment will mediate any relationship between chaos and attention. Given research showing the benefits of both home literacy environment (Griffin & Morrison, 1997) and parental involvement (Booth & Amato, 2001) on child development, it was likely that these constructs are candidates for significant mediation.

Method

Participants

The participants for this study were drawn from the Western Reserve Reading and Math Project (WRRMP; Petrill et al., 2006), which collects data on N = 872 children in Ohio. Each child and his or her same-sex twin were recruited into the study during kindergarten or first grade and assessed annually 7 times. Questionnaire data was collected at each home visit from the mothers. Because one of the measures of interest for this study (child-reported chaos) was only collected at the final home visit, only the data from 157 mothers and their same-sex twins (N=309) at this final visit was utilized. At the time of the home visit, the average age of the children was 11 years. The selection criterion for this sample was any family in which the mother completed the measure of chaos. There were 4 children (from 2 families) who did not complete the questionnaire data along with their parents, but these families did not differ on any demographic information which would lead this to be a major limitation of the study. Parental permission and child assent were obtained at the time of each home visit. The demographics of this sample were that most parents were either married or cohabiting (92%), and most mothers were Caucasian (92%). Furthermore, data collected from the
parent report of their educational attainment demonstrated that 12% completed high school or less, 18% completed some college, 30% hold a bachelor’s degree, 24% had some postgraduate education or degree, and 5% did not specify.

**Procedures and measures**

Two trained testers assessed the twins separately on several measures via an assessment in the home. As part of each assessment, they collected questionnaire information regarding the participants’ home environment and certain behaviors in order to better understand these influences. Additionally, the testers were asked to rate the environment as outside observers.

**Chaos:** Both the mothers and the children were given a questionnaire regarding the level of chaos in their home environment. This questionnaire, referred to as the Confusion, Hubbub, and Order Scale (CHAOS; Matheny et al., 1995), asks a series of likert-type statements to which the parents and children respond that their homes are similar or not similar (on a 5-point scale) to the statement made. For example, “There is always a TV on somewhere in our home”. Rating this statement as a 5 would indicate that it is very true, while rating it as a 1 would indicate that it is not true at all. Some questions, such as “We have a daily bedtime routine”, were reverse-scored in the analyses to indicate that a 5 would still be most chaotic and a 1 would be least chaotic. Data from both mothers and children were utilized for the analyses. In previous literature, the Cronbach’s α (measuring internal consistency) for the CHAOS measure has been estimated between .63 (Petrill et al., 2004) and .79 (Matheny et al., 1995). In this sample, internal
consistency was estimated to be $\alpha=.50$ for child-reported CHAOS and .65 for mother-reported CHAOS.

**Attention:** Two measures of attention were collected via questionnaire. The questionnaire was completed about each child by the child’s mother. This questionnaire was developed using the Strengths and Weaknesses of ADHD symptoms and Normal behavior scale (SWAN; Swanson et al., 2006). The SWAN utilized 18 items on a seven-point likert scale ranging from ‘far below average’ (1) to ‘far above average’ (7). The first nine items corresponded to the Attention Deficit (SWAN Inattention) scale and the last nine items to the Hyperactivity/Impulsivity (SWAN Hyperactivity) scale. The more attention problems a child had, the lower his or her score on the SWAN rating scales.

**Socioeconomic Status:** At the first home visit, mothers were asked to provide their highest level of education and employment status. At each of the following home visits, they were asked to update that status if applicable. However, these measures remained stable throughout the study. Using both the mothers’ job status and educational attainment at the first home visit, a factor score of SES was created for this study. The SES factor score has a total Eigenvalue of 1.04, explaining 51.79% of the variance for this measure.

**Family Size:** Family size was determined using a questionnaire report of the number of people living in the home at the time of the final home visit. This was one specific question in which the tester asked a parent how many people were living in the home at the time of the visit.
Parent involvement: During the final home visit, the children were also asked to report (via questionnaire) how closely they were monitored by their parents. Specifically, a question which asked how much the children perceived that the mother knew about their after school activities was utilized for the current study. The questionnaire used in the WRRMP study was based on a scale called the My Parents scale (Lamborn, Mounts, Steinberg, & Dornbusch, 1991). This specific question was taken from the portion of the questionnaire regarding the child’s allotment of free time, and how much it was or was not supervised. The internal consistency of this sample, using Cronbach’s α, was α=.73.

Home Literacy Environment: The study included questions pertaining to environmental characteristics from the Home Literacy Environment (HLE) questionnaire (Griffin & Morrison, 1997) given to the mothers at the assessment. The questionnaire utilized in the WRRMP sample contained 4 questions. Some of the items taken from the HLE questionnaire included how often the child was read to, whether or not the family had a library card, or whether the family subscribed to any magazines. Reliability of the measure was adequate (Cronbach’s α=.62) in previous studies using the WRRMP sample. For the current sample, reliability was again adequate (Cronbach’s α=.61).

Analyses

To address the first aim of this study regarding the relationship between chaos and attention in childhood, several methodologies were employed. Upon gathering the descriptive statistics for each measure, Pearson correlations between the chaos and inattention measures were conducted to determine any significant relationships.
Additionally, correlations were estimated between the measures of chaos and attention with the home environment measures.

Secondly, this research addressed whether any relationships between chaos and attention were moderated by other factors in the home environment using a generalized linear model which estimated the amount of variance in SWAN Inattention or Hyperactivity accounted for by both main effects of child- or mother-reported CHAOS and either family size or SES, as well as an interaction variable created by multiplying each measure of CHAOS with each of the potential moderating home environment measures. Additionally, this generalized linear model accounted for increased standard error due to data nested within families in the child-report measures by holding a weighted constant of 1 throughout the analyses.

Next, Sobel’s test of mediation (Preacher & Leonardelli, 2003) was utilized to test for mediating effects of either home literacy environment or parent involvement on the relationship between chaos and attention. Sobel’s test of mediation compared the strength of the pathway between the independent and dependent variables with the pathway between the independent, mediating, and dependent variables. A significant difference between the two pathways would suggest a significant mediation, while no significant difference between the two pathways would suggest that there was no mediation.

Finally, integrated into these aims were discussions regarding the different results produced between family members. Intercorrelations between the mother- and child-ratings of CHAOS were estimated to demonstrate the different raters of chaos. With
these unique reports, this study addressed whether or not there may be differences in perceptions of chaos between family members.

**Results**

The first aim of this study was to establish the relationship between chaos and attention by reporting the descriptive statistics and estimating the correlations between each measure. Table 2.1 illustrates the descriptive statistics for each measure in the study. Additionally, intercorrelations between the attention measures and the chaos measures were estimated using Pearson correlations. SWAN Inattention and SWAN Hyperactivity were significantly correlated at $r=.747$ ($p<.05$). Mother-reported CHAOS was correlated at $r=.329$ ($p<.05$) with child-reported CHAOS.

Furthermore, correlations between these two constructs, as demonstrated in Table 2.2, estimated significant relationships between mother-reported CHAOS and both SWAN scales, but not between child-reported CHAOS and the SWAN scales. Table 2.3 illustrates the correlations between the SWAN scales and CHAOS reports with the other home environment measures. Although in many samples, SES is highly correlated with CHAOS (Evans et al., 2010), there appeared to be no significant correlation between either SES and CHAOS or SES and SWAN in the current sample. Furthermore, the only measure significantly related to attention was parent involvement (SWAN Inattention, $r=.119$; SWAN Hyperactivity, $r=.140$). Family size ($r=.119$) was significantly related to child-reported CHAOS, while both family size ($r=.141$) and HLE ($r=-.190$) were significantly related to mother-reported CHAOS.
The second aim of this study was to explore whether the relationship between CHAOS and SWAN Inattention or Hyperactivity was moderated by any other factors in the home environment. In order to assess this relationship, generalized linear regressions estimating the interactions of the moderating and independent variables was conducted. First, family size was incorporated as a moderator for the relationship between CHAOS and the SWAN scales. As seen in Table 2.4, child-reported CHAOS did appear to explain a significant proportion of variance in both SWAN Inattention, even when controlling for family size.

Furthermore, Table 2.4 demonstrates that there were not only main effects of both CHAOS ($\chi^2=11.334, p<.05$) and family size ($\chi^2=8.241, p<.05$), but also a significant interaction ($\chi^2=7.193, p<.05$), demonstrating that family size did moderate the relationship between child-reported CHAOS and SWAN Inattention. Child-reported CHAOS had a negative main effect association with SWAN Inattention, suggesting that as CHAOS scores decreased (indicating a lower perception of chaos in the home), scores on the SWAN Inattention measure increased (indicating better attention). Additionally, the significant negative main effect association between family size and SWAN Inattention suggested that as family size decreased, scores on the SWAN Inattention measure increased.

However, there was also a significant positive interaction demonstrated in the model. The interaction was positively associated with SWAN Inattention. In order to illustrate this interaction clearly, both family size and child-reported CHAOS were dichotomized by the upper and lower quartiles for this sample. This methodology was
employed in order to clearly mark the extremes and highlight the existing interaction (as opposed to keeping continuous variables, which would result in a graph which is more difficult to read and interpret). This resulted in categories of small (\(\leq 4\) people) and large (\(\geq 5\) people) families and categories of low (\(\leq 2\) on CHAOS) and high (\(\geq 3\) on CHAOS) levels of chaos. As shown in Table 2.4, the interaction between child-reported CHAOS and family size was significant (\(\chi^2=7.193, p<.05\)), suggesting that the slope of the line for small families is significantly different from the slope of the line for large families. Figure 1 clearly demonstrates that the influence of high levels of chaos on attention is greater for small families, while the influence of low levels of chaos on attention is similar for both small and large families. In other words, the level of chaos in the home is more important for small families than large families when predicting inattention.

On the other hand, in the model which included mother-reported CHAOS as the independent variable, the main effects and interaction did not account for a significant proportion of the variance in SWAN Inattention. When SWAN Hyperactivity was the outcome (Table 2.5) there were no main effects or significant interactions were found.

Tables 2.6 and 2.7 illustrate similar findings in which SES was utilized as a potential moderating variable. When SES was the potential moderator of the relationship between CHAOS and SWAN Inattention (Table 2.6), there was a significant main effect of both child- (\(\chi^2=7.903, p<.05\)) and mother-reported CHAOS (\(\chi^2=23.967, p<.05\)). The same trend was found when using SWAN Hyperactivity in the model. Child-reported CHAOS showed a significant main effect (\(\chi^2=3.718, p<.05\)), as did mother-reported CHAOS (\(\chi^2=21.260, p<.05\)). However, there were again no significant interactions,
suggesting that SES did not moderate the relationship between chaos and attention in this sample.

Table 2.8 revealed that although it was hypothesized that the relationship between chaos and attention would be mediated by factors such as home literacy environment and parental involvement, no significant mediation effects were found with this sample using Sobel’s test of mediation (Preacher & Leonardelli, 2003). This test utilized results from regression analyses to estimate the pathway between the independent variable and dependent variable, as well as the pathway between the mediating variable and dependent variable, given the independent variable. There was no significant difference between the two pathways, illustrating that there was no mediation in any of the models.

**Discussion**

The present study found that chaos and attention were significantly related, but that this relationship was dependent on whether it was the child- or mother-report of chaos, suggesting that the hypothesis regarding different perceptions and effects of chaos may be true. Both inattention and hyperactivity were significantly correlated with mother-reported chaos, but not with child-reported chaos. Interestingly, both the measures of attention and the mother-report of chaos were completed as self-report questionnaire measures by the mother. In this case, a possible explanation for the relationship between mother-reported chaos and attention was the fact that these measures were being reported by the same person. This is important because in a study which places emphasis on perception, it is clear that rater-bias is influential in regards to whether or not two measures are related. If the mother perceived higher chaos in the
home environment, perhaps she was similarly biased in her perceptions of her child’s attention and related abilities.

Another interesting finding in the correlations was that family size was the only environmental factor significantly associated with both child- and mother-reported chaos. This is unique because in many studies, SES and chaos are highly correlated (Evans et al., 2010). An explanation for this nonsignificant relationship may be the homogeneity of the WRRP sample. A lack of variability in SES would likely lead to a nonsignificant statistical correlation with other measures. On the other hand, home literacy environment was significantly correlated with mother-reported chaos. Because the home literacy environment questionnaire was given only to the mothers, this finding again supports the notion that it is this perceptual bias which may have lead to these significant correlations.

Finally, attention was only significantly correlated with one home environment measure in the current sample, parent involvement. Unlike the previous findings, this connection did not support the perceptual hypothesis because the SWAN questionnaire was completed by the mothers and the parent involvement questionnaire by the children. While some of the measures were not as highly correlated as anticipated, it is important to note that the hypothesis regarding differential perceptions of chaos was supported by many of these findings.

In turning to the regression analyses for moderation effects, the results, while not in line with the original hypotheses, led to some interesting conclusions. First, it was noteworthy that each measure of chaos produced independent and unique results in relation to both the dependent measure of attention and each of the moderating variables.
Again, this illustrated that individual perception may be a key to understanding the relationship between chaos and behavior. While moderating effects were found when child-reported chaos and family size were in a model predicting variance in inattention, there were no moderating (or even main) effects of mother-reported chaos and family size in a similar model predicting inattention. This suggested that it cannot be generalized in all cases, but it instead may be dependent on who is reporting the data. When children were reporting their perceptions of chaos in the home, their perceptions interacted with the size of the family to significantly predict variance in inattention.

Overall, the measures of chaos and home environment accounted for significant variance in inattention scores, but not hyperactivity scores. This was understandable because the inattention scale more appropriately captured the focusing and perceptual abilities of the children, while the hyperactivity scale captured the disruptiveness and effortful control of the children. While both scales could theoretically be related to perceptions of chaos, the ability to focus throughout distractions seems a more obvious connection. In fact, all of the regression models suggested that chaos, whether reported by child or mother, accounted for significant variance in both scales of attention, even when controlling for family size or SES in the model; and in several cases, chaos as an independent variable in the model was still a significant predictor of variance in attention when the interaction was added to the model. So, despite the nonsignificant moderation terms, it was clear that chaos and attention were related and more research should be conducted to explore these relationships.
Finally, the results of the Sobel’s tests of mediation (Preacher & Leonardelli, 2003) were all nonsignificant, suggesting that neither home literacy environment nor parent involvement mediated the relationship between chaos and attention in this sample. These results, while unexpected on a conceptual level, may again have been due to the lack of variability in the sample for home literacy environment and parent involvement. It may also be that different environmental factors would be more likely to mediate this relationship instead of those which were available in this sample.

**Limitations**

One limitation was that because data on child-reported chaos was only collected at one time point, it was impossible to examine longitudinal growth or development. Cross-sectional data can only provide transactional data; not only was cause and effect unable to be estimated, but plotting the growth of attention and perceptions of chaos over time was not feasible.

Also, the sample utilized for the current study was a somewhat homogeneous group of mothers and children in that their family structure, ethnicity, and SES were not variable, so the results from this study should not be generalized to the greater population. Furthermore, the homogeneity of the WRRP sample may have led to the lack of significant findings between several of the measures included in the analyses. For example, many of the children have similar SES, and the range for measures such as parent involvement and chaos were limited. Results from studies of extreme populations, including differing levels of SES, marital status, race and ethnicity, or location would
likely provide different and useful information regarding the relationship between chaos and attention in those unique populations.

Finally, while it is important to address the differences in perceptions of chaos within each family, this study did not account for the statistical differences between the regression coefficients associated with the child- versus mother-reports of CHAOS. The first reason for this omission was that the effect sizes and sample size were small and any comparison of these betas would likely demonstrate nonsignificant findings, which do not appropriately illustrate the true relationship between the ratings of chaos. It would be necessary to incorporate a larger sample and test the statistical relationship between these models in a study with larger effect sizes. Secondly, the current study intended to focus on the relationship between chaos and attention, while simply highlighting possible differences in perceptions of chaos and the related outcomes. Therefore, a statistical comparison of regression coefficients between several raters of the same measure is a necessary direction for future research.

Implications

The findings from the current study show a complex and intricate relationship between chaos and attention. First, the results suggest that researchers must consider several points of view when collecting information about the home environment, because perception is unique to each individual, and the influence that environmental factors have on developmental outcomes may be dependent on the perception of each person. Future research should focus on interpreting these unique perceptions when exploring the effects of environment on different family members. While it is most efficient to collect
questionnaire data from a parent while children are being tested during an assessment, the responses will certainly be biased to that parent’s perceptions. Collecting questionnaire data from each person and utilizing those results may yield a number of new connections which were previously undiscovered. Additionally, future studies should consider the statistical relationship between the unique perceptions of chaos within the family. This would more accurately address the issue of sibling and family differences.

Furthermore, because chaos and attention are so highly correlated that chaos significantly predicts attention above and beyond other environmental measures in the hierarchical regression models, it is essential to wholly understand the concept of chaos. The study of chaos lacks unification and clarity, leading to a misunderstanding of what it truly encompasses as a construct. As shown in this and other similar studies, chaos is related to behavior in a very significant manner, so it is crucial that we work to unify the definition of chaos.

Finally, due to the implications that chaos has on behavior and other developmental outcomes, it is important to explore other related factors in the context of the home environment. Chaos is only one piece of the puzzle, and future research associating chaos with developmental outcomes should account for any other possible moderating variables. Accounting for factors such as gender, race, and attachment style may present interactions, while searching for other clues in the home environment, such as parenting style, may lead to a greater understanding of chaos.
Chapter 3: Chaos, Attention, and Academic Performance

Introduction

Attention problems, particularly symptoms of inattention and hyperactivity, have been demonstrated to significantly predict behavioral and academic problems for children and adolescents (Polderman, Boomsma, Bartels, Verhulst, & Huizink, 2010). Attention-deficit/hyperactivity disorder (ADHD) affects roughly 9% of all children in the United States (American Psychological Association, 2012). Children with ADHD experience attention and behavior difficulties that can negatively affect social development and academic achievement (Hart et al., 2010). Research by Toner, O’Donoghue, and Houghton (2006) stated that attention problems were associated with increased stress in the home regarding finances, relationships, and disorder. The amount of distress and distraction caused by attention problems depends highly on how other members of the family handle it (Toner et al., 2006). In fact, literature has associated chaos (e.g., noise, distraction, lack of family routines) with children’s and adolescents’ socioemotional and academic development (Fiese et al., 2002). Several studies have demonstrated that children in households with more structure and routines have higher academic achievement (Brody & Flor, 1997; Fiese et al., 2002). Family organization was positively associated with academic self-concept and school engagement (Seaton & Taylor, 2003).
Given these findings, the current study aims to illustrate the relationship between attention and chaos in order to understand how these constructs may be related. Despite the independent collections of work on each measure, research has not fully explored the relationship between chaos and attention. However, both constructs demonstrate a relationship with a number of behavioral, social, and academic outcomes in children and adolescents (Breslau et al., 2009).

A second goal of the study intends to illustrate the associations between both attention and chaos with academic performance. Up to 40% of individuals with ADHD are reported to have comorbid learning disabilities, suggesting that learning and attention problems are related (Willcutt, Pennington, Chabildas, Olson, & Hulslander, 2005). Furthermore, findings from educational and cognitive literature suggest that problems with attention may be associated with lower academic achievement because of underlying deficits in executive functions, such as working memory (Martinussen, Hayden, Hogg-Johnson, & Tannock, 2005). Specifically, poorer attention is predictive of lower future academic achievement in both mathematics and reading, even after controlling for intelligence (Rapport, Scanlan, & Denney, 1999). Even after accounting for factors such as intelligence (IQ), socioeconomic status (SES), and comorbid disorders, the negative relationship between inattention and academic achievement is powerful. Children with attention problems are at high risk for lower academic achievement (Polderman et al., 2010).

Research has also demonstrated that preschool-age children living in more chaotic homes suffer deficits in both verbal and math ability (Goduka, Poole, & Aotake-Phenice,
1992). Elementary school–aged children from more chaotic homes do more poorly on standardized reading tests (Evans et al., 1998). This may be due to the fact that children in chaotic homes lack a place to study and find it more difficult to get away from their family to be alone (Evans, 1998). On the other hand, children with a place to study in crowded homes suffer fewer cognitive consequences (Wachs, 1979).

Given the findings on the relationship between chaos and attention in chapter 2, the purpose of this study was to further investigate the relationship between attention and academic performance, and whether that relationship was moderated by perceptions of chaos in the home. Additionally, because the current sample afforded the availability of multiple ratings of chaos within the same family, it was possible to examine which raters were correlated with specific outcomes. It was hypothesized that the individual ratings of chaos would yield information demonstrating that two or more people in the same home may perceive chaos at different levels, therefore demonstrating unique relationships with other measures.

The second aim explored any moderating effects that chaos had on the relationship between attention and academic performance. First, it was necessary to illustrate the relationship between attention and academic performance, as well as between chaos and academic performance. It was hypothesized that both attention and chaos would be significantly related to academic performance. Next, by highlighting potential interactions between chaos and attention, it was hypothesized that a significantly greater proportion of variance in reading and math performance would be explained. Additionally, this study considered individual perceptions and effects of
chaos by noting the differences in ratings of chaos and how each viewpoint was uniquely related to both attention and academic performance.

**Method**

**Participants**

The participants for this study were taken from the Western Reserve Reading and Math Project (WRRMP; Petrill et al., 2006), which collects data on N=872 children in Ohio. Same-sex twins and their parents were recruited into the study during kindergarten or first grade and assessed annually over 7 years. Parental permission and child assent were obtained at the time of each home visit. While mothers’ questionnaire data was collected at each home visit, relevant questionnaire information from the children was only collected at the final home visit, when the children were approximately 11 years old. Families in which the mother completed a measure of chaos at the final visit were included in the current sample. Therefore, the current study employed cross-sectional data from N=157 mothers and their same-sex twins (N=309) at the final visit. The demographics of this sample indicated that most parents are either married or cohabiting (92%), and a majority were White (92% of mothers). Furthermore, the data suggest that 12% completed high school or less, 18% completed some college, 30% hold a bachelor’s degree, 24% had some postgraduate education or degree, and 5% did not specify.

**Procedures and measures**

Once participation in the study was established, an initial questionnaire assessing information on the family members and home life of the family was completed by the mothers. Additionally, trained testers assessed each child on a battery of reading and
mathematics performance measures. This was repeated annually, with additional questionnaires assessing measures of the home environment given to parents at each assessment, and to the children at the final assessment. Finally, the testers were also asked to rate the environment as outside observers.

**Chaos:** Both the mothers and the children completed a questionnaire referred to as the Confusion, Hubbub, and Order Scale (CHAOS; Matheny, Wachs, Ludwig, & Phillips, 1995). This questionnaire asks a series of likert-type statements to which the parents and children respond that their homes are similar or not similar to the statement made (on a 5-point scale). For example, “There is always a TV on somewhere in our home”. Rating this statement as a 5 would indicate that it is very true, while rating it as a 1 would indicate that it is not true at all. Some questions, such as “We have a daily bedtime routine”, were reverse-scored in the analyses to indicate that a 5 would still be most chaotic and a 1 would be least chaotic. Data from the mothers and their children were utilized for the analyses in order to visually compare perceptions and effects of chaos. The internal consistency (measured using Cronbach’s α) has been demonstrated at .79 (Matheny et al., 1995) in previous research. For the current sample, the internal reliability was α=.50 for child-reported CHAOS and α=.61 for mother-reported CHAOS.

**Attention:** Two scales of attention were assessed via a parent-report questionnaire. This questionnaire was developed based on the Strengths and Weaknesses of ADHD symptoms and Normal behavior scale (SWAN; Swanson et al., 2006). The SWAN measures 18 items on a seven-point likert scale ranging from ‘far below average’ (1) to ‘far above average’ (7). The first nine items correspond to the Attention Deficit (SWAN
Inattention) scale and the last nine items to the Hyperactivity/Impulsivity (SWAN Hyperactivity) scale. The more attention problems a child has, the lower his or her score on the SWAN rating scales.

**Reading Performance:** The current study utilized three tests from the Woodcock Johnson Reading Mastery Test (WRMT; Woodcock, 1987). It focused on three early reading measures: Word Identification, and Word Attack, and Passage Comprehension. In both Word Identification and Word Attack, children were asked to read a list of words (or pseudo-words, in the Word Attack subtest) as fast as they could and were assessed based on the number of correct pronunciations within a 3-minute timeframe. The Passage Comprehension subtest assessed children’s ability to understand the concepts relayed in a passage that was read to them. Using all three measures of reading performance, a factor score of reading ability was created for this study. The reading factor score had a total Eigenvalue of 2.31, explaining 76.99% of the variance for this measure.

**Math Performance:** Three tests from the Woodcock Johnson III Tests of Achievement: Calculation, Fluency, and Applied Problems (Woodcock et al., 2001, 2007) were used for this study. The Calculation subtest measured the ability to perform mathematical computations with no time limit on items including addition, subtraction, multiplication, division, combinations of these basic operations, as well as some geometric, trigonometric, logarithmic, and calculus operation. Fluency also measured the child’s ability to solve addition, subtraction, and multiplication problems, but with a 3-minute time limit. Applied Problems measured the child’s ability to analyze and solve applied mathematics word problems. Published median reliabilities for these tests are .85, .89,
and .92, respectively (Woodcock et al., 2001). Using all three measures of math performance, a factor score of math ability was created for this study. The math factor score had a total Eigenvalue of 2.11, explaining 70.34% of the variance for this measure.

**Analyses**

Because the relationship between attention and chaos was established in chapter 2, the first aim for this chapter explored the relationship between attention and academic performance, as well as the relationship between chaos and academic performance.

The second aim of this study explored whether or not there were moderating effects of chaos on the relationship between attention and academic performance. This was completed utilizing attention as an independent variable, chaos as a potential moderator, and academic performance on reading and math measures as dependent variables in generalized linear regression models. These models demonstrated the main effects of each predictor, as well as the interactions. The generalized linear regression models also accounted for the standard error in the sample due to children being nested within families by holding a weighted constant of 1 throughout the analyses.

Finally, this study considered the individual perceptions of chaos by highlighting the data for two different raters of chaos within each family (mother and child), and their unique relationships with the children’s academic performance.

**Results**

The first aim of this study was to address the relationships between attention and academic performance, as well as chaos and academic performance. Descriptive information on each of the measures used in this study was demonstrated in Table 3.1.
Additionally, Table 3.2 illustrated the intercorrelations between each of the math and reading performance measures, demonstrating that they were each significantly related. Both CHAOS and SWAN Inattention and Hyperactivity were correlated with each reading and math performance measure, as demonstrated in Table 3.3. Overall, the results suggested that while CHAOS was significantly correlated with both reading and math performance, SWAN Inattention and Hyperactivity were only significantly correlated with math performance.

The second aim of this study was to explore whether the relationship between SWAN Inattention or Hyperactivity and reading or math performance was moderated by CHAOS. In order to assess this relationship, generalized linear regression models estimating the proportion of variance explained by the independent and moderating variables were conducted. Both measures of CHAOS (child- and mother-reports) were incorporated as moderators of the relationship between the SWAN measures and the reading performance factor score in 4 separate models. Tables 3.4 and 3.5 demonstrate there were no significant main effects or interactions between SWAN Inattention, CHAOS and the reading factor score. This followed the trend from Table 3.3, in which there was only 1 significant correlation between attention and reading performance (SWAN Inattention with reading comprehension; \( r = .150, p < .05 \)).

Unlike the reading factor score, Table 3.6 demonstrated that SWAN Inattention was significantly associated with the math factor score, although there was no evidence of moderation or main effects of CHAOS. And finally, Table 3.7 demonstrated a similar
trend in that there were no main effects or interactions between SWAN Hyperactivity, CHAOS, and math performance.

**Discussion**

The goals of this study were to examine the relationship between attention and academic performance, demonstrate whether this relationship was moderated by chaos, and to address whether or not there may be individual perceptions of chaos which should be addressed in future research.

The results demonstrated that chaos did not significantly moderate the relationship between attention and academic performance in this sample. It is also worth noting that each measure of chaos produced unique results in connection to both attention and the reading and math performance factors. This suggests that perception may be a key to understanding the influence of chaos on developmental outcomes. These findings also indicated that while there was a significant relationship between both chaos and attention with math performance, the relationship to reading performance was less consistent. Overall, the Word Attack measure was not significantly related to either chaos or attention, while the other two measures of reading were only significantly related with chaos. These findings suggest that there is something inherently different about the way that both chaos and attention influence reading versus math performance.

Previous research does suggest that math and reading abilities may have unique etiologies in their association with ADHD (Hart et al., 2010). One possible explanation is the type of instruction given in math versus reading courses throughout elementary and middle
school. According to DePaul and Stoner (2004), mathematics learning requires more sustained attention in class and more independent seat work than reading learning.

Limitations

Although this study offers important insight into the relationship between chaos, attention, and academic performance, there are some limitations to be aware of when interpreting these analyses. First, one limitation of the current study is that it does not demonstrate statistical differences between the separate reports of chaos. In other words, any inferences regarding different perceptions and effects of chaos are observational and not statistically verified.

Additionally, because data on child-reported chaos were only collected at one time point, it was impossible to examine longitudinal analyses. Cross-sectional data produces analyses based on correlations, not cause and effect or growth and development. Therefore, measuring the growth of attention and perceptions of chaos over time was not feasible.

Lastly, the sample utilized for the current study was homogeneous in that several of the measures lacked variability, such as SES and parent involvement. Furthermore, the homogeneity of the WRRMP sample may have contributed to the lack of significant findings between several of the measures included in the analyses. Finally, this sample was comprised of twin families, which are inherently different than non-twin families, whether or not both twins are incorporated in analyses. A suggestion for future research would include performing analyses on different populations, based on race, sex, poverty, or age.
Implications

Understanding how other factors interact with chaos to promote or hinder development can aid not only in explaining outcomes, but providing more appropriate interventions. Furthermore, research should focus on whether or not chaos mediates or moderates other influences that have been previously associated with academic performance, such as parent involvement, home literacy environment, and socioeconomic status.

Additionally, the results provide support for the collection of several points of view when gathering information about the home environment. Future research should statistically analyze these different ratings when exploring the effects of environment on several family members. Currently, most studies collect questionnaire data from one or both parents. However, those responses would likely be biased toward that parent’s perceptions. Collecting questionnaire data from several family members and utilizing those results may present interesting relationships which were previously undiscovered.

Finally, because of the implications that chaos and attention have demonstrated on academic outcomes in prior studies, it is important for both research and practice to address the impact that elements in the home environment have on children’s performance at school. While research should continue to explore possible factors in the home which explain variance in academic achievement, those who implement interventions and educate the public should place emphasis on addressing issues in the home which may be transferred to the school environment.
Chapter 4: Discussion

Summary

This dissertation has established several important issues which address gaps in the literature and provide a basis for future research, policy, and intervention. First, Chapter 1 described a lack of unity within the study of chaos, as well as outcomes associated with perceptions of chaos in the home. However, an all-encompassing definition was applied utilizing Evans and Wachs (2010) book, in which the authors specified research stating that chaos is anything from stimulation, disruption, noise, instability, or lack of routines and rituals in the home. Articles employing all or parts of this definition were collected and organized in order to evaluate the measurement techniques and outcomes related to elements of chaos (as defined in Evans & Wachs, 2010).

The review demonstrated that there are two unique patterns found in the literature, that which studies chaos and that which studies instability. While the research on chaos focuses on elements such as noise, distraction, stimulation, and lack of routines or rituals in the home (Johnson et al., 2008); research on instability measures elements such as partner changes, relocations, atypical family structure, inconsistent parenting, and SES (Baldridge, 2011). However, the associations with child outcomes for both the chaos literature and instability literature are parallel, demonstrating that both chaos and instability have similar influences on outcomes such as academic performance,
internalizing and externalizing behaviors, delinquency, and effortful control. This suggests that chaos and instability share qualities and could be interpreted as one broad concept.

Secondly, Chapter 2 analyzed the relationship between chaos and attention as well as the indirect relationships influenced by other factors in the home environment. While both chaos and attention have been associated with academic outcomes (Breslau et al., 2009) and behavior (Evans & Wachs, 2010), no research had yet explored the relationship between chaos and attention. Additionally, this study addressed the unique perceptions of chaos as reported by mothers and their children.

The results of this study demonstrated a significant relationship between chaos and attention, which was moderated only by family size. More specifically, correlations between chaos and attention suggested that while mother-reported chaos was significantly associated with inattention and hyperactivity, child-reported chaos was not. However, when estimating regressions between chaos and attention using measures of the home environment as moderators, a significant moderation was found between child-reported chaos and family size when predicting inattention in the hierarchical regression model. This interaction suggested that small families were more strongly influenced by high levels of chaos when accounting for variance in inattention.

Finally, Chapter 3 expanded on the established relationship between chaos and attention by assessing their relationship with academic performance. Chapter 2 demonstrated that mother-reported chaos is associated with both inattention and hyperactivity. Additionally, inattention has been shown to predict poorer reading and
math performance (Polderman et al., 2010). Therefore, the goal of this chapter was to understand how chaos may moderate the relationship between attention and academic performance, given those previously established relationships.

Pearson correlations demonstrated that while chaos was significantly related to both reading and math performance, attention was associated with only math performance in this sample. Additionally, after creating a reading factor score and a math factor score, regressions were estimated in order to assess whether or not the relationship between attention and academic performance was moderated by perceptions of chaos. The results demonstrated that while attention was significantly associated with math performance (as evidenced by the correlations provided), adding chaos to the model did not increase the amount of variance explained for either reading or math, and there were no significant interactions. These results suggested that although attention was independently associated with academic performance, it did not interact with chaos to explain more variance in academic performance in this sample.

**Limitations**

As with any research, there were some limitations to these findings, and results should be interpreted with these shortcomings in mind. First, the sample used for each of the analyses was homogeneous both demographically and operationally. For example, most of the mothers were white, highly educated, and either married or cohabiting. Additionally, the range of answers given was limited by the construct design in some cases (i.e. CHAOS is measured on a 5-point scale).
However, it is important to note that while homogeneity is a limitation in these regards, there are also some benefits to examining a sample with some degree of uniformity. For example, the majority of the current sample is white, therefore reducing the effect of race influencing these results. Additionally, because the majority of the parents in this sample were highly educated, the possibility of a 3rd variable effect of parent educational attainment is also reduced. In diverse populations, each of these factors (as well as many others) must be rigorously controlled for.

Additionally, some results may be construed by reporter-bias not directly accounted for in the analyses. For example, data on attention, SES, and home literacy environment were collected only from the mothers, while information on parent involvement was given by the children. It is possible that the respondents were vulnerable to social desirability bias (especially mothers, whose responses may reflect their own perceived abilities as parents).

Another limitation is that the current study addressed only cross-sectional analyses when comparing attention, chaos, and academic performance. This was due to the fact that chaos was only collected via child-report at a single time point. As with any cross-sectional analysis, it is possible that there are reciprocal associations which were not addressed. For example, Chapter 2 discussed the effect that measures of the home environment had on the relationship between chaos and attention. Chaos was used as an independent variable in regression analyses predicting attention as the dependent measure. However, because each of these measures was collected at the same time, it is possible that this relationship is inverted and attention actually predicts variance in chaos
in the home. Furthermore, the relationships addressed in Chapter 3 between chaos, attention, and academic performance, are subject to the same issue. Cross-sectional data does not control for the fact that the children’s academic performance could actually be predicting variance in chaos and/or attention.

**Implications**

Despite the limitations, these studies are the first to illustrate the association between chaos and attention. Furthermore, this manuscript includes the first study to address how this relationship is associated with academic performance in children. Therefore, it has several implications for both research and practice and provides supporting evidence for similar future studies.

The body of research in the field of chaos and child behavior, as evidenced by these chapters, is very broad. However, Chapter 1 demonstrated that the literature is anything but all-encompassing and complete. The lack of unity in this field calls for more research to be completed. Furthermore, there are still gaps in our knowledge which should be addressed in future studies.

One of the key issues that remains is how we can and should define chaos in the home. It is clear that chaos has an impact on child behavior; however, there is disagreement about which aspects of chaos (whether instability or distraction) provide the greatest risks to behavioral outcomes. The constructs of chaos and instability should be studied in detail to assess whether these elements are one-in-the-same or should be categorized as separate influences on development. Another goal of future research
should be to explore what the optimal level of chaos may be, as well as how this
threshold may differ between or even within families.

Parent-reports of chaos have demonstrated associations with a wide variety of
developmental issues in previous literature (Deater-Deckard et al., 2009). These studies
implicate parents’ responsibilities to provide an appropriate environment which enhances
healthy development (Deater-Deckard et al., 2009). However, Chapter 1 indicated that
this assumption is not so simple. While it is indeed the goal of this research to improve
the quality of life for children and their families, the current studies suggest some slightly
different paths for future research.

For example, the studies outlined in this manuscript suggest that each person may
experience chaos differently and therefore be influenced by its effects differently. Future
research should aim to address the unique within-family differences in perception of
chaos in a statistical analysis which compares betas from different regression models.
Not only would this provide point-of-view references for how chaos is perceived, it could
lead to the etiology of chaos or whether chaos is an antecedent or precedent of other
developmental problems. Additionally, because this and other research has provided
evidence for the pervasiveness of chaos, any researchers who study family environments
should consider including chaos and other similar measures of the home environment
whenever possible.

Another implication for researchers in this field is the need to develop a new
standardized instrument to measure both chaos and instability. Understanding both the
item-level and broad relationship between this hypothetical measure and other variables
may help construct a definition accepted by both chaos and instability researchers. While there are measures currently utilized to determine chaos, a measure which accounts for a broader variety of dimensions related to chaos may be a useful tool. Given the information that Chapter 1 summarized about the factors that impact children’s development, a measure that examines risk factors for both instability and chaos is needed to determine which children are truly at risk for poorer behavioral and academic outcomes based on the level of chaos or instability within their families.

Furthermore, new information could be gathered by assessing different populations: low SES, minorities, urban, rural, or adopted families, for example. While the data in the current studies were valuable to the population similar to the current sample, expanding our knowledge to other populations is crucial.

A final implication for research addresses the need for longitudinal data. Because of the reciprocal nature of any assessments made in most previous research, true analyses of which factors predict which outcomes has not been possible. An interesting proposition would be to collect families who are expecting their first child (via hospitals or gynecologists) and then following those families annually for several years. This would address questions about whether children promote higher levels of perceived chaos or how much chaos is present before children are even in the picture. Analyses would also be able to provide evidence on whether or not attention problems precede the stress related to higher levels of chaos or vice versa. Perhaps it is even true that poorer academic performance breeds chaos. None of these predictive associations have yet been addressed.
In addition to implications for future research, there are many implications for practice. The problems faced by unstable or chaotic families are prevalent in fields which work with families on a daily basis. For example, poverty, mobility, and maternal mental health directly impact the field of social work. By knowing how these issues impact children, professionals can better understand the steps to be taken in order to help families set up stable, non-chaotic homes. The results of this manuscript demonstrate that professionals in social work and policy should actively help families stay in one residence for an extended period of time by attempting to provide stable jobs and resources.

The development of a standardized measure to identify unstable or chaotic families (as discussed in the research implications) would be useful to promote interventions for children at risk. Clinicians in schools and government agencies could use this measure to identify which children are at risk for behavioral or academic difficulties based on levels of instability and chaos in the home.

Additionally, family leave policies for families of all demographics should be influenced by the information regarding the association between chaos and behavioral and academic development. It has been established that stress is a correlate to chaos, and the transition to parenthood is clearly a stressful time for many families. In addition to the sudden change in family structure, many new parents must make the decision of whether or not to return to work and how that decision will impact their family financially. Policies should take these stresses into consideration when implementing state or nationwide family leave policies (paid or unpaid). In some cases, one or both
parents are not granted any leave at all and must adjust to this additional stress with no
time to relax.

Finally, broader economic policy should also assist families financially in order to
develop of a more stable home environment. For instance, families in danger of having
to move due to financial constraints or change in parental makeup (e.g., death of
caregiver) could be eligible for federal or state aid in order to keep their primary
residence. This would greatly cut down on the number of chaotic relocations. Stricter
child-support laws requiring parents to help families stay in one primary residence could
also do much for creating stable family environments.

All in all, it is clear that chaos is the new frontier in assessing the quality of the
home environment. Therefore, it is necessary for researchers and practitioners to explore
what it means to have a chaotic home and how this problem can be addressed.
Hopefully, this dissertation will provide a starting point from which many studies can
explore solutions to this problem.
References


childhood: Environmental mediators identified in a genetic design. *Intelligence, 32*(5), 445-460.


### Table 1.1

Research on the relationship between one or more aspects of chaos and behavioral, socioemotional, and/or academic outcomes.

<table>
<thead>
<tr>
<th>CHAOS</th>
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Table 1.1 Continued

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Table 1.1 Continued

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Note. CHAOS=Confusion, Hubbub, and Order Scale (Matheny et al., 1995); Ac=poorer academic/cognitive outcomes; Em=poorer emotional/psychosocial development; Be=behavioral problems
Table 2.1

Descriptive Statistics for SWAN, CHAOS, and Home Environment measures

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Note. SWAN=Strengths and Weaknesses of ADHD Symptoms and Normal behavior scales (Swanson, et. al., 2006); CHAOS=Confusion, Hubbub, and Order Scale (Matheny, et. al., 1995); SES=socioeconomic status; HLE=home literacy environment (Griffin & Morrison, 1997).
Table 2.2

*Pearson Correlations between CHAOS and SWAN measures*

<table>
<thead>
<tr>
<th></th>
<th>SWAN</th>
<th>SWAN</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Inattention</td>
<td>Hyperactivity</td>
</tr>
<tr>
<td>Child-reported</td>
<td>-.093</td>
<td>-.078</td>
</tr>
<tr>
<td>CHAOS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mother-reported</td>
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<td>-.282*</td>
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<tr>
<td>CHAOS</td>
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<td></td>
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</tbody>
</table>

Note. SWAN=Strengths and Weaknesses of ADHD Symptoms and Normal behavior scales (Swanson, et. al., 2006); CHAOS=Confusion, Hubbub, and Order Scale (Matheny, et. al., 1995).

*significant at \( p < .05 \)

Table 2.3

*Pearson Correlations between CHAOS and home environment measures and between SWAN and home environment measures*

<table>
<thead>
<tr>
<th></th>
<th>SES</th>
<th>Family Size</th>
<th>HLE</th>
<th>Parent Involvement</th>
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<tr>
<td>CHAOS</td>
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</tr>
<tr>
<td>Child-report</td>
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<td>.119*</td>
<td>-.103</td>
<td>.099</td>
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<tr>
<td>Mother-report</td>
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<td>-.190*</td>
<td>.093</td>
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<td></td>
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<td>.095</td>
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<td>Hyperactivity</td>
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<td>.080</td>
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</table>

Note. SWAN=Strengths and Weaknesses of ADHD Symptoms and Normal behavior scales (Swanson, et. al., 2006); CHAOS=Confusion, Hubbub, and Order Scale (Matheny, et. al., 1995); SES=socioeconomic status; HLE=home literacy environment (Griffin & Morrison, 1997).

*significant at \( p < .05 \)
### Table 2.4

*Family size as moderator between CHAOS and SWAN Inattention*

<table>
<thead>
<tr>
<th></th>
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<tr>
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<td>.086</td>
<td>7.193</td>
<td>.01*</td>
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<tr>
<td><strong>Mother</strong></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>CHAOS</td>
<td>-.326</td>
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<td>1.195</td>
<td>.27</td>
</tr>
<tr>
<td>Family Size</td>
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<td>.162</td>
<td>.111</td>
<td>.74</td>
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<tr>
<td>Interaction</td>
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<td>.057</td>
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<td>.57</td>
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Note. SWAN=Strengths and Weaknesses of ADHD Symptoms and Normal behavior scales (Swanson, et. al., 2006); CHAOS=Confusion, Hubbub, and Order Scale (Matheny, et. al., 1995).

*significant at $p<.05$
Table 2.5

*Family size as moderator between CHAOS and SWAN Hyperactivity*

<table>
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<th></th>
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<td>Interaction</td>
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<td>.097</td>
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<td><strong>Mother</strong></td>
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<td>Interaction</td>
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<td>.080</td>
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<td>.86</td>
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Note. SWAN=Strengths and Weaknesses of ADHD Symptoms and Normal behavior scales (Swanson, et. al., 2006); CHAOS=Confusion, Hubbub, and Order Scale (Matheny, et. al., 1995).

*significant at $p<.05$
Table 2.6

*SES as moderator between CHAOS and SWAN Inattention*

<table>
<thead>
<tr>
<th></th>
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<th>Std. Error</th>
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<td>.08</td>
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<tr>
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<td>.116</td>
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<tr>
<td><strong>Mother</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
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<tr>
<td>Interaction</td>
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<td>.104</td>
<td>.131</td>
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Note. SWAN=Strengths and Weaknesses of ADHD Symptoms and Normal behavior scales (Swanson, et. al., 2006); CHAOS=Confusion, Hubbub, and Order Scale (Matheny, et. al., 1995); SES=socioeconomic status.
*significant at $p<.05$
Table 2.7

*SES as moderator between CHAOS and SWAN-Hyperactivity/Impulsivity*

<table>
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<tbody>
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<td>3.718</td>
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<td>.288</td>
<td>.324</td>
<td>.57</td>
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<tr>
<td>Interaction</td>
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<td>.111</td>
<td>.070</td>
<td>.79</td>
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<td><strong>Mother</strong></td>
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<td>.65</td>
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Note. SWAN=Strengths and Weaknesses of ADHD Symptoms and Normal behavior scales (Swanson, et. al., 2006); CHAOS=Confusion, Hubbub, and Order Scale (Matheny, et. al., 1995); SES=socioeconomic status.

*significant at $p<.05$
Table 2.8

Results of Sobel’s test of mediation for mediating effects of HLE and Parent Involvement on CHAOS and attention

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<th>Hyperactivity</th>
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<td>Standard Error</td>
<td>Test Statistic</td>
<td>Standard Error</td>
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<tr>
<td>Child-reported CHAOS</td>
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<td>-.81</td>
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<td>Mother-reported CHAOS</td>
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<td>-.47</td>
<td>.02</td>
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<tr>
<td>Parent Involvement</td>
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</tr>
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<td>Child-reported CHAOS</td>
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<td>-.87</td>
<td>.02</td>
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<tr>
<td>Mother-reported CHAOS</td>
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<td>.01</td>
<td>-.50</td>
<td>.01</td>
</tr>
</tbody>
</table>

Note. HLE=home literacy environment (Griffin & Morrison, 1997); CHAOS=Confusion, Hubbub, and Order Scale (Matheny, et. al., 1995).
*significant at $p<.05$
Table 3.1

*Descriptive Statistics for Measures of SWAN, CHAOS, and Academic Performance*

<table>
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<th>Mean</th>
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<td>1.13</td>
</tr>
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<td><strong>CHAOS</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child-Report</td>
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<td>2.47</td>
<td>0.61</td>
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<td>Mom-Report</td>
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<td>119</td>
<td>102.71</td>
<td>14.77</td>
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<td>58</td>
<td>102.59</td>
<td>11.02</td>
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<td>100.69</td>
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<tr>
<td>Fluency</td>
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<td>101</td>
<td>100.64</td>
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<td>74</td>
<td>106.43</td>
<td>11.15</td>
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</table>

Note. SWAN=Strengths and Weaknesses of ADHD Symptoms and Normal behavior scales (Swanson, et. al., 2006); CHAOS=Confusion, Hubbub, and Order Scale (Matheny, et. al., 1995).
### Table 3.2

**Pearson Correlations demonstrating the intercorrelations between the scores on the measures of reading and math taken from the WJIII and WRMT**

<table>
<thead>
<tr>
<th></th>
<th>Word Identification</th>
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<th>Reading Comprehension</th>
<th>Calculation</th>
<th>Fluency</th>
<th>Applied Problems</th>
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<td></td>
</tr>
<tr>
<td>Calculation</td>
<td>.371*</td>
<td>.281*</td>
<td>.478*</td>
<td>1</td>
<td></td>
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</tr>
<tr>
<td>Fluency</td>
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<td>.188*</td>
<td>.185*</td>
<td>.533*</td>
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<td>Applied Prob</td>
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<td>.530*</td>
<td>.652*</td>
<td>.404*</td>
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</table>

*Note. WJIII=Woodcock Johnson III tests of math achievement (Woodcock, 2007); WRMT=Woodcock Reading Mastery Test (Woodcock, 1987). *significant at p<.05

### Table 3.3

**Pearson Correlations of CHAOS and SWAN with the measures of reading and math taken from the WJIII and WRMT**

<table>
<thead>
<tr>
<th></th>
<th>Word Identification</th>
<th>Word Attack</th>
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<th>Calculation</th>
<th>Fluency</th>
<th>Applied Problems</th>
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<td>Child-report</td>
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<td>-.058</td>
<td>-.145*</td>
<td>-.149*</td>
<td>-.167*</td>
<td>-.169*</td>
</tr>
<tr>
<td>Mother-report</td>
<td>-.139*</td>
<td>-.089</td>
<td>-.221*</td>
<td>-.169*</td>
<td>-.059</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Inattention</td>
<td>.033</td>
<td>.037</td>
<td>.057</td>
<td>.213*</td>
<td>.121*</td>
<td>.175*</td>
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<td>.046</td>
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<td>.240*</td>
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<td>.208*</td>
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*Note. SWAN=Strengths and Weaknesses of ADHD Symptoms and Normal behavior scales (Swanson, et. al., 2006); CHAOS=Confusion, Hubbub, and Order Scale (Matheny, et. al., 1995); WJIII=Woodcock Johnson III tests of math achievement (Woodcock, 2007); WRMT=Woodcock Reading Mastery Test (Woodcock, 1987). *significant at p<.05
Table 3.4

*CHAOS as moderator between SWAN Inattention and the WRMT reading factor score*

<table>
<thead>
<tr>
<th></th>
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<th>Std. Error</th>
<th>Wald $\chi^2$</th>
<th>Sig.</th>
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</thead>
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<td><strong>Child</strong></td>
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<tr>
<td>Inattention</td>
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<tr>
<td>CHAOS</td>
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<td>.459</td>
<td>.079</td>
<td>.78</td>
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<tr>
<td>Interaction</td>
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<td>.087</td>
<td>.316</td>
<td>.57</td>
</tr>
<tr>
<td><strong>Mother</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inattention</td>
<td>.172</td>
<td>.239</td>
<td>.516</td>
<td>.47</td>
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<tr>
<td>Interaction</td>
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<td>.404</td>
<td>.53</td>
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</table>

Note. SWAN=Strengths and Weaknesses of ADHD Symptoms and Normal behavior scales (Swanson, et. al., 2006); CHAOS=Confusion, Hubbub, and Order Scale (Matheny, et. al., 1995); WRMT=Woodcock Reading Mastery Test (Woodcock, 1987).

*significant at $p<.05$
Table 3.5

*CHAOS as moderator between SWAN Hyperactivity and the WRMT reading factor score*

<table>
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<tr>
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<th>Wald $\chi^2$</th>
<th>Sig.</th>
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<td>.73</td>
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<tr>
<td>Interaction</td>
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<td>.087</td>
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<td>.54</td>
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<tr>
<td><strong>Mother</strong></td>
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<td>.087</td>
<td>.093</td>
<td>.76</td>
</tr>
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</table>

Note. SWAN=Strengths and Weaknesses of ADHD Symptoms and Normal behavior scales (Swanson, et. al., 2006); CHAOS=Confusion, Hubbub, and Order Scale (Matheny, et. al., 1995); WRMT=Woodcock Reading Mastery Test (Woodcock, 1987).

*Significant at $p<.05$
Table 3.6

*CHAOS as moderator between SWAN Inattention and the WJIII math factor score*

<table>
<thead>
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<th>Wald $\chi^2$</th>
<th>Sig.</th>
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<td><strong>Child</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td>.459</td>
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<tr>
<td>CHAOS</td>
<td>.022</td>
<td>.580</td>
<td>.001</td>
<td>.97</td>
</tr>
<tr>
<td>Interaction</td>
<td>-.039</td>
<td>.121</td>
<td>.105</td>
<td>.75</td>
</tr>
</tbody>
</table>

Note. SWAN=Strengths and Weaknesses of ADHD Symptoms and Normal behavior scales (Swanson, et. al., 2006); CHAOS=Confusion, Hubbub, and Order Scale (Matheny, et. al., 1995); WJIII=Woodcock Johnson III tests of math achievement (Woodcock, 2007).

*significant at $p<.05$
Table 3.7

**CHAOS as moderator between SWAN Hyperactivity and the WJIII math measure score**

<table>
<thead>
<tr>
<th></th>
<th>B</th>
<th>Std. Error</th>
<th>Wald $\chi^2$</th>
<th>Sig.</th>
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<tr>
<td><strong>Child</strong></td>
<td></td>
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</tr>
<tr>
<td>Hyperactivity</td>
<td>.441</td>
<td>.231</td>
<td>3.644</td>
<td>.06</td>
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<td>CHAOS</td>
<td>.329</td>
<td>.474</td>
<td>.483</td>
<td>.49</td>
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<tr>
<td>Interaction</td>
<td>-.098</td>
<td>.091</td>
<td>1.152</td>
<td>.28</td>
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<td><strong>Mother</strong></td>
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<td></td>
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<tr>
<td>Hyperactivity</td>
<td>.066</td>
<td>.235</td>
<td>.079</td>
<td>.78</td>
</tr>
<tr>
<td>CHAOS</td>
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<td>.523</td>
<td>.598</td>
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<tr>
<td>Interaction</td>
<td>.057</td>
<td>.105</td>
<td>.298</td>
<td>.59</td>
</tr>
</tbody>
</table>

Note. SWAN=Strengths and Weaknesses of ADHD Symptoms and Normal behavior scales (Swanson, et. al., 2006); CHAOS=Confusion, Hubbub, and Order Scale (Matheny, et. al., 1995); WJIII=Woodcock Johnson III tests of math achievement (Woodcock, 2007).

*significant at $p<.05$
Figure 1. Interaction between CHAOS and family size accounting for significant variance in SWAN Inattention