HHS Public Access

Author manuscript

Dev Psychol. Author manuscript; available in PMC 2019 June 01.

Published in final edited form as:

Dev Psychol. 2018 June ; 54(6): 1086–1098. doi:10.1037/dev0000516.

A Smartphone-Based Ecological Momentary Assessment of Parental Behavioral Consistency: Associations with Parental Stress and Child ADHD Symptoms

James J. Li[1] and **Jennifer E. Lansford**[2]

[1]Department of Psychology, Waisman Center, University of Wisconsin – Madison

[2]Sanford School of Public Policy, Duke University

Abstract

Inconsistent parental discipline is a robust correlate of child attention-deficit/hyperactivity disorder (ADHD) symptoms, but few studies have considered the role of inconsistent *positive* parenting on ADHD, as well as the effects of stress on negative and positive parental consistency. This study advanced a novel ecological momentary assessment (EMA) using participant smartphones to measure parental consistency, and examined its associations with family, social and parenting-related dimensions of stress and child ADHD symptoms. Participants were 184 kindergartners with and without ADHD and their parents. Harsh and warm dimensions of parental behavior were assessed using questionnaires, observations, and an EMA administered through parents' smartphones, which measured parent-child behaviors every day for a period of one week. Family, social and parenting-related stress were assessed from questionnaires, and child ADHD symptoms were assessed from a fully structured diagnostic interview with the parent. Child ADHD symptoms were associated with variability in warm parenting behaviors, and higher levels of parenting-related stress were related to greater variability in harsh parenting behaviors. No significant interactions were detected between parental stress and child ADHD on parental variability. These findings suggest that different factors influence the *consistency* in parenting behavior, depending on whether positive parenting or negative parenting is assessed. Parent-based treatment programs for children with ADHD should include a stronger focus on reducing stress from parenting (e.g., teaching coping skills for parents), as this may lead to greater consistency in parental behavior more generally, and presumably better child outcomes.

Keywords

parenting; stress; ADHD; parent-child relationships; ecological momentary assessment

Attention-deficit/hyperactivity disorder (ADHD) is a childhood-onset disorder characterized by developmentally inappropriate levels of inattention, hyperactivity and impulsivity. ADHD is also one of the most prevalent disorders of childhood (Polanczyk, Willcutt, Salum, Kieling, & Rohde, 2014) that not only results in significant impairments in academic and

Correspondence concerning this article should be addressed to James J. Li, Department of Psychology, University of Wisconsin – Madison, 1202 West Johnson Street, Madison, WI 53706. james.li@wisc.edu.

social functioning, but also prospectively predicts substance use and criminality in later life (Langley et al., 2010). The economic impact of ADHD on the U.S. economy has been substantial, resulting in nearly $138 billion in lost income and productivity among adults and $72 billion in costs to health care and education among children and adolescents per year, between 1990 and 2011 (Doshi et al., 2012). Furthermore, ADHD frequently co-occurs with oppositional defiant disorder (ODD) or conduct disorder (CD) during childhood, leading to disruptions in family dynamics (Chronis, Jones, & Raggi, 2006; Johnston & Mash, 2001). Despite its public health significance and negative impact on children and their families, uncovering its precise etiology has been a major challenge, particularly with respect to understanding how complex psychosocial processes and individual factors contribute to its development. Understanding how various factors impact parent-child relationships is especially paramount, given that most evidence-based psychosocial interventions for child ADHD center on improving parent-child relationships (Pelham & Fabiano, 2008).

Although the association between negative parenting behaviors and child ADHD is well-established (Burke, Pardini, & Loeber, 2008; Chamberlain & Patterson, 1995; Kaiser, McBurnett, & Pfiffner, 2011), parental behavior itself is influenced by contextual factors, such as the experience of stress (i.e., lack of social support, family stress) and/or the characteristics of the child (i.e., “child effects,” Jaffee et al., 2004; Patterson, 1982). Higher levels of stress negatively affect the parent-child relationship and increase the use of negative parenting practices (Theule, Wiener, Tannock, & Jenkins, 2013; Webster-Stratton, 1990). For example, in a community sample of low-income African American single mothers and their offspring, mothers engaged in more scolding or yelling, hitting, and threatening behaviors with their offspring when they also reported having fewer *social supports* available to them, which was defined as the degree of help and support that could be obtained from others outside the house (e.g., friends, co-workers) when needed (Ceballo & McLoyd, 2002). Similarly, parents reporting fewer and lower quality social supports (i.e., high social stress) often engage in higher levels of maladaptive parenting behaviors, including neglect and other forms of maltreatment (Brooks-Gunn & Duncan, 1997). Beyond social stressors, there is also evidence that the more *family stress* (e.g., marital discord, lack of cohesion or increased stress from other family members) parents experience, the less supportive and the more non-supportive they are in response to their children’s negative emotions (Nelson, O’Brien, Blankson, Calkins, & Keane, 2009). In fact, a longitudinal study of 282 Latino families found that greater cohesion among family members (i.e., emotional closeness, support, dependability) prospectively predicted greater improvements in child social problem-solving skills and social self-efficacy (Leidy, Guerra, & Toro, 2010). Parenting a child with ADHD also affects parenting behaviors and contributes to *parenting-related stress*, which arises when parents’ perceptions of the demands of parenting outweigh their resources for dealing with them (Theule et al., 2013). Scholars have differentiated child characteristics that contribute to parenting-related stress (i.e., child ADHD) from parent characteristics (i.e., personality factors, psychopathology), although a meta-analysis concluded that parents of children with ADHD experience significantly more parenting-related stress across both domains compared to parents of non-ADHD children (see Theule et al., 2013). Collectively, these studies point to the crucial role that stress generated by

contextual factors (e.g., family and life circumstances) and child factors (e.g., parenting a difficult child with ADHD) may play on parental behavior.

However, few studies have examined the interactive role of parental stress and child ADHD on parental behavior. This understanding may be crucial because not all parents who experience high levels of stress or have a child with ADHD will engage in negative parenting practices (see review by Morgan, Robinson, & Aldridge, 2002). Investigating the interactive role of stress and child ADHD on parenting behavior may shed light on why only some, but not all families of children with ADHD benefit from psychosocial interventions that specifically target parenting behavior (e.g., parent management training). For instance, it is plausible that the negative effects of social and family stressors on parental behavior may be exacerbated by the offspring's diagnosis, as previous studies have shown that parents of children with psychopathology more broadly are more likely to report additional forms of stress beyond parenting stress alone relative to parents of typically-developing children (e.g., Baker-Ericzen, Brookman-Frazee, & Stahmer, 2005; Johnston, 1996). Interestingly, early intervention programs for children with autism spectrum disorder (ASD) have been found to significantly reduce the stress related to parenting a child with ASD (i.e., parenting-related stress) but not the stress related to non-child-specific domains (e.g., personal adjustment and family functioning) (Baker-Ericzen et al., 2005). Their findings suggest that parental functioning and behavior may be influenced by a breadth of stressors, beyond those simply related to parenting a child with psychopathology. Despite its potential treatment implications, we are aware of no existing studies that have examined the moderating role of child ADHD on the link between social, familial, and parenting-related stress with parental behavior.

Furthermore, very few studies have also considered how stress and child factors may impact intra-individual consistency of parenting behaviors. Previous studies on the *stability* of parenting (i.e., inter-individual consistency) have generally shown that harsh and negative parenting behaviors tend to decline as children age, whereas warmth and monitoring tend to be relatively stable (Carrasco et al., 2011; Forehand & Jones, 2002). Intra-individual parental consistency differs from stability, however, in that it refers to the follow-through in maintaining and adhering to rules and standards of conduct for the child's behavior (Halgunseth, Perkins, Lippold, & Nix, 2013). Patterson (1982) posited through his theory of coercive family processes that parents and children reinforce each others' behavior, such that deviant child behaviors may be inadvertantly reinforced and trained through the parents' own harsh or inconsistent behaviors. In fact, several studies have shown that parental inconsistent discipline is among the most robust predictors of behavior problems in children and adolescents (Barry, Dunlap, Lochman, & Wells, 2005; Edens, Skopp, & Cahill, 2008; Halgunseth et al., 2013), and has also been identified as one of the key treatment targets in psychosocial interventions for ADHD (see meta-analysis by Kaminski, Valle, Filene, & Boyle, 2008).

There are several theoretical and methodological gaps in this literature. First, the field has predominantly focused on consistency in parental *discipline* as it relates to child behaviors, rather than on consistency across parenting behaviors, such as positive reinforcement or child engagement. This is a crucial omission given that effective parenting not only involves

maintaining and enforcing rules as they pertain to problem behaviors of the child (i.e., discipline), but it also involves engaging in the child's prosocial behaviors with positive reinforcement and attention as well. Furthermore, evidence suggests that aspects of positive parenting behavior (e.g., warm and supportive parenting, involvement, and positive reinforcement) are independent from negative parental behaviors (e.g., inconsistent discipline, negativity, harsh punishment) rather than simply reflecting different ends of a spectrum, and are differentially predictive of ADHD symptoms in children (Pettit et al., 1997). Rarely have these processes been measured concurrently or been considered in studies that examine parental consistency as they relate to child outcomes. Second, theorists have long characterized the day-to-day (and moment-to-moment) parent-child interactions as the "proximal engines of development," forming the experiences that directly contribute to child behavioral and social development (Granic, O'Hara, Pepler, & Lewis, 2007).

Yet, measuring the dynamics of parental consistency and parent-child interactions on a day-to-day basis has been challenging because these constructs have traditionally been measured using self-report questionnaires and/or observational methods, which do not provide the type of high-temporal resolution data that are needed to measure consistency of behavior over time (Power et al., 2013; Stewart & Bond, 2002). Properly measuring parental consistency may be crucial for elucidating the mechanisms of change with respect to parent-based psychosocial interventions for ADHD (Granic et al., 2007), but reliable methods to measure this construct have yet to emerge (Power et al., 2013). The current study employed an ecological momentary assessment (EMA) through a novel smartphone application (app) platform to measure daily parent-child behaviors and their consistency over the course of a week. Smartphone-based assessments potentially offer several advantages over traditional paper-and-pencil questionnaires and observational methods. First, smartphones are widely owned among Americans, including lower income and minority populations. The Pew Research Center (2017) estimated that approximately 77% of all Americans owned a smartphone as of 2015, including 64% of the lowest-income Americans (household income < $30,000 per year). Smartphone ownership is especially high across younger and middle-age groups (92% among 18 to 29-year-olds, 88% among 30 to 49-year-olds, 74% among 50 to 64-year-olds). Thus, smartphones offer impressive accessibility to patients and participants (Dunton et al., 2014). Second, smartphones can be used to collect information from participants conveniently, potentially minimizing confounds due to recall bias (e.g., having the participant focus on the events or behaviors of that day) and maximizing ecological validity (e.g., describing the event or behavior as it is happening), relative to traditional questionnaire or observational methods. Third, smartphones can be used to collect high temporal resolution information on complex behaviors. Researchers can program assessments to be administered repeatedly with a relatively low burden on the participant, such that it is possible to directly measure consistency and variability of certain behaviors as reported by the participant on a day-to-day basis (Power et al., 2013).

The present study had two objectives. First, we tested the concordance of a novel smartphone-based measure of daily parent-child functioning (i.e., means and variabilities for positive and negative dimensions of parenting rated each day for one-week) with traditional measures of parenting, including both questionnaire and direct observational methods. It was hypothesized that mean levels of positive and negative parenting assessed through the

smartphone-based EMA would be associated with analogous parenting outcomes assessed via questionnaire and observational methods. More specifically, we expected that negative and positive parenting variability would be associated with the negative dimensions of parenting assessed via questionnaire and observational measures given that inconsistent discipline (and perhaps parental inconsistency more generally) has been previously found to factor analytically load with the negative dimension of parenting (see Essau, Sasagawa, & Frick, 2006) and has been associated with negative child outcomes (e.g., Barry, Dunlap, Lochman, & Wells, 2005; Edens, Skopp, & Cahill, 2008; Halgunseth et al., 2013). The second objective was to test the independent and interactive effects of multiple domains of parental stress, including social (i.e., amount of stress from co-workers, close friends, etc.), family (i.e., stress from close family members), and parenting-related stress (i.e., difficulty in parenting of a child), and child ADHD on variability in positive and negative parenting. It was hypothesized that greater levels of parental stress (across social, familial, and parenting domains) and child ADHD would predict greater variability of positive and negative parenting behaviors. Furthermore, it was hypothesized the association between multiple domains of stress and greater variability in both positive or negative parenting would be strengthened by greater child ADHD symptoms. The current study focused on kindergarten children with and without early attentional and behavioral problems. The transition into kindergarten marks an important milestone in which children must interact with new peers and adult authority figures (other than their caregivers) (Kiel & Buss, 2011). Children entering kindergarten are also exposed to a variety of contingency-based rules in the classroom (as opposed to the home setting), making the expression of behavioral and attentional difficulties especially visible for parents.

Method

Participants and Procedures

The current study is part of a longitudinal study on biological and environmental antecedents of trajectories of ADHD and co-occurring externalizing psychopathology in children. We recruited an enriched sample of young children with and without early signs of attentional and behavioral problems, with the goal of following these children over time to identify the factors that predict developmental trajectories of ADHD and related psychopathology. Parents were told we were interested in recruiting families of kindergarten children “with and without attention and/or behavioral problems” through child development research registries, social media (i.e., Facebook posts, parenting blogs) and from brochures and flyers distributed in the community, including elementary schools, outpatient clinics, community centers and doctors’ offices. Participants were ineligible to participate if they were previously diagnosed with an intellectual disability or Autism Spectrum Disorder, did not live with a biological parent at least half of the time, or were not fluent in English. Using this recruitment strategy, 184 parents and their kindergarten children (mean age = 6.04, *S.D.* = . 40) participated in the study. Among child participants, 55.4% were male, 85.9% were Caucasian, and 20.7% met clinical criteria for any subtype of ADHD (4.9% inattentive subtype, 9.8% hyperactive/impulsive subtype, and 6.0% combined subtype) according to the *Diagnostic Interview Schedule for Children, Version IV* (DISC-IV; Shaffer, Fisher, Lucas, Dulcan, & Schwab-Stone, 2000) conducted with the child’s biological parent. Ninety-three

percent of the parents who participated in the study were mothers, and 87.5% reported being married and living with a spouse. The sample was well-educated (84% held at bachelor's degree) and had a high gross household income (median = $92,000), which is representative of the surrounding community. Perhaps due to the young age of the sample, none of the children in the sample were reported to be on stimulant medications at the time of assessment. All study protocols were approved by the University of Wisconsin-Madison institutional review board (IRB#2015-1177, Study title: Self-Control and Reward Sensitivity During Child Development).

Eligible families were mailed a packet with study questionnaires to complete and then invited to the laboratory to complete a comprehensive cognitive and behavioral battery consisting of interviews and laboratory-based tasks (i.e., parent-child observations, neuropsychological tests, behavioral paradigms). All parent and child assessments were conducted by doctoral students in school or clinical psychology along with highly trained undergraduate research assistants. All research assistants were directly supervised by a licensed clinical psychologist and attended weekly supervision meetings with the clinical psychologist to ensure that the administration and interviews were valid and reliable. Families were also provided a written summary of the results based on the data obtained from the clinical interview, child psychological assessment, and other cognitive and behavioral questionnaires. All reports were reviewed and signed by the licensed clinical psychologist. Participants were also paid $40 for their participation in the study.

Measures

Diagnostic Interview Schedule for Children, Version IV (DISC-IV; Shaffer, Fisher, Lucas, Dulcan, & Schwab-Stone, 2000)—Child ADHD symptoms were assessed from a fully-structured computer-assisted clinical interview conducted with the child's parent. The presence of ADHD symptoms was assessed based on DSM-IV criteria for ADHD. The ADHD module of the DISC-IV has good psychometric properties, including test-retest reliability (r = .79 after 1 year) and internal consistency (Cronbach's alpha = .84 for symptoms) based on parent ratings in a large community sample (Shaffer et al., 2000). The current study used a dimensional conceptualization of ADHD by using a total symptom count score (out of 18) for child ADHD in all analytic models.

Duke Social Support and Stress Scale (DUSOCS; Parkerson, Broadhead, & Tse, 1991)—The DUSOCS is a 12-item scale that assesses two dimensions corresponding to family and non-family (i.e., social) stress from individuals who "cause problems for [the parent] and makes [the parent's] life more difficult…at this time your life." Family stress refers to stress from significant others, children or grandchildren, parents or grandparents, brothers or sisters, other blood relatives, and relatives by marriage (in-laws, ex-spouses). Social stress refers to stress from neighbors, coworkers, church members, or other friends. Parents were also asked to identify whether "there is one particular person who is causing [the parent] the most personal stress now," and if so, to specify who that person is. For each individual, parents were asked to report on how much stress they felt from each of those individuals on a 3-point Likert scale, where 0 = *none*, 1 = *some*, and 2 = *a lot*. Parents could also respond *there is no such person*, which was scored a 0. Scores were computed per

Parkerson et al. (1991). Family stress was scored as the sum of the six categories of family members. If the item endorsed for "the most stressful person" was a family member, a score of 2 was added (otherwise, a score of 0 was added). Social stress was scored as the sum of the four categories of non-family members. If the "most stressful person" was a non-family member, a score of 2 was added (otherwise, a score of 0 was added). For both subscales, an average total score was computed then multiplied by 100, such that higher scores represent greater family or social stress for the individual. A timeframe regarding each question was not specified in the instructions of the questionnaire. The family stress and social stress subscales demonstrated acceptable internal consistency (Cronbach's alpha = .73 and .76, respectively).

Parenting Stress Index-Short Form (PSI; Abidin, 1995)—The PSI is a 36-item index of parenting stress, with three subscales corresponding to personal distress (e.g., 12 items; "feel that I cannot handle things"), parent-child dysfunction (e.g., 12 items; "child rarely does things for me"), and child difficulty (e.g., 12 items; "child is more of a problem than expected"). Each item was rated on a 5-point Likert scale, where 0 = *strongly disagree* and 4 = *strongly agree* (two items were reverse scored). A timeframe regarding each question was not specified in the instructions of the questionnaire. We used the parenting-related stress scale, which is a mean score of the combination of parent-child dysfunction and child difficulty subscales. This composite was factor-analytically identified and validated in a previous study (i.e., Child Rearing Stress; Haskett, Ahern, Ward, & Allaire, 2006) and specifically pertains to parenting-related stress from the child's characteristics (e.g., child problem behaviors), independent from the parent's own characteristics. Higher scores on this scale represent greater parenting-related stress. The parenting-related stress scale demonstrated excellent internal consistency in the current sample (Cronbach's alpha = .91).

Alabama Parenting Questionnaire (APQ; Frick, 1991)—Parents self-reported on the frequency (i.e., 1 = *never* to 5 = *always*) of 42 items related to parenting practices and behaviors. A timeframe regarding each question was not specified in the instructions of the questionnaire. Positive and negative dimensions of parenting behaviors have been delineated based on previous factor analytic studies (Frick & Dantagnan, 2005; Kaiser, McBurnett, & Pfiffner, 2011; Li & Lee, 2012; Shelton, Frick, & Wootton, 1996). The global positive parenting dimension includes parents' level of involvement (e.g., "you help your child with his/her homework;" 10 items) and frequency of using positive reinforcement strategies (e.g., "you praise your child if he/she behaves well;" 6 items) with their child. The global negative parenting dimension includes the parents' self-reported frequency of using corporal punishment (e.g., "you spank your child with your hand when he/she has done something wrong;" 10 items), having poor monitoring (e.g., "your child is at home without adult supervision;" 10 items) and being inconsistent in their discipline (e.g., "the punishment you give your child depends on your mood;" 6 items) with their child. Mean scores for global positive parenting and global negative parenting were computed for the current analyses, where higher scores on either scale represent more positive and more negative global parenting behaviors, respectively. The APQ scales demonstrate convergence with observed parent-child interaction measures (e.g., Chronis-Tuscano et al., 2008; Hawes & Dadds,

2006) as well as adequate internal consistency in other studies (Shelton et al., 1996). Cronbach's alphas were .82 and .65 for the positive parenting (16 items) and negative parenting (26 items) dimensions, respectively.

Mobile Survey of Parent-Child Dynamics (MSPCD)—Parents were asked to fill out a questionnaire about their interactions with their child that day, administered directly from their own smartphone. The questionnaire was completed once a day, for a period of seven days starting on the evening of their laboratory visit. Push notifications ensured that the questionnaire would show up on the parents' mobile device each evening at 8pm. This time was chosen based on parental feedback from initial pilot testing, as parents reported that 8pm was the appropriate time of the day in which they could accurately assess the quality of interaction with their child earlier during the day. If parents missed the first notification at 8pm, the application would deliver reminders on the mobile device every 10 minutes, until the last reminder at 9pm (afterwards, the questionnaire would be skipped for the day).

The questionnaire was designed and administered through a proprietary multi-platform (i.e., iOS and Android compatible) smartphone app (Metricwire; www.metricwire.com) that has been previously used in health and behavioral studies (Levin, Pierce, & Schoendorff, in press; Liu, Sparks, & Coghlan, 2016; Sperry & Kwapil, in press). Participants who did not have compatible mobile devices were emailed a link, which would enable them to complete the daily survey on any computer. Ninety-six percent of participants used either an Android or iOS mobile device (see Appendix, Table A1 for additional details).

The mobile questionnaire consisted of 15 questions, each presented on a separate screen on the participants' own mobile device about the child's behavior and parents' response to these behaviors each day. Questions were adapted from the Alabama Parenting Questionnaire (APQ) and the Wave 1 Parent Questionnaire from the Childhood and Beyond Study (Eccles, personal communication) to assess both *positive* and *negative* dimensions of parental behavior, child behavior, and parent-child interactions. The full list of questions is presented in the Appendix. Each question includes multiple response options with built-in skip logic, such that follow up questions were only asked if the participant positively endorsed a response choice that necessitated a follow up question. For example, participants were asked the question, "How many instances of misbehavior did your child have today?" If the participant selected "none," then all questions about misbehavior were skipped. If the participant selected "1 – 3 instances," then the following question was presented: "Please think back to those instances in which your child misbehaved today. What did your child do? Select all that apply." A checklist of 10 response options was presented on the same screen, including "lost his/her temper," "argued with adults," or "other." If "other" was selected, participants were then asked to type in the misbehavior on the following screen. The parent was then asked: "How did you respond to your child's worst instance of misbehavior?" to which they were given eight different checklist options, including harsh parenting (e.g., "spanked my child"), active discipline (e.g., "gave my child a time out"), or passive discipline (e.g., "did nothing").

Two subscales were used to assess positive and negative parent-child interactions. *Harsh parenting* was derived from the frequency of the three harsh parenting behaviors in response

to child misbehavior for each day: “spanked my child,” “threatened my child,” “yelled or screamed at my child.” The *warm parenting* subscale consisted of the amount of positive interactions the parent engaged in with the child for each day (10 items; e.g., “had a friendly chat,” “played games together,” “read a book together”) and their responsiveness to the child’s positive behavior (7 items; e.g., “praised my child,” “explained why he/she did a good job,” “rewarded my child with a treat”). Based on previous EMA literature, parenting variability was measured using mean square successive difference (MSSD) (von Neumann, Kent, Bellinson, & Hart, 1941), an index of temporal stability (or instability) that accounts for the frequency, amplitude, and temporal dependency of change within a data series (Rosen & Factor, 2012). MSSD scores are particularly robust against systematic time trends and do not require that time series data be re-trended prior to analysis (Jahng, Wood & Trull, 2008; Wange, Hamaker, & Bergeman, 2012). The MSSD statistic was calculated by computing the squared successive difference for each variable from each day to the next (where data were provided) and then averaging those scores across all days of the task (approximately seven days):

$$MSSD = \frac{\sum_{i=1}^{n-1} (x_{i+1} - x_i)^2}{n-1}$$

where x_i is the daily measure or parenting behavior at the ith day, and n is the total number of assessments for that participant. High MSSD scores indicate higher variability, whereas low MSSD scores indicate lower variability. Individual mean scores throughout the week were also computed for both variables. Participants with excessive missing data, which we defined as participants who had two or fewer days of available EMA data, were excluded from the analyses because they did not provide enough data to generate meaningful MSSD and mean score calculations. Missing data may be due to participants who did not positively endorse the EMA stem item on enough days (i.e., three or more days) or if they simply missed their EMA assessments during the assessment window. On average, participants provided 5.56 data points, and only nine participants were excluded due to having provided less than two days of data (see Appendix Table A1 for more information about the characteristics of the EMA data), a response rate that is in line with other EMA studies (e.g., Rosen & Factor, 2012). Importantly, participants who were excluded from the analyses due to excessive missing EMA data did not statistically differ from the other participants on any of the key independent variables assessed in the current study, including social stress (t = .59, p = .55), family stress (t = −1.15, p = .27), parent-related stress (t =.11, p = .90), and child ADHD symptoms (t =.15, p = .88). Cronbach’s alpha for the harsh parenting and warm parenting scales were both in the excellent range (α = .85 and .87, respectively).

Dyadic Parent-Child Interaction Coding System (DPICS; Eyberg et al., 2013)— Parents and their children were asked to engage in three play-oriented conditions using toys strategically placed around an observation room. The three conditions consisted of 10 minutes of child-led play, 10 minutes of parent-led play, and 5 minutes of cleanup time. Experimenters entered the room at each 5-minute interval to ensure the parent-child dyad was fully engaged in the task. These interactions were video recorded with parental consent.

Observed instances of parental negativity and praise for the 25-minute task were coded using the DPICS (see Eyberg et al., 2013 for specific details on coding procedures). The DPICS is a well-validated rating system of parent-child interaction that has previously demonstrated strong predictive validity and sensitivity to intervention effects (Thomas & Zimmer-Gembeck, 2007). Coding was conducted by undergraduate research assistants and supervised by a Ph.D.-level research assistant with previous experience in DPICS coding. Coders participated in a full day of training, followed by several weeks of practice until 70% inter-rater agreement was reached. After this threshold was reached, weekly coding team meetings were held to ensure reliability and accuracy. Twenty percent of videos were randomly selected and coded by two separate coders to estimate inter-rater reliability. Parent negative talk was coded whenever a parent "expressed disapproval of the child or the child's attributes, activities, products, or choices, and includes sarcastic, rude, critical, threatening or imprudent speech" (Eyberg et al., 2013, *pp.* 24). Examples include "you're being naughty," "that's not quite right, sweetie," or "what's with you today?" Parental praise was coded when a parent expressed a favorable judgment of an attribute, product, or behavior of the child. This includes both labeled (i.e., a positive evaluation of a specific behavior, activity or product of the child, e.g., "you did a great job building that tower.") and unlabeled praise (i.e., unspecified evaluation of behavior, activity or product of the child, e.g., "great job"). Based on the recommendations described in Eyberg and colleagues (2013, *pp.* 250) and by previous studies (e.g., Chronis-Tuscano et al., 2008; Li & Lee, 2012), the current study used percent parent negative talk (negative talk divided by total verbalizations during the entire task) and percent parent praise (sum of labelled and unlabeled praise, divided by total verbalizations during the entire task) as the independent variables. The overall inter-rater agreement across all coded DPICS categories was 72%. Inter-rater agreement was 86% for praise and 72% for negative talk, which is consistent with previous studies that used the same DPICS protocol (Chronis-Tuscano et al., 2008; Li & Lee, 2013).

Data Analysis

For objective 1, bivariate correlations between child ADHD symptoms, global (i.e., APQ negative and positive parenting), observed (i.e., DPICS % negative talk and % praise), and daily parenting variables (i.e., MSPCD harsh parenting means and MSSD, and warm parenting means and MSSD). For objective 2, hierarchical linear regression models were fit to test the association of child ADHD status, family stress, social stress, and parenting-related stress on warm-active and harsh-permissive parenting means and MSSD, respectively. Step 1 was a covariates-only model (for list of covariates, see below). Step 2 of the model added the main effects, including family stress, social stress, and parenting-related stress, and child ADHD symptoms. Step 3 of the model added the covariates, main effects, and interactions between parental stress and child ADHD symptoms. All analyses were performed in Stata 14.2 (StataCorp, 2015). Missing data were listwise deleted, given that Little's test of missing completely at random (MCAR) was consistent with the assumption that the data were missing at random (*Chi-square* = 33.69, *df* = 31, *p* = .34). Power calculations for the regressions were performed using *powerreg*. The sample size (n = 184) was well powered (= .86) to detect a full model R^2 = .20 (7 covariates, 4 main effects, 3 interactions, 2 separate model tests).

Covariates

Several covariates were included in the models to account for their possible influence on interpreting the associations between parental stress and child ADHD on parenting behaviors. On theoretical bases, we controlled for the child's sex (Theule et al., 2013), child race-ethnicity (measured as Caucasian versus non-Caucasian), socioeconomic status (measured as gross household income, with groups separated into quintiles; Counts et al., 2005), and the parent's own ADHD symptomatology (Harvey et al., 2003) given previous studies that have found associations of each variable in relation to child ADHD outcomes. For parent ADHD symptomatology, we used T-scores on the DSM-based syndrome scale on the Adult Self Report form (Achenbach, 2009). Furthermore, we controlled for the primary respondent of the EMA and self-report questionnaires (i.e., mothers versus fathers), marital status (i.e., married versus unmarried) given that the consequences of parental behaviors and parental stress on child ADHD may be contingent upon the reporter (Johnston, 1996).

Results

Descriptive Statistics

Table 1 shows the summary statistics of study variables, comparing children with and without ADHD (any subtype) per structured clinical interview. Parents of children with ADHD reported more global negative parenting behaviors (i.e., more corporal punishment, less supervision, and more inconsistent discipline), were observed to use more harsh language and critical or hostile comments during the structured play task in the lab, exhibited more variability in their warm-active parenting behaviors, and reported more family, social and parenting-related stress compared to parents of children without ADHD. With respect to participant demographics, group differences were observed between children with and without ADHD in terms of child sex (more males in the ADHD group), marital status (more unmarried parents in the ADHD group), and parent ADHD problems (more parent ADHD problems in the ADHD group), but not on gross household income and child age.

Objective 1: Concordance among global, observed, and daily parenting variables

Table 2 shows the bivariate correlations among ADHD, stress, global, observed, and daily parenting-related variables. Variables measured from the daily MSPCD were generally correlated with global and observed parenting measures. Warm parenting means were positively correlated with global positive parenting behaviors ($r = .38$, $p < .01$) and observed praise ($r = .23$, $p < .01$) and inversely correlated with the global negative parenting behaviors ($r = -.21$, $p < .01$). Somewhat as expected, warm MSSD (i.e., variability) was only correlated with global negative parenting ($r = .21$, $p < .01$), but not correlated with any of the observed measures of parenting. Harsh parenting means were positively correlated with global negative parenting behaviors ($r = .35$, $p < .01$) and observed negative talk ($r = .26$, $p < .01$) and inversely correlated with global positive parenting ($r = -.17$, $p < .05$). Harsh parenting MSSD was correlated with global negative parenting ($r = .35$, $p < .01$) and observed negative talk ($r = .29$, $p < .01$). Additionally, we found that child ADHD symptoms were positively correlated with global negative parenting ($r = .22$, $p < .01$) and observed negative talk ($r = .34$, $p < .01$), but not with any of the measures of daily parenting behaviors

from the MSPCD. Overall, mean parenting variables assessed from the MSPCD showed consistent convergence with global and observed measures of parenting in the expected directions.

Objective 2: Parental stress and child ADHD as predictors of parenting variability

Tables 3 and 4 show the hierarchical linear regression models testing the effects of family stress, social stress, parenting-related stress, and child ADHD status on warm and harsh parenting variability (i.e., MSSD), respectively. Family, social, and parenting-related stress were not significantly associated with warm parenting MSSD. However, child ADHD symptoms were associated with greater warm parenting MSSD ($B = .24$, $p = .02$). No significant interactions between parental stress and child ADHD symptoms were detected.

With respect to harsh parenting MSSD, a significant main effect was detected for parenting-related stress ($B = .19$, $p = .05$), but not for family or social stress ($B = .13$, $p = .19$ and $B = .05$, $p = .61$, respectively). Child ADHD was not associated with harsh parenting MSSD ($B = .13$, $p = .19$), and interactions between child ADHD and parental stress were not significant.

Discussion

The present study addressed two main objectives using a well-characterized sample of kindergarten-aged children. The first objective was to examine the predictive validity for a novel smartphone-based measure of daily parent-child functioning by examining its concordance across traditional measures of parenting, including global questionnaire and direct observational methods. Results indicated that means and variabilities for positive (i.e., warm) and negative (i.e., harsh) daily parenting behaviors, assessed via smartphones over the course of a week, were significantly correlated with global measures of parenting from the APQ and observed measures of parenting from the DPICS in the expected direction, suggesting that this measure may be a valid assay of parental behavior. The second objective was to examine the independent and interactive effects of multiple domains of stress, including social stress, family stress, parenting-related stress and child ADHD symptoms on variability in parenting behaviors. Child ADHD symptoms, but not family, social or parenting-related stress, were associated with variability in warm parenting behaviors. Furthermore, parenting-related stress, but not family or social stress, or child ADHD symptoms was associated with variability in harsh parenting behaviors. Interactions between multiple domains of stress and child ADHD symptoms were not detected in models for warm parenting variability or harsh parenting variability. These findings suggest that various dimensions of stress and child characteristics (i.e., ADHD symptomatology) may influence the *consistency* of parenting behavior, depending on whether positive parenting or negative parenting is assessed.

Few studies have employed rigorous multimethod assays of parenting despite the well-known challenges of measuring parental behavior (Kuppens, Frietens, Onghena, & Michiels, 2009; Power et al., 2013). Not surprisingly, means of the parenting variables assessed using different methods were modestly (albeit significantly) correlated with one another, which is consistent with previous studies (e.g., parenting measured by different informants; Kuppens

et al., 2009). Furthermore, variability in day-to-day warm and harsh parenting behaviors in response to child behavior was similarly correlated with observational and questionnaire measures of negative parenting behaviors, reinforcing the notion that inconsistent or unpredictable parenting may be a crucial aspect of negative parenting that has received relatively little attention in the field to-date. Children may be negatively affected by the unpredictability in positive parenting (e.g., engagement in positive parent-child activities, responsiveness to child prosocial behaviors) in addition to negative parenting (i.e., inconsistent discipline). Evidence from the developmental literature has shown an important function of warm parental consistency in predicting typical child cognitive and emotional development. Landry and colleagues (2001) assessed maternal warmth and responsiveness from in-home observations of daily activities and play between mothers and their children at 6, 12, and 24 months and 3 and 4 years of child age and found that children exhibited the fastest growth in cognitive development when they had mothers who were consistent, as opposed to inconsistent, in their responsiveness to their children. Importantly, they also found that mothers who were inconsistent in their responsiveness across time predicted significant deceleration of cognitive development in children, suggesting that 1) consistency in parental warmth is crucial for optimal development, and 2) inconsistency in parental warmth may be a significant risk factor for cognitive and emotional impairment in children (Landry et al., 2001). Measuring the consistency of day-to-day interactions between parents and children may tap into important developmental processes that contribute to child behavioral and social development (Granic et al., 2007).

We note that any of these measures alone are likely insufficient in characterizing the complexity of the relationship between parents and their children, but the combination of multiple assessment methods may contribute to a deeper understanding about the way that parents and children influence one another. Crucially, the current study advances the importance of focusing on both positive and negative dimensions of parenting in relation to child outcomes. Several facets of positive parenting behavior, including warm and supportive parenting, involvement, and positive reinforcement, have not only been shown to be factorially independent from negative parental behaviors (e.g., inconsistent discipline, negativity, harsh punishment), but have also been found to be differentially predictive of ADHD symptoms (Pettit et al., 1997). Previous research suggests that negative and positive parenting behaviors are qualitatively distinct, rather than reflecting opposite ends of the parenting spectrum (Kaiser, McBurnett, & Pfiffner, 2011; Li & Lee, 2011). Disentangling positive and negative parenting as separate experiences (that may plausibly overlap) may help to elucidate the pathways of behavioral development.

Parenting-related stress, but not family stress, social stress, or child ADHD symptoms, was associated with harsh parenting variability. That is, parents were more inconsistent in their use of harsh disciplinary practices in response to child misbehavior when their perceptions of stress from parenting were high, even after accounting for sociodemographic factors, child ADHD and parent ADHD. The unique main effect of parenting-related stress was surprising, given that a previous study found that stressful life events, which included aspects of family and social stressors, were associated with harsh and inconsistent disciplinary practices (Ge, Conger, Lorenz, & Simmons, 1994). Our finding suggests that parents who feel especially overwhelmed from the demands of parenting may be more likely

to demonstrate inconsistency in their disciplinary practices in response to child misbehavior, irrespective of whether the child has ADHD or not. Considering that several previous studies have linked inconsistent parental discipline with ADHD and other negative child outcomes (Barry, Dunlap, Lochman, & Wells, 2005; Edens, Skopp, & Cahill, 2008; Halgunseth, Perkins, Lippold, & Nix, 2013; Pfiffner, McBurnett, Rathouz, & Judice, 2005), we speculate that inconsistent discipline may be a potential *mechanism* (i.e., mediator) or risk for child ADHD and related outcomes. If this hypothesis is supported, parenting-based interventions for ADHD (e.g., parent management training) should include a stronger focus on reducing stress from parenting (e.g., teaching coping skills for parents), as this may lead to greater consistency in parental discipline and presumably better child outcomes.

Additionally, family, social, and parenting-relating stress were not associated with warm parenting variability, unlike the literature showing the strong associations of stress with mean levels of maladaptive parenting behaviors generally (Brooks-Gunn & Duncan, 1997; Ceballo & McLoyd, 2002; Deater-Deckard, 2004; Nelson et al., 2009) and inconsistent parenting specifically (Barry, Dunlap, Lochman, & Wells, 2005; Edens, Skopp, & Cahill, 2008; Halgunseth, Perkins, Lippold, & Nix, 2013). However, we found that child ADHD symptoms were associated with greater warm parenting variability. In other words, parents were more inconsistent in their displays of warmth and engagement in fun activities with their children on a day-to-day basis (measured over the course of a week) when their children's ADHD symptoms were high. We speculate that child ADHD symptoms may make it more challenging for parents to consistently engage their children with positivity, warmth and reinforcement, especially if parents outweigh their child's attention/behavioral problems over their prosocial behaviors. The findings also seem to suggest that the consistency of positive parenting may be relatively robust to the effects of external stressors from family and social influences. One explanation is that positive parental influences may be partly inherited, as previous studies have shown that parental nurturing behaviors (e.g., licking-and-grooming behavior in rats; sensitivity in humans) may be biologically-mediated and modestly heritable across human and non-human species (Bakermans-Kranenburg & van Ijzendoorn, 2008; Meany, 2001; Meany & Szyf, 2005; Michalska et al., 2014; Oliver & Plomin, 2014). Future studies will need to examine whether associations between genetic factors (e.g., oxytocin receptor gene, *OXYR*) and parenting behaviors overlap or share similar genetic signals with *consistency* in warm parenting. Considering that parent ADHD (which was examined as a covariate) was also predictive of greater variability in warm parenting behaviors, the presence of a passive gene-environment correlation may be plausible as the parent's genotype may confer greater risk for both child ADHD and an environment that exacerbates their offspring's ADHD (i.e., inconsistency in child engagement, poor family structure, etc.). Another plausible explanation for the findings is that parental consistency may be influenced by socioemotional processes that were not explicitly measured in the current study. For instance, Ge and colleagues (1994) found that the associations between inconsistent discipline and offspring outcomes were partially mediated by parental depression, suggesting that there may be other psychological factors that may explain why parenting-related stress may be especially related to harsh-permissive parenting variability (Ge et al., 1994).

Several limitations should be noted. First, although smartphone-based assessments present unique opportunities in the measurement of complex behaviors by having assessments be conducted anywhere with relative ease, they also still rely on self-report and thus share similar limitations, such as faulty recall, social desirability bias, and unique to this measure, user fatigue. Although user response rates were impressive considering the lack of incentives provided after their first visit to the laboratory, it is possible that some participants became less engaged in the study as the week progressed. This may have led to systematic differences between parents who failed to complete all assessments from those parents who were highly engaged and completed each assessment. Future smartphone-based surveys could reduce the burden on participants by including audio-recording in lieu of having to type in responses to open-ended questions (e.g., what other strategies did you use to deal with your child's misbehavior?). Second, the sample was predominantly Caucasian and of relatively high socioeconomic status, which was representative of the surrounding community but unrepresentative of the general population. Furthermore, because our sample was enriched with children with early attention problems (but was not a case-control sample *per se* as roughly a quarter of our child participants met diagnostic criteria for ADHD on the DISC interview), the current results may lack generalizability to a general population. It will be crucial to replicate these findings in community populations, as well as more diverse and lower socioeconomic status populations, particularly given the use of a smartphone app as an assessment tool. Third, the EMA only assessed a single week period of parent-child behaviors. This was partly due to the preliminary nature of the study in which we were focused on establishing feasibility and predictive validity of the measure. Treatment studies may benefit from longer assessments which may be helpful for troubleshooting inefficacious aspects of treatment. Fourth, several of the questionnaires used in the study did not state explicit time frames in the instructions for participants when responding to the questions. The lack of a stated timeframe on these questionnaires may partially explain why the bivariate correlations among our questionnaire, observations, and EMA measures of parenting behaviors were modest. Fifth, although our full statistical models explained between 19–34% of the variance in warm and harsh parenting variability, respectively, we also note that individual effects of each variable (stress and child ADHD) were small in magnitude and accounted for a modest proportion of the variance in either outcome. Results from this preliminary study should be interpreted with caution until the findings have been replicated.

These findings lead to promising new avenues for future research and clinical applications. First, research using smartphone-based apps may wish to incorporate models in which variability in child behaviors, such as ADHD symptomology is also measured. Researchers have suggested that within-person variability be considered an etiologically important characteristic of ADHD, rather than a nuisance variable (see Castellanos et al., 2005 for an expansive review of this literature). Although the current study was not designed as a study of intra-individual variability in child ADHD symptoms, promising examples in which child behaviors are assessed using EMA approaches (e.g., emotion dysregulation in children with and without ADHD; Rosen & Factor, 2015) have started to emerge. Regarding interventions, smartphone technology may pave the way for drastically improving the assessment of the patient's individual context, such that information gathered from a daily assessment can be

used to tailor the treatment per the characteristics of the child and family. Furthermore, once in treatment, smartphones can be used to monitor the family's progress during the treatment, and enhance the family's engagement in the intervention. For example, push notifications can be programmed to remind parents to complete homework and notify the parent to log/track the child's behaviors over the course of the day. Considering that most psychosocial treatments for childhood ADHD focus on child behavior modification through parent training, having improved methods to assess outcomes may help to more precisely disentangle the mechanism of action regarding these outcomes, such as whether a treatment is not effective because the parent is not engaged in the treatment, or whether the treatment needs to be modified in some way to suit the characteristics of the family better.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

The authors express deep gratitude to all the families that participated in the study. This study was supported in part by a core grant to the Waisman Center from the National Institute of Child Health and Human Development (P30-HD03352) and by the Wisconsin Alumni Research Foundation (WARF).

Appendix

Table A1

User statistics for the Mobile Survey of Parent-Child Dynamics (MSPCD).

	N	Mean	S.D.
Sample size	184	–	–
% Android	78	–	–
% iOS	104	–	–
Mac/Windows	2	–	–
Average # days completed	–	5.56	1.63
Average minutes spent completing survey	–	–	–
# Days completed			
1 day	8	0:05:45[1]	0:04:48
2 days	1	0:04:21	0:03:09
3 days	12	0:04:04	0:03:39
4 days	18	0:03:46	0:02:57
5 days	26	0:03:30	0:02:45
6 days	45	0:03:12	0:02:16
7 days	74	0:03:09	0:01:58

[1]Means represent the average amount time (in minutes) spent completing the measure on each day of the task.

References

Abidin, RR. Manual for the parenting stress index. Odessa, FL: Psychological Assessment Resources; 1995.

Baker-Ericzén MJ, Brookman-Frazee L, Stahmer A. Stress levels and adaptability in parents of toddlers with and without autism spectrum disorders. Research and Practice for Persons with Severe Disabilities. 2005; 30:194–204. DOI: 10.2511/rpsd.30.4.194

Bakermans-Kranenburg MJ, van IJzendoorn MH. Oxytocin receptor (OXTR) and serotonin transporter (5-HTT) genes associated with observed parenting. Social Cognitive and Affective Neuroscience. 2008; 3:128–134. DOI: 10.1093/scan/nsn004 [PubMed: 19015103]

Barry TD, Dunlap ST, Cotten SJ, Lochman JE, Wells KC. The influence of maternal stress and distress on disruptive behavior problems in boys. Journal of the American Academy of Child and Adolescent Psychiatry. 2005; 44:265–273. DOI: 10.1097/00004583-200503000-00011 [PubMed: 15725971]

Brooks-Gunn J, Duncan GJ. The effects of poverty on children. The Future of Children. 1997; 7:55–71. DOI: 10.2307/1602387 [PubMed: 9299837]

Burke JD, Pardini DA, Loeber R. Reciprocal relationships between parenting behavior and disruptive psychopathology from childhood through adolescence. Journal of Abnormal Child Psychology. 2008; 36:679–692. DOI: 10.1007/s10802-008-9219-7 [PubMed: 18286366]

Carrasco MA, Rodriguez MA, Del Barrio MV, Holgado FP. Relative and absolute stability in perceived parenting behaviour: A longitudinal study with children and adolescents. Psychological Reports. 2011; 108:149–166. DOI: 10.2466/02.09.10.21.PR0.108.1.149-166 [PubMed: 21526601]

Castellanos FX, Tannock R. Neuroscience of attention-deficit/hyperactivity disorder: The search for endophenotypes. Nature Reviews Neuroscience. 2002; 3:617–628. DOI: 10.1038/nrn896 [PubMed: 12154363]

Ceballo R, McLoyd VC. Social support and parenting in poor, dangerous neighborhoods. Child Development. 2002; 73:1310–1321. DOI: 10.1111/1467-8624.00473 [PubMed: 12146749]

Chamberlain P, Patterson GR. Discipline and child compliance in parenting. Handbook of Parenting. 1995; 4:205–225.

Chronis AM, Jones HA, Raggi VL. Evidence-based psychosocial treatments for children and adolescents with attention-deficit/hyperactivity disorder. Clinical Psychology Review. 2006; 26:486–502. DOI: 10.1016/j.cpr.2006.01.002 [PubMed: 16483703]

Chronis-Tuscano A, Raggi VL, Clarke TL, Rooney ME, Diaz Y, Pian J. Associations between maternal attention-deficit/hyperactivity disorder symptoms and parenting. Journal of Abnormal Child Psychology. 2008; 36:1237–1250. DOI: 10.1007/s10802-008-9246-4 [PubMed: 18553132]

Conger RD, Ge X, Elder GH, Lorenz FO, Simons RL. Economic stress, coercive family process, and developmental problems of adolescents. Child Development. 1994; 65:541–561. DOI: 10.2307/1131401 [PubMed: 8013239]

Counts CA, Nigg JT, Stawicki JA, Rappley MD, Von Eye A. Family adversity in DSM-IV ADHD combined and inattentive subtypes and associated disruptive behavior problems. Journal of the American Academy of Child and Adolescent Psychiatry. 2005; 44:690–698. DOI: 10.1097/01.chi.0000162582.87710.66 [PubMed: 15968238]

Darling N, Steinberg L. Parenting style as context: An integrative model. Psychological Bulletin. 1993; 113:487–496. DOI: 10.1037/0033-2909.113.3.487

Doshi JA, Hodgkins P, Kahle J, Sikirica V, Cangelosi MJ, Setyawan J, Neumann PJ. Economic impact of childhood and adult attention-deficit/hyperactivity disorder in the United States. Journal of the American Academy of Child and Adolescent Psychiatry. 2012; 51:990–1002. DOI: 10.1016/j.jaac.2012.07.008 [PubMed: 23021476]

Dunton GF, Dzubur E, Kawabata K, Yanez B, Bo B, Intille S. Development of a smartphone application to measure physical activity using sensor-assisted self-report. Frontiers in Public Health. 2014; 2:88–100. DOI: 10.3389/fpubh.2014.00012 [PubMed: 25101256]

Eccles, J. Childhood and Beyond Study. personal communicationAccess to interviews and questionnaires retrieved from http://www.rcgd.isr.umich.edu/cab/

Edens JF, Skopp NA, Cahill MA. Psychopathic features moderate the relationship between harsh and inconsistent parental discipline and adolescent antisocial behavior. Journal of Clinical Child and Adolescent Psychology. 2008; 37:472–476. DOI: 10.1080/15374410801955938 [PubMed: 18470783]

Essau CA, Sasagawa S, Frick PJ. Psychometric properties of the Alabama parenting questionnaire. Journal of Child and Family Studies. 2006; 15:595–614. DOI: 10.1007/s10826-006-9036-y

Eyberg, SM., Nelson, MM., Ginn, NC., Bhuiyan, N., Boggs, SR. Dyadic-Parent-Child Interaction Coding System: Comprehensive Manual for Research and Training. 4th. Gainesville, FL: PCIT International; 2013. Retrieved from http://www.pcit.org/measures.html

Forehand R, Jones DJ. The stability of parenting: A longitudinal analysis of inner-city African-American mothers. Journal of Child and Family Studies. 2002; 11:455–467. DOI: 10.1023/A:1020935525335

Frick, PJ. The Alabama parenting questionnaire. Unpublished rating scale, University of Alabama. 1991. Retrieved from https://cyfar.org/alabama-parenting-questionnaire

Frick PJ, Dantagnan AL. Predicting the stability of conduct problems in children with and without callous-unemotional traits. Journal of Child and Family Studies. 2005; 14:469–485. DOI: 10.1007/s10826-005-7183-1

Granic I, O'Hara A, Pepler D, Lewis MD. A dynamic systems analysis of parent–child changes associated with successful "real-world" interventions for aggressive children. Journal of Abnormal Child Psychology. 2007; 35:845–857. DOI: 10.1007/s10802-007-9133-4 [PubMed: 17549621]

Halgunseth LC, Perkins DF, Lippold MA, Nix RL. Delinquent-oriented attitudes mediate the relation between parental inconsistent discipline and early adolescent behavior. Journal of Family Psychology. 2013; 27:293–302. DOI: 10.1037/a0031962 [PubMed: 23544924]

Harrison C, Sofronoff K. ADHD and parental psychological distress: Role of demographics, child behavioral characteristics, and parental cognitions. Journal of the American Academy of Child and Adolescent Psychiatry. 2002; 41:703–711. DOI: 10.1097/00004583-200206000-00010 [PubMed: 12049445]

Harvey E, Danforth JS, McKee TE, Ulaszek WR, Friedman JL. Parenting of children with attention-deficit/hyperactivity disorder (ADHD): The role of parental ADHD symptomatology. Journal of Attention Disorders. 2003; 7:31–42. DOI: 10.1177/108705470300700104 [PubMed: 14738179]

Haskett ME, Ahern LS, Ward CS, Allaire JC. Factor structure and validity of the parenting stress index-short form. Journal of Clinical Child and Adolescent Psychology. 2006; 35:302–312. DOI: 10.1207/s15374424jccp3502_14 [PubMed: 16597226]

Hawes DJ, Dadds MR. Assessing parenting practices through parent-report and direct observation during parent-training. Journal of Child and Family Studies. 2006; 15:554–567. DOI: 10.1007/s10826-006-9029-x

Jaffee SR, Caspi A, Moffitt TE, Polo-Tomas M, Price TS, Taylor A. The limits of child effects: Evidence for genetically mediated child effects on corporal punishment but not on physical maltreatment. Developmental Psychology. 2004; 40:1047–1058. DOI: 10.1037/0012-1649.40.6.1047 [PubMed: 15535755]

Johnston C. Parent characteristics and parent-child interactions in families of nonproblem children and ADHD children with higher and lower levels of oppositional-defiant behavior. Journal of Abnormal Child Psychology. 1996; 24:85–104. DOI: 10.1007/BF01448375 [PubMed: 8833030]

Johnston C, Mash EJ. Families of children with attention-deficit/hyperactivity disorder: Review and recommendations for future research. Clinical Child and Family Psychology Review. 2001; 4:183–207. DOI: 10.1023/A:1017592030434 [PubMed: 11783738]

Kaiser NM, McBurnett K, Pfiffner LJ. Child ADHD severity and positive and negative parenting as predictors of child social functioning: Evaluation of three theoretical models. Journal of Attention Disorders. 2011; 15:193–203. DOI: 10.1177/1087054709356171 [PubMed: 20424006]

Kaminski JW, Valle LA, Filene JH, Boyle CL. A meta-analytic review of components associated with parent training program effectiveness. Journal of Abnormal Child Psychology. 2008; 36:567–589. DOI: 10.1007/s10802-007-9201-9 [PubMed: 18205039]

Kiel EJ, Buss KA. Prospective relations among fearful temperament, protective parenting, and social withdrawal: The role of maternal accuracy in a moderated mediation framework. Journal of Abnormal Child Psychology. 2011; 39:953–966. DOI: 10.1007/s10802-011-9516-4 [PubMed: 21537895]

Kuppens S, Grietens H, Onghena P, Michiels D. Measuring parenting dimensions in middle childhood: Multitrait-multimethod analysis of child, mother, and father ratings. European Journal of Psychological Assessment. 2009; 25:133–140. DOI: 10.1027/1015-5759.25.3.133

Landry SH, Smith KE, Swank PR, Assel MA, Vellet S. Does early responsive parenting have a special importance for children's development or is consistency across early childhood necessary? Developmental Psychology. 2001; 37:387–403. DOI: 10.1037/0012-1649.37.3.387 [PubMed: 11370914]

Langley K, Fowler T, Ford T, Thapar AK, Van Den Bree M, Harold G, Thapar A. Adolescent clinical outcomes for young people with attention-deficit hyperactivity disorder. The British Journal of Psychiatry. 2010; 196:235–240. DOI: 10.1192/bjp.bp.109.066274 [PubMed: 20194547]

Levin ME, Pierce B, Schoendorff B. The acceptance and commitment therapy matrix mobile app: A pilot randomized trial on health behaviors. Journal of Contextual Behavioral Science. in press.

Li JJ, Lee SS. Interaction of dopamine transporter gene and observed parenting behaviors on attention-deficit/hyperactivity disorder: A structural equation modeling approach. Journal of Clinical Child & Adolescent Psychology. 2013; 42:174–186. DOI: 10.1080/15374416.2012.736355 [PubMed: 23153115]

Liu W, Sparks B, Coghlan A. Measuring customer experience in situ: The link between appraisals, emotions and overall assessments. International Journal of Hospitality Management. 2016; 59:42–49. DOI: 10.1016/j.ijhm.2016.09.003

Meaney MJ, Szyf M. Environmental programming of stress responses through DNA methylation: Life at the interface between a dynamic environment and a fixed genome. Dialogues in Clinical Neuroscience. 2005; 7:103–123. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3181727/. [PubMed: 16262207]

Michalska KJ, Decety J, Liu C, Chen Q, Martz ME, Jacob S, Lahey BB. Genetic imaging of the association of oxytocin receptor gene (OXTR) polymorphisms with positive maternal parenting. Frontiers in Behavioral Neuroscience. 2014; 8doi: 10.3389/fnbeh.2014.00021

Nelson JA, O'Brien M, Blankson AN, Calkins SD, Keane SP. Family stress and parental responses to children's negative emotions: Tests of the spillover, crossover, and compensatory hypotheses. Journal of Family Psychology. 2009; 23:671–679. DOI: 10.1037/a0015977 [PubMed: 19803603]

NICHQ. Vanderbilt Assessment Scales (1st Ed). American Academy of Pediatrics. 2002. Retrieved from http://www.nichq.org/childrens-health/adhd/resources/vanderbilt-assessment-scales

Oliver BR, Trzaskowski M, Plomin R. Genetics of parenting: The power of the dark side. Developmental Psychology. 2014; 50:1233–1240. DOI: 10.1037/a0035388 [PubMed: 24364831]

Parkerson GR, Broadhead WE, Tse CK. Validation of the Duke Social Support and Stress Scale. Family Medicine. 1991; 23:357–360. Retrieved from https://cfm.duke.edu/research/duke-health-measures. [PubMed: 1884930]

Patterson, GR. Coercive family process. Vol. 3. Eugene, OR: Castalia Publishing Company; 1982.

Patterson GR. Continuities – A search for causal mechanisms: Comment on special section. Developmental Psychology. 1998; 34:1263–1268. DOI: 10.1037/0012-1649.34.6.1263 [PubMed: 9823510]

Pelham WE, Fabiano GA. Evidence-based psychosocial treatments for attention-deficit/hyperactivity disorder. Journal of Clinical Child and Adolescent Psychology. 2008; 37:184–214. DOI: 10.1080/15374410701818681 [PubMed: 18444058]

Pettit GS, Bates JE, Dodge KA. Supportive parenting, ecological context, and children's adjustment: A seven-year longitudinal study. Child Development. 1997; 68:908–923. DOI: 10.1111/j.1467-8624.1997.tb01970.x [PubMed: 29106716]

Pew Research Center. Mobile fact sheet [report]. 2017. Retrieved from http://www.pewinternet.org/fact-sheet/mobile/

Podolski CL, Nigg JT. Parent stress and coping in relation to child ADHD severity and associated child disruptive behavior problems. Journal of Clinical Child Psychology. 2001; 30:503–513. DOI: 10.1207/S15374424JCCP3004_07 [PubMed: 11708238]

Polanczyk GV, Willcutt EG, Salum GA, Kieling C, Rohde LA. ADHD prevalence estimates across three decades: An updated systematic review and meta-regression analysis. International Journal of Epidemiology. 2014; 43:434–442. DOI: 10.1093/ije/dyt261 [PubMed: 24464188]

Power TG, Sleddens EF, Berge J, Connell L, Govig B, Hennessy E, St George SM. Contemporary research on parenting: Conceptual, methodological, and translational issues. Childhood Obesity. 2013; 9:S87–S94. DOI: 10.1089/chi.2013.0038 [PubMed: 23944927]

Puff J, Renk K. Relationships among parents' economic stress, parenting, and young children's behavior problems. Child Psychiatry and Human Development. 2014; 45:712–727. DOI: 10.1007/s10578-014-0440-z [PubMed: 24500325]

Rosen PJ, Factor PI. Emotional impulsivity and emotional and behavioral difficulties among children with ADHD: An ecological momentary assessment study. Journal of Attention Disorders. 2015; 19:779–793. DOI: 10.1177/1087054712463064 [PubMed: 23172248]

Shaffer D, Fisher P, Lucas CP, Dulcan MK, Schwab-Stone ME. NIMH Diagnostic Interview Schedule for Children Version IV (NIMH DISC-IV): Description, differences from previous versions, and reliability of some common diagnoses. Journal of the American Academy of Child and Adolescent Psychiatry. 2000; 39:28–38. DOI: 10.1097/00004583-200001000-00014 [PubMed: 10638065]

Shelton KK, Frick PJ, Wootton J. Assessment of parenting practices in families of elementary school-age children. Journal of Clinical Child Psychology. 1996; 25:317–329. DOI: 10.1207/s15374424jccp2503_8

Sonuga-Barke EJ, Halperin JM. Developmental phenotypes and causal pathways in attention deficit/hyperactivity disorder: Potential targets for early intervention? Journal of Child Psychology and Psychiatry. 2010; 51:368–389. DOI: 10.1111/j.1469-7610.2009.02195.x [PubMed: 20015192]

Sperry SH, Kwapil TR. What can daily life assessment tell us about the bipolar spectrum? Psychiatry Research. in press.

Stewart SM, Bond MH. A critical look at parenting research from the mainstream: Problems uncovered while adapting Western research to non-Western cultures. British Journal of Developmental Psychology. 2002; 20:379–392. DOI: 10.1348/026151002320620389

Theule J, Wiener J, Rogers MA, Marton I. Predicting parenting stress in families of children with ADHD: Parent and contextual factors. Journal of Child and Family Studies. 2011; 20:640–647. DOI: 10.1007/s10826-010-9439-7

Theule J, Wiener J, Tannock R, Jenkins JM. Parenting stress in families of children with ADHD: A meta-analysis. Journal of Emotional and Behavioral Disorders. 2013; 21:3–17. DOI: 10.1177/1063426610387433

Thomas R, Zimmer-Gembeck MJ. Behavioral outcomes of parent-child interaction therapy and Triple P—Positive Parenting Program: A review and meta-analysis. Journal of Abnormal Child Psychology. 2007; 35:475–495. DOI: 10.1007/s10802-007-9104-9 [PubMed: 17333363]

Von Neumann J, Kent RH, Bellinson HR, Hart BT. The mean square successive difference. The Annals of Mathematical Statistics. 1941; 12:153–162. DOI: 10.1214/aoms/1177731746

Webster-Stratton C. Stress: A potential disruptor of parent perceptions and family interactions. Journal of Clinical Child Psychology. 1990; 19:302–312. DOI: 10.1207/s15374424jccp1904_2

Wymbs BT, Wymbs FA, Dawson AE. Child ADHD and ODD behavior interacts with parent ADHD symptoms to worsen parenting and interparental communication. Journal of Abnormal Child Psychology. 2015; 43:107–119. DOI: 10.1007/s10802-014-9887-4 [PubMed: 24882503]

Table 1

Descriptive statistics and mean comparisons between children with and without ADHD

	No ADHD (*n* = 146)	ADHD (*n* = 38)	
	N* or *M (SD)	***N or M (SD)***	***p***
Males (*n*)	71	27	.03
Household income levels (*n*)	–	–	.11
<$60,000	26	12	–
$60,001 – 89,000	24	7	–
$89,001 – 120,000	27	7	–
$120,001 – 160,000	33	3	–
>$160,001	28	4	–
Not reported	8	5	–
Child age	6.04 (.41)	6.05 (.36)	.83
Child ethnicity (1=white, 2=non-white)	1.14 (.34)	1.22 (.42)	.17
Marital status (1=married, 2=unmarried/other)	1.04 (.19)	1.41 (.50)	<.001
Respondent (1=mother, 2=father)	1.08 (.27)	1.07 (.26)	.89
Parent ADHD (T-scores)	51.99 (4.09)	56.16 (9.25)	<.001
DISC-IV child ADHD symptoms	2.29 (2.56)	11.05 (3.01)	<.001
Global positive parenting	66.88 (5.15)	66.21 (5.70)	.53
Global negative parenting	28.65 (4.04)	31.33 (5.31)	<.01
Observed % praise	.06 (.03)	.05 (.03)	.30
Observed % negative talk	.02 (.03)	.05 (.05)	<.01
Daily warm parenting mean	8.25 (1.67)	8.15 (2.10)	.78
Daily warm parenting MSSD	2.09 (.61)	2.41 (.73)	.02
Daily harsh parenting mean	.46 (.47)	.54 (.57)	.38
Daily harsh parenting MSSD	.43 (.42)	.47 (.47)	.63
Family stress	24.48 (14.56)	30.40 (15.17)	.03
Social stress	8.28 (10.76)	14.36 (16.35)	<.01
Parenting-related stress	24.05	34.28	<.01

Note. Mean differences on categorical outcomes were measured using a chi-squared test; Mean differences on continuous outcomes were measured using independent samples t-tests; *MSSD* = mean square successive difference (i.e., variability).

Table 2

Bivariate correlations (continued on next page)

	Variable	1	2	3	4	5	6	7	8	9	10	11	12
1	Child ADHD symptoms	1											
2	Parenting-related stress	.40**	1										
3	Family stress	.09	.11	1									
4	Social stress	.12	−.01	.07	1								
5	Global positive parenting	−.08	−.27**	−.07	.12	1							
6	Global negative parenting	.22**	.38**	.24**	.08	−.20**	1						
7	Observed % praise	−.01	−.15	−.19*	.05	.10	−.05	1					
8	Observed % negative talk	.34**	.162*	.20**	.14	−.02	.31**	−.05	1				
9	Daily warm parenting mean	−.05	−.10	−.06	.09	.25**	−.16*	.18*	−.09	1			
10	Daily warm parenting MSSD	.15	−.01	.01	.02	−.01	.21**	−.02	.12	−.14	1		
11	Daily harsh parenting mean	.04	.14	.27**	−.09	−.17*	.35**	−.08	.29**	−.02	.02	1	
12	Daily harsh parenting MSSD	.02	.181*	.21*	−.01	−.02	.35**	−.14	.29**	−.06	.11	.48**	1

Note.

** $p < .01$,

* $p < .05$. *MSSD* = mean square successive difference (i.e., variability).

Table 3

Hierarchical linear regressions predicting warm parenting MSSDs from parental stress, child ADHD, and their interactions

	Std. Beta	***p-value***	***Model R^2***
Step 1: Covariates			*.11*
Child sex	.00	.96	
Household income			
$60,001 – 89,000	−.09	.40	
$89,001 – 120,000	−.08	.49	
$120,001 – 160,000	.09	.42	
>$160,001	.11	.30	
Child ethnicity (1=white, 2=non-white)	−.08	.35	
Marital status (1=married, 2=unmarried/other)	.13	.14	
Respondent (1=mother, 2=father)	.07	.40	
Parent ADHD symptoms	.20	.02	
Daily warm parenting mean	−.05	.57	
Step 2: Main effects			*.16*
Family stress	−.02	.83	
Social stress	−.04	.64	
Parenting-related stress	−.08	.38	
Child ADHD symptoms	.24	.02	
Step 3: Interactions			*.19*
Family stress × Child ADHD symptoms	.30	.22	
Social stress × Child ADHD symptoms	−.27	.11	
Parenting-related stress × Child ADHD symptoms	.27	.37	

Table 4

Hierarchical linear regressions predicting harsh parenting MSSDs from parental stress, child ADHD, and their interactions

	Std. Beta	***p-value***	***Model R^2***
Step 1: Covariates			*.26*
Child sex	.06	.50	
Household income			
$60,001 – 89,000	−.10	.42	
$89,001 – 120,000	−.10	.36	
$120,001 – 160,000	−.16	.19	
>$160,001	−.01	.94	
Child ethnicity (1=white, 2=non-white)	.01	.90	
Marital status (1=married, 2=unmarried/other)	−.07	.44	
Respondent (1=mother, 2=father)	−.08	.36	
Parent ADHD symptoms	−.08	.39	
Daily harsh parenting mean	.47	<.01	
Step 2: Main effects			*.30*
Family stress	.13	.19	
Social stress	.05	.61	
Parenting-related stress	.19	.05	
Child ADHD symptoms	.01	.97	
Step 3: Interactions			*.34*
Family stress × Child ADHD symptoms	−.02	.95	
Social stress × Child ADHD symptoms	−.21	.21	
Parenting-related stress × Child ADHD symptoms	−.60	.06	