ASSOCIATIONS BETWEEN INFANT BEHAVIOR DURING THE FACE-TO-FACE STILL FACE PARADIGM AND OPPOSITIONAL DEFIANT AND CALLOUS-UNEMOTIONAL BEHAVIORS IN EARLY CHILDHOOD

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ABSTRACT

Nicholas James Wagner: Associations between Infant Behavior during the Face-to-Face Still Face Paradigm and Oppositional Defiant and Callous-Unemotional Behaviors in Early Childhood
(Under the direction of Martha J. Cox)

Extant research with child and adolescent samples investigating the behavioral correlates of oppositional defiant (ODD) and callous-unemotional (CU) traits have identified deficits in social orienting during dyadic interactions and hyporeactivity to stressful stimuli. The goal of the current study was to investigate infants' mother-directed gaze and affective behavior during the face-to-face and still-face episodes of the face-to-face still face paradigm performed at 6 months in the prediction of oppositional defiant and callous-unemotional behaviors in early childhood. Hierarchical regression analyses revealed that infants' expressed negative affect and mother-directed gaze predicted fewer ODD behaviors in early childhood. Similarly, infants' expressed negative affect during the still face episode predicted fewer ODD and CU behaviors in early childhood. Further, mother-directed gaze during the free play episode attenuated the negative relationship between negative affect during the still face episode and ODD and, at least marginally, CU behaviors in early childhood.

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LIST OF ABBREVIATIONS

ADHD	Attention Deficit Hyperactive Disorder
ASEBA	Achenbach System of Empirically Based Assessment
CU	Callous-unemotional
DCHDS	Durham Child Health and Development Study
FFSFP	Face-to-face Still-Face Paradigm
FF	Face-to-face
ODD	Oppositional Defiant
RE	Reunion
SD	Standard Deviation
SE	Standard Error
SF	Still-face

Associations between Infant Behavior during the Face-to-Face Still Face Paradigm and Oppositional Defiant and Callous-Unemotional Behaviors in Early Childhood

Both developmental and clinical fields of research have invested substantial resources in understanding the course, causes, and consequences of antisocial behaviors and psychopathic traits. The monetary and societal costs incurred by individuals exhibiting disruptive behavior problems has prompted an increase of research on the unique etiological pathways to these outcomes, including potential origins in early oppositional defiant disorder (ODD) and elevated callous-unemotional (CU) behaviors (Frick et al., 2003; Frick & Viding, 2009; Hawes, Brennan, & Dadds, 2009). There is great variability in the behavioral, emotional, cognitive, and biological functioning of children who demonstrate disruptive behavior problems and this variability has implications for later functioning and response to treatment. Although the corpus of literature highlighting environmental (see Waller, Gardner, & Hyde, 2013), biological, and behavioral correlates of ODD and CU behaviors in childhood and adolescence is growing (see Frick, Ray, Thornton, & Kahn, 2014 for review), there is a dearth of prospective longitudinal research that has investigated if specific behavioral phenotypes associated with these outcomes precede the manifestation of these disruptive outcomes in infancy.

ODD is typically characterized by defiant, disobedient, and uncooperative behaviors and is often accompanied by anger and irritability (Stringaris & Goodman, 2009), whereas CU traits describe non-normative emotional, affective, and cognitive deficits such as a lack of guilt, empathy, and fear as well as an over-focus on reward and insensitivity to punishment (Blair, Peschardt, Budhani, Mitchell, & Pine, 2006; Dadds, Fraser, Frost, & Hawes, 2005; Frick & White, 2008; Kotler & McMahon, 2005). From a construct perspective, factor analyses indicate

that CU traits are distinct from symptoms of Attentional Deficit Hyperactive Disorder (ADHD), ODD, and Conduct Disorder (Dadds et al., 2005; Frick, Bodin, & Barry, 2000; Pardini, Obradović, & Loeber, 2006) and are distinguishable as early as 3 years of age (Willoughby, Mills-Koonce, Gottfredson, & Wagner, 2013; Willoughby, Waschbusch, Moore, & Propper, 2011). Furthermore, individuals exhibiting elevated ODD and CU behaviors are at greater risk for later antisocial behavior and psychopathy (Lynam, Caspi, Moffitt, Loeber, & Stouthamer-Loeber, 2007; Rowe et al., 2010). Of particular interest to the current study are previous findings relating elevated ODD and CU traits to deficits in orienting towards caregivers (i.e., less eye contact and mutual orienting) during dyadic interactions and hyporeactivity in response to arousing stimuli later in childhood and adolescence (Blair 1999; Colder, Mott, & Berman, 2002; Dadds, Jambrak, Pasalich, Hawes, & Brennan, 2011; Frick, Cornell, Bodin, Dane, Barry, & Loney, 2003; Loney, Lima, & Butler, 2006; Frick & White, 2008; Willoughby et al., 2011). Researchers have suggested that a failure to orient towards a caregiver and attend to the caregiver's eyes may contribute to errors in the development of appropriate emotional responses to arousing stimuli (Dadds et al., 2011, 2012, 2013). What remains unclear is the extent to which deficits in social orientation and reactivity are present in infancy and precede the emergence of later ODD and CU behaviors.

Mother-Directed Gaze and Social Orienting

There is a rather large research literature examining associations between early familial experiences and the development and persistence of ODD (Deater-Deckard & Dodge, 1997; Loeber & Hay, 1997; Shaffer, Lindhiem, Kolko, & Trentacosta, 2013), and a growing literature on early experiences and the development of CU behaviors (see Waller et al., 2013 for review). Specifically, harsh (Barker, Oliver, Viding, Salekin, & Maughan, 2011) and insensitive (Pardini,

Lochman, & Powell, 2007) parenting have been shown to be predictive of ODD and CU behaviors. In addition to the influence of harsh and insenstive parenting influences on the child, emerging research suggests that children exhibiting concurrent behavioral problems and CU traits make less eye contact with caregivers during emotionally charged discussions (Dadds et al., 2012) and during normative free play (Dadds et al., 2011). In a sample of 92 males (mean age = 8.9 years), youth high on both conduct problems and CU traits showed a consistent lack of eye contact towards their parents during a free play task and an "emotion talk" scenario (Dadds et al., 2011). Similarly, Dadds and colleagues (2012) found similar phenotypic behavior in caregiver-directed eye contact for youth high on ODD and CU traits during an emotionally charged discussion using a mixed-sex sample of youth (mean age = 5.9 years) (Dadds et al., 2012). A number of studies support the finding that youth high on ODD and CU traits show impaired attention to the eye region when interacting with parenting figures (Dadds et al., 2011; Dadds et al., 2012) and when freely viewing emotional faces (Dadds et al., 2006; Dadds, El Masry, Wimalaweera, & Guastella, 2008). Together with work by Kochanska and others, these findings suggest that lack of attention to caregivers during social interactions, may contribute to cascading errors in the development of empathy and conscience (Kochanska, 1997; Kochanska, Forman, Aksan, & Dunbar, 2005; Kochanska & Murray, 2000).

When integrated, this research suggests that dyadic relations between children and their caregivers which are characterized by less positive and more negative interactions, often resulting in less social orienting and mother-directed gaze, may be at risk for later psychopathology. How early youth exhibit deficits in orienting toward their caregivers and the extent to which this behavior precedes later ODD and CU behaviors is an open question. As such, the current study investigates the extent to which orienting towards the caregiver during a

normative interaction in infancy predicts later ODD and CU behaviors above and beyond the influences of harsh and sensitive caregiving experiences. To our knowledge, the current study is the first to extend down the examination of the associations between mother-directed gaze and later ODD and CU behaviors into infancy.

Negative Affect and Reactivity

The extant research on affective and relational correlates of CU traits consistently identifies negative correlations between behavioral reactivity and ODD and CU symptomatology (c.f., Blair, J., Mitchell, & Blair, K., 2005; Newman & Lorenz, 2003; Patterson & Newman, 1993) just as hyporeactivity to stress-inducing stimuli has been linked with adult antisocial behavior and psychopathy (Hare, Hart, & Harpur, 1991; Lykken, 1995). For example, CU traits have been associated with low basal cortisol levels in a community sample of 12 to 18 year old youths (Loney et al, 2006) and blunted cortisol reactivity in a sample of 8 to 14 year old boys with ADHD and disruptive behavior symptoms (Stadler et al., 2011). Lower baseline levels and blunted reactivity of other physiological systems including heart rate, skin conductance, and parasympathetic nervous system functioning have been shown to be associated with ODD and CU behaviors (Raine, 2002; Dietrich et al., 2006; Anastassiou-Hadjicharalambous & Warden, 2008) suggesting that children and adolescents high on ODD and CU traits may exhibit distinct physiological and behavioral phenotypes characterized by underreactivity. Importantly, research on developmental precursors of adult antisocial behavior and psychopathy linking hyporeactivity to ODD and CU traits has largely focused on later childhood (Colder et al., 2002; Frick et al., 2003; Loney, Frick, Clements, Ellis, & Kerlin, 2003) and adolescence (Loney et al., 2006), very few have extended this model downward into the infancy and toddlerhood years (Willoughby et al., 2011).

Developmental scientists have stressed the importance of infants' behavioral signaling (e.g. negative affect, orienting) as a means of communicating emotional needs to the parent which, when responded to appropriately, support adaptive social development (Kochanska, 1997; Kochanska & Murray, 2000; Maccoby, 1992; Tronick, 1989). The Mutual Regulation Model (MRM; Tronick, 1989) describes early mother-infant dyadic interactions as being jointly regulated toward reciprocity through a system of infant-directed behavioral and affective feedback. When the behaviors of each member of the dyad are reciprocated, these socio-emotional processes help to generate adaptive mutual states of regulation that support healthy development (Tronick et al., 1998). Potential errors in this dyadic system, possibly fueled by infant underreactivity and low-signaling during stressful parent-child interactions, may also contribute to errors in healthy social development and be particularly informative for the etiology of ODD and CU traits. As such, a goal of the current study was to investigate the extent to which behavioral underreactivity during a stressful mother-child interaction in infancy predicts later ODD and CU behaviors above and beyond the influences of harsh and sensitive caregiving experiences.

Infant Reactivity and Social Orienting in the Face-to-Face Still Face Paradigm (FFSFP)

Tronick and colleagues (1978) developed the FFSFP (Tronick et al., 1978) to measure and highlight 1) what happens when social connectedness and mutual regulation are disrupted and 2) the importance of mother-infant connectedness and mutual regulation (Tronick et al., 1978; Tronick et al., 1998). The FFSFP consists of three episodes during which the parent first is asked to engage in typical face-to-face play (FF episode), then to stop responding to the infant and maintain a neutral facial expression (SF episode) and, finally, to resume playing with the infant (RE episode) (see Adamson & Frick, 2003 for a review of the FFSFP in infancy research).

The FFSFP is an ideal task for assessing infants' reactivity to aversive interactions with the caregiver and social orientation towards the caregiver (Weinberg & Tronick, 1996), and individual differences in infant behaviors during the FFSFP have been associated with both relational development (Braungart-Rieker, Garwood, Powers, & Wang, 2001; Cohn, Campbell, & Ross, 1991; Ekas et al., 2013; Mesman, van IJzendoorn, & Bakermans-Kranenburg, 2009) and behavior problems in children (Ekas et al., 2013; Moore, Cohn, & Campbell, 2001). In a clinically informed (ODD 90th percentile and CU 96th percentile) subsample (N = 37) taken from a largely urban community sample of lower- and higher-income African American and European American families, Willoughby and colleagues (2011) found that infants high on both ODD and CU behaviors at 36 months demonstrated significantly less negative reactivity during the SF episode in infancy, providing support for extending downward investigations of the role of hyporeactivity in the etiology of early ODD and CU (Frick & Morris, 2004; Willoughby et al., 2011). Researchers have demonstrated that when the mother-infant dyad is engaged, such as they are during the interactive episodes of the FFSFP, mutual orientation between mothers and infants is related to the development of conscience and internalization of rules and expectations (Kochanska, 1997; Kochanska et al., 2005; Kochanska & Murray, 2000). Furthermore, Moore and colleagues (2001) demonstrated that infants who fail to signal mothers in an attempt to reengage them during the FFSFP are more likely to exhibit externalizing behaviors later in development.

Beyond the main effects of observed infant reactivity and social orienting, the current study poses the question of whether the qualities of the mother-child interaction may interactively predict later ODD and CU behaviors. This question is motivated by recent research highlighting the importance of mother-directed gaze as a correlate of CU behaviors in children

(i.e., Dadds and colleagues, 2011), as well as research with adults suggesting that associations between psychopathic behaviors and diminished reactivity to emotion-related cues is moderated by higher-order cognitive attentional deficits (Newman, Curtin, Bertsch, & Baskin-Sommers, 2010). As such, the current study considered the extent to which mother-directed gaze during the FFSFP buffers any relationship between infant reactivity and later ODD and CU behaviors. Such a prediction is also consistent with work by Ekas and colleagues (2013) linking infant mother-directed gaze during the FFSFP to later attachment security (see also Cohn et al., 1991), and evidence suggesting that early secure relationships with caregivers may buffer against coercive pathways to antisocial conduct (Kochanska, Barry, Stellern, & O'Bleness, 2009). These findings suggest that reactivity and social orienting may represent both independent and interactive pathways to later ODD and CU behaviors and investigating the extent to which these relational behaviors precede ODD and CU behaviors in infancy may offer new developmental insight into the heterotypic continuity of the elevated ODD and CU phenotype over time.

Current Study

Data from a prospective longitudinal study was used to examine the correlation between child behavior in the FFSFP at 6 months and later ODD and CU behaviors. Specifically, the following questions were addressed: 1) Does expressed negative affect during the still face episode of the FFSFP predict later ODD and CU behaviors above and beyond the influence of harsh and sensitive parenting? 2) Does mother directed gaze during the face-to-face episode of the FFSFP predict later ODD and CU behaviors above and beyond the influence of harsh and sensitive parenting? 3) Is any association between infant negative affect during the still face episode attenuated by mother-directed gaze during the face-to-face episode in the prediction of later ODD and CU behaviors? Analyses presented in the current study controlled for numerous

demographic variables as well as mother's behavior during the FFSFP in an attempt to isolate the relationship between infants' behavioral and affective responses to the FFSFP and later ODD and CU behaviors, as well as observed sensitive parenting and harsh-intrusive parenting during a separate free play task to control for the broader relationship quality between child and mother.

Methods

Participants

The current study used participants from the Durham Child Health and Development Study (DCHDS), a prospective longitudinal study of 206 full-term infants and their families who were recruited when their children were 3 months old. Approximately equal numbers of African American and European American families from lower- and higher-income groups were recruited. The study included only infants who were healthy, full-term, and born without significant complications. Family's race and income status were determined from mother self-report.

Of the 206 children recruited into the DCHDS, 185 (89.8%) had data for ODD and CU behaviors at one of the three time points of interest (24, 30, or 36 months). There was no evidence that children with (N = 185) and without (N = 21) outcome data varied as a function of sex (51% male vs. 57% male; $p = .58$), race (56% African American vs. 62% African American; $p = .62$), or total family income at 6 months ($p = .79$). Furthermore, there was no evidence that missingness was related to positive parenting at 6 months ($p = .12$), negative parenting at 6 months ($p = .26$), or mother (infant directed gaze during face-to-face, $p = .27$) and infant (mother directed gaze during the face-to-face, $p = .38$; mother directed gaze during the still face, $p = .08$; affect during face-to-face, $p = .43$; affect during still face, $p = .53$) behaviors during the FFSFP.

Procedure

The current study used observational and questionnaire data that were collected at visits completed when the children were 6, 24, 30, and 36 months old. Information on children's sex and race was collected upon entry into the study. All ratings and observations occurred in a laboratory setting except for the observation of parent-child interactions during free play (coded for maternal sensitivity and harsh-intrusiveness), which were conducted at the participants' homes. At each visit, infants and their mothers participated in a number of joint and individual activities and mothers completed a standardized interview and demographic questionnaires. Transportation was provided to families who required assistance getting to and from the laboratory. Families were compensated $50 for their participation at each time point.

Measures

Face-to-Face Still-Face Paradigm (FFSFP; Adamson and Frick 2003; Tronick et al. 1978.)

The infants' were observed in the FFSFP during the 6 month lab visit to assess infants' behaviors, specifically mother-directed gaze, positive affect, and negative affect. Mothers placed infants in an infant chair on a table and situated themselves in a chair that was placed directly in front of the infants' chair. Mothers were given a set of standardized instructions for each episode of the FFSFP (i.e., FF, SF, RE). As the behaviors we are most interested in, mother-directed gaze and negative affect, are demonstrated most often during the FF and SF episodes (Ekas et al., 2013; Mesman et al., 2009), the RE phase of the FFSFP is of less interest to the current study and will not be included in subsequent analyses. During the FF episode, mothers were instructed to play with their babies as they normally would for 2-minutes. Then mothers were told to turn away from their infant for 15 seconds and then to turn back toward their infants for the SF episode. Mothers were to look at their infant for 2 minutes without providing any verbal or facial

response to the infant (i.e., maintaining a still face). The research assistant made it known that they would stop the still-face episode if the infant became too distressed. The FFSFP was stopped if the infant was unable to be soothed at any point during the procedure. The episodes were video recorded using a split-screen procedure to ensure that the behaviors of both mothers and infants could be observed during the entire interaction.

Coding Infants' and Mothers' Behavior during FFSFP

As previously described by Moore and colleagues (2009), infants' and mothers' affect and gaze during the FFSFP episodes were coded by trained coders. In separate viewings of the videotapes, different research assistants coded infants' and mothers' facial affect and direction of gaze in 1-s intervals. Affect was coded as positive, neutral, or negative, and gaze was coded as toward or away from the partner. Infants' behavior was coded during all three episodes of the FFSPF (FF, SF, and RE) and mothers' behaviors were coded only during the FF and RE as their behavior was constrained by the directions of the SF episode.

Coders were initially trained to reliability using a pre-existing video recorded FFSFP interactions. Inter-observer agreement was determined by randomly selecting 15% of the interactions to be coded by a second coder. The coders were considered in agreement if they coded the same behavior within one second of each other. Reliability was calculated using kappa to correct for chance agreement. Overall, coders reliably identified mother affect (K = .83), infant affect (K = .89), infants' direction of gaze (K = .90), and mothers' direction of gaze (K = .85). Mother affect is not used in the current analyses because observed measures of maternal parenting and mothers' direction of gaze were included as covariates. Affect and gaze scores used in the current analyses were computed as proportions of the total valid interaction time.

Achenbach System of Empirically Based Assessment, Preschool Forms (ASEBA; Achenbach and Rescorla, 2000)

Primary caregivers completed the ASEBA at the 24, 30, and 36 month visits. This standardized assessment indexes children's behavioral and emotional problems using caregivers' ratings of their child's behavior currently or within the last two months (Achenbach & Rescorla, 2000). The ASEBA includes a scoring profile drawn from DSM-referenced scales for ODD and ADHD, both comprised of six items. Further, drawing from the sample used in the current study, Willoughby and colleagues (2011) demonstrated that five items drawn from the ASEBA could be used to measure individual differences in CU behaviors at these early ages. Taken together, they demonstrated that items indicating CU behaviors (e.g., "punishment doesn't change behavior", "shows too little fear of getting hurt"), ODD (e.g., "defiant", "uncooperative"), and ADHD (e.g., "can't sit still, "quickly shifts from one activity to another"), although highly correlated, were best conceptualized as distinct latent factors. In addition to demonstrating that mothers can reliably distinguish between CU behaviors, ODD and ADHD in early childhood, Willoughby and colleagues showed that the individual stability of CU in early childhood was comparable to that of ODD, and ADHD (Willoughby et al., 2011). Measures of ODD behaviors at 24, 30, and 36 months were significantly correlated between 0.48 to 0.62. Further, measures of CU behaviors at 24, 30, and 36 months were significantly correlated between 0.41 to 0.51. Given the strong intra-correlation between time points for ODD and for CU, respectively, a mean of standardized scores (M = 50; STD = 10) from the ASEBA at 24, 30, and 36 months was used to represent the two outcomes of interest. Standardized scores of ODD and CU behaviors in early childhood were used to support interpretability of regression coefficients and interaction plots.

Observed Parent-Infant Interactions

Mothers and their infant were observed during a free play task as part of the home visit completed when the infants were 6 months of age. A set of standard toys were arranged on a blanket and the mothers were asked to play with their infants as they normally would on a typical day. The mother-child free play task was structured to last 10 minutes. All interactions were videotaped and later viewed by trained and reliable coders who rated the interactions using 5-point subscales to measure parental sensitivity, intrusiveness, detachment, stimulation of development, positive regard, negative regard, and animation (measures adapted from the NICHD Early Child Care Research Network, 1999). Previous factor analysis supported the creation of two composite measures of maternal parenting at 6 months. The first composite was harsh and intrusive parenting, what we refer to as harsh parenting, and included measures of intrusiveness and negative regard. The second composite was sensitive parenting and included measures of sensitivity, detachment (reverse scored), stimulation of development, positive regard, and animation. Each coding team consisted of four to five coders and included one or two master coders. Each coder was trained to be reliable with the master coder(s). Reliability was calculated using the intraclass correlation for the independent ratings made for the overlapping coding assignments. Reliability across subscales and composites was high (intraclass correlations >.80 for all subscales).

Additional Covariates

Child's sex and *race* were collected at the time of recruitment. *Family income* was collected at the 6 month home visit. Sex, race, and income were included in the first covariate model and in all subsequent OLS regression models.

Analytic Strategy

The primary analytic approach involved estimating a series of ordinary least squares multiple regression models in which CU and ODD behaviors were separately regressed on indices of parenting behaviors, infant behaviors during the face-to-face and still face episodes of the FFSFP. Child gender, race, and total family income at 6 months were included as covariates in all OLS regression models. Measures of observed sensitive and harsh parenting at 6 months and mothers' infant-directed gaze during the FF episode of the FFSFP were included as covariates in the second regression model and all subsequent models.

In order to examine the extent to which mother-directed gaze during FF predicted ODD and CU behaviors in early childhood, the third model regressed ODD and CU behaviors on covariates, infants' positive affect, negative affect, and infants' mother-directed gaze during the FF episode. In order to examine the extent to which expressed negative affect in response to a relational stressor predicted ODD and CU behaviors in early childhood, the fourth model regressed ODD and CU behaviors on covariates, infants' positive affect, negative affect, and infants' mother-directed gaze during the SF episode. In order to test the hypothesis that mother-directed gaze attenuates the risk associated with the absence of negative reactivity, the final model tested the interaction between infant gaze during the FF episode and infant negative affect during the SF in the prediction of ODD and CU behaviors in early childhood. Each set of OLS regression models was completed for ODD and CU behaviors separately. Significant interactions were probed using the online utility and computational tools for probing 2-way interaction effects in multiple linear regressions (Preacher, Curran, & Bauer, 2006).

Results

Descriptive Analyses

Table 1 presents the bivariate correlations, means, and standard deviations for the model covariates and variables of interest. Observed measures of sensitive and harsh parenting were significantly correlated with race and income. ODD and CU behaviors were both positively correlated with sex indicating higher scores for boys. CU behaviors in early childhood were associated with more harsh and less positive parenting at 6 months. ODD in early childhood was associated with less expressed infant negative affect and infants' mother-directed gaze during the FF episode and less negative affect during the SF episode. ODD and CU behaviors in early childhood were strongly positively correlated with each other which is consistent with previous work (Willoughby et al., 2011, 2013).

Hierarchical OLS Regression Models

To test the associations between demographic variables, infancy measures (mothers' parenting and FFSFP behaviors, and infant behaviors during the FFSFP) and ODD and CU behaviors in early childhood, we completed a set of OLS regressions where means of ODD and CU behavior standardized scores from 24, 30, and 36 months were separately regressed on (a) sex, race, and income, (b) sensitive parenting, harsh parenting, and mothers' child-directed gaze during FF, and (c) infant expressed affect and infants' mother-directed gaze during the FF episode and then during the SF episode. Lastly, (d) an interaction term was added to test the extent to which infants' mother-directed gaze during the FF moderated the association of underreactivity during the SF with ODD and CU behaviors in early childhood. Unstandardized coefficients, standardized coefficients, and R^2 statistics for each set of OLS regression models can be found in Table 2 and Table 3 for ODD and CU behaviors, respectively.

Covariates and parent contributions

Contributions of sex, race, and household income approached significance in the prediction of both ODD (R^2 = .04, F(3, 155) = 2.56, p = .057) and CU behaviors (R^2 = .04, F(3, 155) = 2.57, p = .056). Results from model 2 indicate that greater harsh parenting at 6 months predicted higher ODD (B = 2.07, β = .20, p < .05) and higher CU (B = 1.99, β = .20, p < .05) behaviors in early childhood. The association between positive parenting and CU behaviors approached significance (B = -1.78, β = -.16, p =.10). Mothers' child-directed gaze was not predictive of ODD (B = 2.76, β = .02, *n.s*) or CU (B = 9.63, β = .09, *n.s*).

Infant behavior during the FF and SF episodes

Results from models 3[a] and 3[b] indicate that CU behaviors and ODD in early childhood are predicted by infant behaviors during the FFSFP at 6 months. Specifically, infant behaviors during the FF episode explained a significant amount of variance in ODD (R^2 = .18, F(9, 113) = 2.82, p < .01). Infants' expressed negative affect (B = -12.68, β = -.21, p < .05) and mother-directed gaze (B = -8.29, β = -.21, p = .05) during the FF episode predicted fewer ODD behaviors in early childhood. Additionally, infant behaviors during the SF episode explained a significant amount of variance in ODD (R^2 = .18, F(8, 118) = 3.45, p < .01) and CU (R^2 = .17, F(8, 118) = 3.10, p < .01) behaviors. Infants' expressed negative affect predicted fewer ODD (B = -10.01, β = -.27, p < .01) and CU (B = -8.18, β = -.22, p < .05) behaviors in early childhood.

Model 4 tested the extent to which the association between infants' expressed negative reactivity to a stressor and ODD and CU behaviors in early childhood is moderated by a propensity to socially orient during free play. Results suggest that infants' mother-directed gaze during the FF episode interacted with expressed negative affect during the SF episode to predict a mean of ODD from 24 to 36 months (B = 27.27, β = .21, p < .05). This interaction was probed and 1 standard deviation above and below the mean for infants' mother-directed gaze during the

FF episode (Figure 1). Examination of simple slopes indicated that, although the association between expressed negative affect during the SF episode and ODD in early childhood is negative for children who were at or below the mean for amount of mother-directed gaze during the FF episode (-1 SD simple slope = -15.3774(SE = 4.9837), t=-3.0856, p=0.0026; mean simple slope = -9.3497(SE = 3.669), t=-2.5483, p=0.0123) (i.e., children who expressed less negative affect during the SF episode demonstrated higher ODD scores), this association was attenuated (i.e., not significantly different from zero) for those children who consistently oriented or gazed towards their mother during the FF episode (+1 SD simple slope = -3.3219(SE = 4.0754), t=-0.8151, p=0.4169). Furthermore, regression results and examination of graphed estimated values of CU behaviors (Figure 2) suggest a similar moderating relationship between expressed negative affect during the SF episode and infants' mother-directed gaze during the FF episode in the prediction of CU behaviors (-1 SD simple slope = -13.0986(SE = 4.9033), t=-2.6714, p=0.0088; mean simple slope = -8.0417(SE = 3.6098), t=-2.2277, p=0.0281; +1 SD simple slope = -2.9847(SE = 4.0096), t=-0.7444, p=0.4584, although, this association only approached significance ($B = 22.88$, $\beta = .18$, $p = .059$).

Discussion

Empirical investigations of the etiology of disruptive behavior problems in early childhood have been the focus of substantial developmental and clinical research given the evidence for their relative stability (Campbell, Pierce, Moore, & Marakovitz, 1996; Hawes & Dadds, 2007; Heller, Baker, Henker, & Hinshaw, 1996), their associations with disruptions in other domains of functioning like social competence (Campbell, 2002; Moffitt, 1993), and their predictive relationship with other, more serious, antisocial and psychopathic behavior later in development (Lynam et al., 2007; Rowe et al., 2010). However, despite approximately one-third

of all children who meet diagnostic criteria for behavior disorder also exhibit callous-unemotional traits (Frick & Viding, 2009) and the clear clinical and public health implications of understanding the etiology of these behaviors, there is a paucity of prospective longitudinal research that has extended downward the study of the early correlates of these behavioral phenotypes from adolescence and adulthood into infancy. The current study examined the links between 1) infants' negative affect during the SF episode of the FFSFP and ODD and CU behaviors in early childhood, 2) infants' mother-directed gaze during the FF episode of the FFSFP and ODD and CU behaviors in early childhood, and 3) explored the extent to which infants' mother-directed gaze attenuates the hypothesized relationship between a lack of negative affect during the SF episode and CP and CU behaviors in early childhood. Hierarchical regression analyses revealed that infants' expressed negative affect and mother-directed gaze during the FF episode predicted fewer ODD behaviors in early childhood. Similarly, infants' expressed negative affect during the SF episode predicted fewer ODD and CU behaviors in early childhood. Further, examination of interaction effects suggested that mother-directed gaze during the FF episode attenuated the negative relationship between negative affect during the SF episode and ODD and, at least marginally, CU behaviors in early childhood.

The SF episode of the FFSFP (Tronick et al., 1978), during which mothers are instructed to become verbally and emotionally unresponsive, has been shown to elicit negative affect from the infant. Our findings indicate that, in the context of this relational stressor, less expressed negative affect relative to other infants (i.e., less reactivity) at 6 months was associated with higher levels of ODD and CU behaviors in early childhood controlling for observed parenting outside of the FFSFP and mother behavior during the FFSFP. This is consistent with clinical research on older children showing that behavioral problems and CU traits are associated with

aberrant relational functioning (Frick, Barry, & Bodin, 2000; Loney et al., 2003) and under-arousal to presumed stressful or aversive stimuli (Frick & Morris, 2004; Marsh et al., 2008; Stadler et al., 2011). The current study provides confirmation and extension of work done by Barker and colleagues (2011) in which they found that maternal-rated child lack of inhibition, what could be conceptualized as underreactivity when reactivity is expected, at age 2 predicts both conduct problems and CU traits in early adolescence, controlling for other familial and contextual risks (Barker, Oliver, Viding, Salekin, & Maughan, 2011). Similarly, Baker and colleagues (2012) found that infants' responses to a laboratory based paradigm intended to be stressful predicted blunted behavioral and physiological responses to stress-inducing stimuli in toddlerhood, suggesting some level of stability of this early behavioral phenotype (Baker, Baibazarova, Ktistaki, Shelton, & Van Goozen, 2012).

Our findings also indicate that less mother-directed gaze during the FF episode of the FFSFP at 6 months is associated with more ODD symptoms later, but interestingly we did not find this association with CU behaviors. However, moderation analyses indicated that high amounts of mother-directed gaze diminished the observed relationship between less negative reactivity to mothers' unresponsiveness during the SF episode and later ODD behaviors, and did so marginally for later CU behaviors as well. This is partially consistent with extant findings that older children and adolescents high on ODD and CU traits exhibit deficits in the extent to which they make eye contact with caregivers during dyadic interactions (see Frick et al., 2014 for review) and that these deficits contribute to maladaptive social functioning (Dadds et al., 2011).

A possible explanation of the current findings comes from classic attachment theory (Bowlby, 1969/1982) and identifies the importance of infants' affective displays and visual

orientation as primary mechanisms of communication with caregivers. When viewed through this lens, infants' positive affect and mother-directed gaze during the FF episode of the FFSFP promote affiliation and continued reciprocity which, when responded to appropriately, promote sensitive parenting and the formation of secure attachment relationships (Ainsworth, Blehar, Waters, & Wall, 1978; Bowlby, 1969/1982). Interestingly, children and adolescents high on ODD and CU traits have been shown to have low levels of eye contact with attachment figures (Dadds et al., 2013; Dadds et al., 2011; Dadds et al., 2012) and are more likely to form insecure attachments than youth with normative levels of ODD and CU behaviors (Fearon, Bakermans-Kranenburg, van IJzendoorn, Lapsley, & Roisman, 2010; Pasalich, Dadds, Hawes, & Brennan, 2012). Work by Kochanska and her colleagues has shown that early attachment security may enhance the positive outcomes associated with adaptive parenting (Kochanska, Aksan, Knaack, & Rhines, 2004) and buffer against maladaptive trajectories of antisocial behaviors (Kochanska et al., 2009). Thus, the current findings may suggest that high amounts of infants' mother-directed gaze may indicate the foundations of a secure attachment relationship that buffers the child from affective and emotional risks for ODD and CU behaviors.

Speculative Considerations and Implications for Future Research

The notion of heterotypic continuity as it applies to etiological processes associated with ODD and CU traits in early life suggests that common underlying mechanisms influence multiple phenotypic behaviors and that dynamic relations between these underlying mechanisms may result in one influencing the developmental progression of another. Consistent with the concept of heterotypic continuity, damage to the amygdala, a neural system implicated in emotional dysfunction and fearlessness in children and adults with CU traits (Blair, 2008), has also been shown to be associated with reduced eye contact (Spezio, Huang, Castelli, & Adophs,

2007). Furthermore, there is research to suggest that older samples who exhibit CU traits show low levels of attention to affective cues (Newman et al., 2010) and that these attentional deficits, especially when referring to orienting and attending to the eye region of others, may contribute to dysfunctional recognition and interpretation of emotionally salient stimuli (Richell et al., 2003). For example, Newman and colleagues (2010) showed that the startle response to fear stimuli could be normalized for psychopathic adults if they were told to redirect their attention to key features. Our findings might suggest that very early deficits in relational attention (as demonstrated by orienting towards another during a dyadic interaction) and under-reactivity to arousing stimuli may be independent precursors of later ODD and CU behaviors, and their co-occurrence may multiplicatively affect the likelihood of developing elevated ODD and CU behaviors. More specifically, given the associations between attentional processes and successful interpretation of emotionally salient stimuli, an early ability to socially attend to one's caregiver in infancy may attenuate the risk of developing ODD and CU traits regardless of affective reactivity to a mild relational stressor. It is important to note that the extent to which these infant behaviors are phenotypic behavioral expressions of underlying neurological functioning cannot be inferred from this study. The current findings also cannot speak to the nature or direction of the relationship between attentional behavior and recognition of emotionally salient stimuli. That being said, the presence of these behaviors in infancy and their relation to ODD and CU behaviors in early childhood should provide support for future studies to more thoroughly investigate such questions.

Strengths and Limitations

To our knowledge, this is one of the first studies to downwardly extend the investigation of child affective and eye-gaze correlates of ODD and CU traits into infancy. The use of the

FFSFP, a paradigm that elicits infants' behavioral responses to normative and aberrant interactions with a caregiver, to measure infant behavior rather than maternal report is a unique contribution to this literature. The use of the FFSFP supports increased specificity with regard to the etiological processes of interest in a way that more broad measures of temperamental negativity might not by isolating specific affective and social behaviors that are the basis of emotional and social processes underlying the development of ODD and CU traits, and perhaps later antisocial behavior over time. Further, our findings are strengthened by the longitudinal prospective design of the DCHDS and its demographic diversity, which allows for greater generalizability than is possible with convenience or clinically-based samples.

There are limitations of this study that are important to note. First, although the current study included well-designed and validated measures of parenting, infant behaviors, and ODD and CU behaviors, the age at which we collected the outcomes of interest restricted the extent which we could include truly diagnostic measures of antisocial behaviors. Therefore, we refer throughout to behaviors rather than symptoms, although individual differences in these behaviors are predictive of clinical outcomes. Second, there is emerging evidence that ODD might be more accurately captured using three distinct dimensions (i.e., irritable, headstrong, hurtful), which have distinct external correlates (Stringaris & Goodman, 2009). Use of these three dimensions in future research may provide a more nuanced understanding of atypical development. Third, the use of a community sample in this study, rather than a clinical sample, restricted the extent to which our graphed estimates of the moderating relationship between gaze and negative affect (Figure 1 and 2) were able to predict ODD and CU behaviors at clinically significant levels. We were successful in demonstrating a link between infant behavior and

significantly elevated ODD and CU behaviors in early childhood but the use of an older, clinically informed, sample might yield stronger results.

Conclusions and Next Steps

This study has several implications for future research in this domain. First, it is possible that infants' mother-directed gaze and negative affectivity is representative of underlying individual differences in psychophysiological and neurobiological functioning. Psychobiological models of under-arousal and emotion processing and their etiological significance for behavior problems and CU traits now include physiological (e.g. Gao, Glenn, Schug, Yang, & Raine, 2009; Hawes et al., 2009; Loney et al., 2006; Stadler et al., 2011; Willoughby et al., 2011) and neurological (e.g. Jones, Laurens, Herba, Barker, & Viding, 2009; Marsh et al., 2008; Kiehl et al., 2001) systems that influence these responses. Future studies should investigate infants' concurrent biological and behavioral functioning in response to a stressor and the extent to which individual differences in dual-system functioning predict ODD and CU traits later in childhood. Second, an outstanding empirical question is whether the relationship between under-arousal to stimuli and the development of ODD and CU traits differs as a function of relational (i.e., interacting with a caregiver) versus static (i.e., laboratory fear paradigm) stressors. Third, extant literature suggests that the developmental pathways from low eye contact to behavioral problems and CU traits may be different for mother-child and father-child dyads (Dadds et al., 2011; Dadds et al., 2012). Replication of the current study using the FFSFP with both mothers and fathers would significantly advance the literature. Fourth, given the emerging evidence linking ODD and CU traits to insecure attachment relationships in older samples (e.g., Fearon et al., 2010; Pasalich et al., 2012), a highly relevant line of research would attempt to replicate and extend the current findings by including thoughtful measures of attachment. The downward

extension of the study of behavioral precursors in infancy to ODD and CU behaviors in childhood and adolescence will aid in the development of early and targeted preventive interventions.

Table 1. Zero-order Bivariate Correlations Between Model Outcomes

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Sex (0 = female)	-													
2. Race (0 = white)	-.08	-												
3. Household Income (6 m)	.08	-.21**	-											
4. Sensitive parenting (6 m)	.05	-.30**	.32**	-										
5. Harsh parenting (6 m)	-.05	.31**	-.32**	-.37**	-									
6. Mother's Child-Directed Gaze (FP)	.23**	.01	.06	.13	.05	-								
7. Child's Negative Affect (FP)	.05	-.07	.04	-.04	.01	.04	-							
8. Child's Positive Affect (FP)	-.07	.04	-.11	-.00	.10	.00	-.27**	-						
9. Childs' Mother-Directed Gaze (FP)	-.05	.21**	-.19*	-.02	.17*	.06	.00	.50**	-					
10. Child's Negative Affect (SF)	.11	.02	-.18*	-.05	-.01	-.06	.31**	-.04	.09	-				
11. Child's Positive Affect (SF)	-.08	-.12	.13	.16	-.12	.05	-.10	.43**	.13	-.24**	-			
12. Child's Mother-Directed Gaze (SF)	-.01	.13	-.14	-.03	.10	-.03	-.10	.26**	.41**	.05	.03	-		
13. ODD (24, 20, 36 month mean)	.17*	-.09	-.00	-.09	.13	.06	-.18*	-.07	-.16*	-.17*	-.13	.01	-	
14. CU (24, 20, 36 month mean)	.16*	-.04	-.13	-.19*	.21**	.12	-.04	-.02	-.02	-.10	-.14	.06	.69**	-
Number	206	206	170	175	175	151	165	165	165	159	159	153	184	184
Mean	.51	.57	49,405	3.2	2.5	.90	.06	.21	.40	.19	.05	.49	51	50
Standard Deviation	.50	.49	40,670	.80	.91	.08	.14	.19	.22	.27	..09	.24	8.6	8.3

Notes: $p \leq .05$*, $p \leq .01$**; T-scores reported for ODD and CU

Table 2. Hierarchical Regression Models Predicting mean ODD Standardized Scores from 24 to 36 months

	Model 1		Model 2		Model 3[a]		Model 3[b]		Model 4	
Parameter	*B*	β	*B*	β	*B*	β	*B*	β	*B*	β
Sex (0 = female)	3.41*	0.19*	3.51*	0.19*	3.23*	0.18*	4.69**	0.26**	3.18^	0.17^
Race (0 = white)	-1.01	-0.05	-1.58	-0.08	-1.66	-0.09	-2.34	-0.12	-1.57	-0.08
Household Income (6 m)	0.00	0.03	0.00	0.08	0.00	0.04	0.00	0.01	0.00	0.02
Sensitive parenting (6 m)			-0.20	-0.01	-0.27	-0.02	-1.03	-0.09	-0.89	-0.08
Harsh parenting (6 m)			2.07*	0.20*	2.37*	0.23*	1.38	0.13	1.90^	0.18^
Mother's Child-Directed Gaze (FP)			2.76	0.02	5.96	0.05	-	-	4.01	0.03
Child's Negative Affect (FP)					-12.68*	-0.21*	-	-	-10.98	-0.11
Child's Positive Affect (FP)					-2.11	-0.04	-	-	-1.23	-0.02
Child's Mother-Directed Gaze (FP)					-8.29*	-0.21*	-	-	-5.34	-0.13
Child's Negative Affect (SF)							-10.01**	-0.27**	-9.34*	-0.25*
Child's Positive Affect (SF)							-15.28^	-0.15^	-8.54	-0.09
Child's Mother-Directed Gaze (SF)							-2.95	-0.08	-3.26	-0.08
Negative Affect (SF)*Gaze (FP)									27.27*	0.21*
Total R^2 (Adjusted R^2)	0.04 (0.02)		0.08 (0.03)		0.18** (0.11)**		0.19** (0.13)**		0.24** (0.14)**	

Notes: p ≤ .10^, p ≤ .05*, p ≤ .01**; cont. predictors centered; F*P* = Face-to-face; SF = Still Face; Model 3[a] = FP only; Model 3[b] = SF only

Table 3. Hierarchical Regression Models Predicting mean CU Standardized Scores from 24 to 36 months

	Model 1		Model 2		Model 3[a]		Model 3[b]		Model 4	
Parameter	*B*	β	*B*	β	*B*	β	*B*	β	*B*	β
Sex (0 = female)	2.79*	0.16*	2.13	0.12	1.99	0.11	3.08*	0.17*	1.57	0.08
Race (0 = white)	-0.15	-0.01	-1.74	-0.10	-1.85	-0.10	-2.71^	-0.15^	-2.43	-0.13
Household Income (6 m)	-0.00^	-0.15^	-0.00	-0.07	-0.00	-0.08	-0.15	-0.10	-0.00	-0.08
Sensitive parenting (6 m)			-1.78^	-0.16^	-1.84^	-0.17^	-1.86^	-0.16^	-2.14^	-0.19^
Harsh parenting (6 m)			1.99*	0.20*	2.13*	0.21*	1.62^	0.16^	1.91^	0.19^
Mother's Child-Directed Gaze (FP)			9.63	0.09	10.78	0.10	-	-	11.15	0.11
Child's Negative Affect (FP)					-5.42	-0.09	-	-	-7.63	-0.07
Child's Positive Affect (FP)					-0.96	-0.02	-	-	1.98	0.04
Child's Mother-Directed Gaze (FP)					-3.14	-0.08	-	-	-5.62	-0.14
Child's Negative Affect (SF)							-8.18*	-0.22*	-8.04*	-0.22*
Child's Positive Affect (SF)							-13.26^	-0.14^	-10.21	-0.11
Child's Mother-Directed Gaze (SF)							2.60	0.07	2.55	0.06
Negative Affect (SF)*Gaze (FP)									22.88^	0.18^
Total R^2 (Adjusted R^2)	0.04^ (0.02)^		0.11* (0.06)*		0.13^ (0.06)^		0.17** (0.12)**		0.22** (0.13)**	

Notes: p ≤ .10^, p ≤ .05*, p ≤ .01**; cont. predictors centered; F*P* = Face-to-face; SF = Still Face; Model 3[a] = FP only; Model 3[b] = SF only

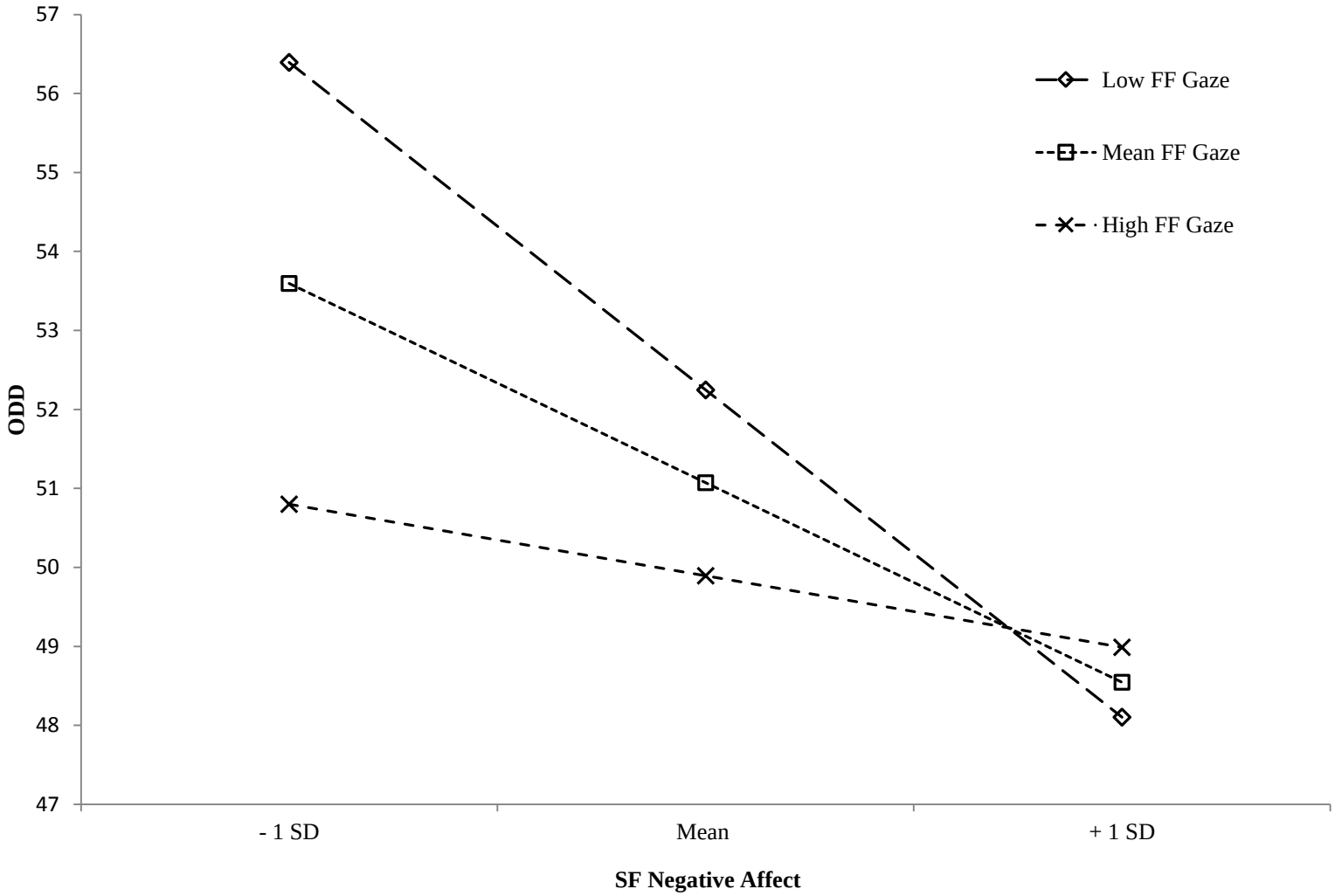

Figure 1. The relationship between negative affect and ODD as a function of mother-directed gaze.

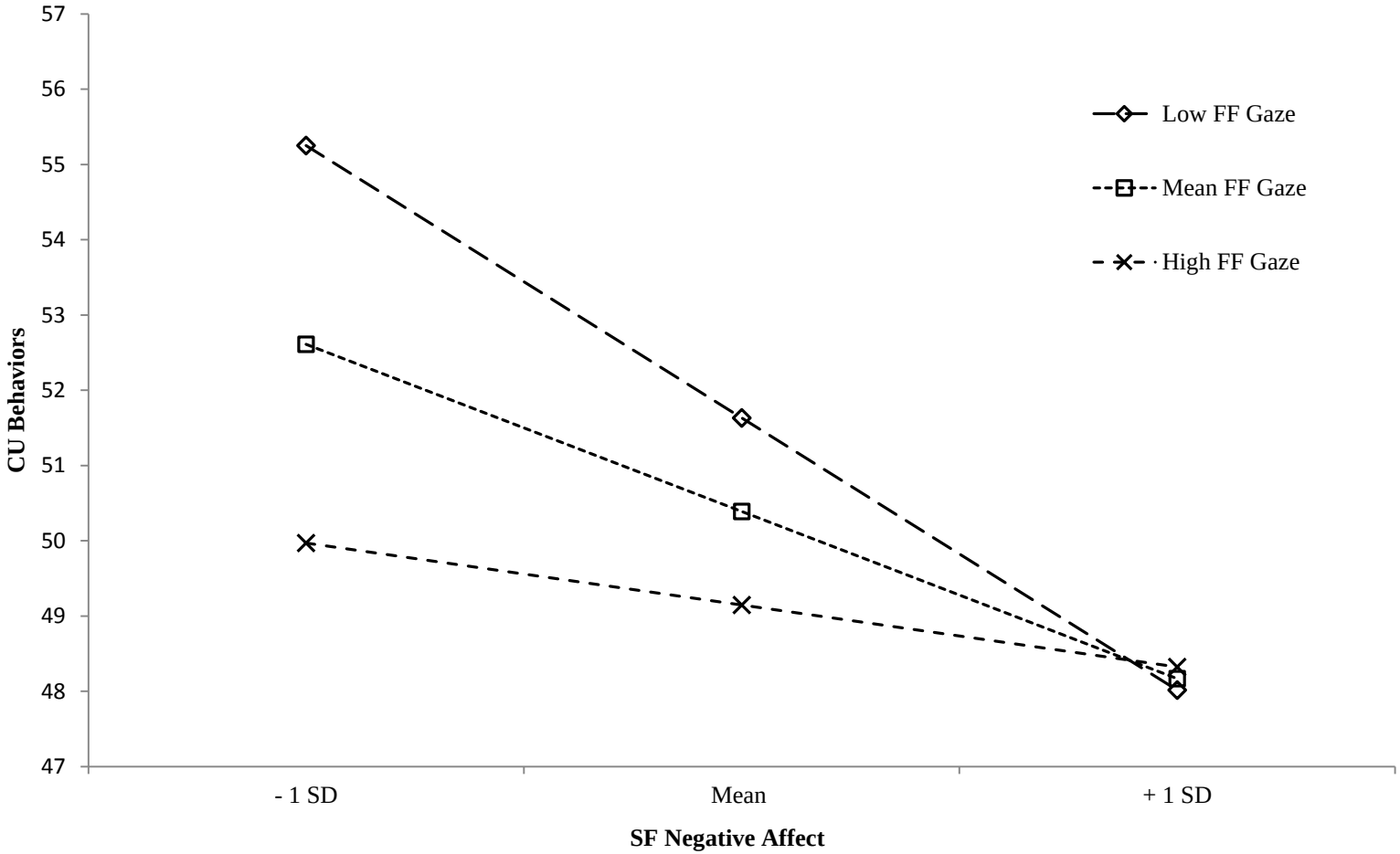

Figure 2. The relationship between negative affect and CU behaviors as a function of mother-directed gaze.

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