5-10-2017

Negatively Biased Facial Affect Discernment and Socially Inhibited Behavior in Middle Childhood

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NEGATIVELY BIASED FACIAL AFFECT DISCERNMENT AND SOCIALLY INHIBITED BEHAVIOR IN MIDDLE CHILDHOOD

by

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ABSTRACT

Negatively biased facial affect discernment may prompt socially inhibited behavior. Characterizing normative patterns of facial affect discernment across emotions and expression intensity during middle childhood will help to identify subtle, yet meaningful, deviations that may emerge for individuals and potentially negatively impact their social behavior. Facial affect discernment for happy, sad, and angry expressions across low, medium, and high intensities and parent-reported socially inhibited behavior were measured in this study in a sample of 7-10 year-old children (N = 80; 53% female). Discernment accuracy improved with increased expression intensity for all emotions. Specifically, we found a quartic effect for the association between intensity and accuracy for anger and negative quadratics effects with decelerating positive rates

of changes for associations between intensity and accuracy for happiness and intensity and accuracy for sadness. Additionally, discernment accuracy for happiness was generally better than for sadness and anger; discernment accuracy for anger was generally better than for sadness. However, at low intensity, discernment accuracy for sadness was comparable to accuracy for happiness but better than for anger. Neither misidentification of neutral and low intensity faces as negative nor discernment accuracy of happiness at low intensity was significantly associated with socially inhibited behaviors. Although accurate discernment of anger and sadness at low intensity was not significantly related to socially inhibited behavior, better discernment accuracy of anger and sadness at medium intensity was significantly related to more socially inhibited behavior. Overall, these results enhance understanding of normative facial affect discernment and its relation to maladaptive social behaviors in middle childhood, a developmental stage at which intervention efforts may prove effective at heading off detrimental outcomes associated with socially inhibited behavior such as loneliness, low self-esteem, peer victimization, social anxiety, and depression that increase in late childhood and adolescence.

INDEX WORDS: Social inhibition, Facial expressions, Middle childhood, Emotion

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A Dissertation Submitted in Partial Fulfillment of the Requirements for the Degree of

Doctor of Philosophy

in the College of Arts and Sciences

Georgia State University

2017

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May 2017

ACKNOWLEDGEMENTS

I am very grateful to Dr. Erin Tully for all of her guidance and insight throughout the project. I would like to thank my committee members Dr. Nicole Caporino, Dr. Robert Latzman, and Dr. Erin Tone for their valuable time and thoughtful feedback that helped shape the project. I would also like to thank Dr. Rebecca Williamson for all her efforts coordinating the GSU Infant and Child Subject Database from which most of the participants in this study were recruited. I am very appreciative of the funding support I received from the GSU dissertation grant that enabled me to compensate families for their time and made recruiting my own sample feasible. Finally, I would like to thank the families who gave so generously of their time and make research like this possible.

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ANOVA = analysis of variance

GEE = Generalized estimating equation

SIP = social information-processing

1 INTRODUCTION

1.1 Purpose of the Study

The ability to accurately discern the emotional states of others from their facial expressions develops over childhood and emerges at different ages for different emotions, with accuracy of discernment improving as expressions become more intense and ability to discern low intensity expressions improving over childhood (e.g., Gao & Maurer, 2010; Montirosso, Peverelli, Frigerio, Crespi, & Borgatti, 2010). Children's accuracy in discerning emotions from facial expressions is correlated with higher sociometric status (Edwards, Manstead, & Macdonald, 1984; Philippot & Feldman, 1990), better social skills, and lower levels of problematic social behavior (Izard et al., 2001).

Childhood deficiencies in the ability to accurately identify facial expressions are associated with peer rejection (Miller et al., 2005) and varied psychological difficulties such as autism (Harms, Martin, & Wallace, 2010; Wallace, Coleman, & Bailey, 2008), attention-deficit hyperactivity disorder (Pelc, Kornreich, Foisy, & Dan, 2006), and antisocial tendencies (Marsh & Blair, 2008). Internalizing psychopathology is associated with more subtle and specific differences in facial affect processing. Atypically strong ability to accurately discern angry and sad facial expressions at low intensities (i.e., high discernment sensitivity for anger and sadness), poor ability to discern happy facial expressions at low intensities (i.e., low discernment sensitivity for happiness), and a bias to misidentify neutral and low intensity expressions of other emotions as sad or angry (hereafter collectively referred to as negatively biased facial affect discernment) have been found in adults and children with internalizing psychopathology (e.g., Jenness, Hankin, Young, & Gibb, 2015; Joormann & Gotlib, 2006).

Negatively biased facial affect discernment may influence internalizing problems through its effect on the generation, selection, and enactment of socially inhibited behaviors (Bell, Luebbe, Swenson, & Allwood, 2009; Crick & Dodge, 1994). Expectations of increased social independence during middle childhood (Lancy & Grove, 2011) make it an important period in which to examine factors that precipitate maladaptive social behaviors. The purpose of this study is to quantify and compare discernment accuracy in middle childhood for happy, sad, and angry facial expressions of low, medium, and high intensities and to investigate associations between negatively biased facial affect discernment and socially inhibited behaviors during this developmental period.

1.2 Development of Facial Expression Discernment Abilities

The rudimentary ability to distinguish facial expressions as positive or negative begins in infancy (for review see Nelson, 1987), but the ability to accurately discern a range of emotions from the facial expressions of others emerges over childhood (Gao & Maurer, 2009, 2010; Gosselin & Larocque, 2000; Montirosso et al., 2010). Although children's facial affect discernment ability has been the subject of many studies, conclusions regarding the age at which accurate discernment of happiness, sadness, and anger is evident and the developmental trajectories of discernment accuracy for each of these emotions relative to the others, are not entirely consistent. This may be due, in large part, to four main methodological differences across facial affect recognition studies: task type, emotions included, characteristics of the stimuli, and method of calculating the accuracy variable. First, although some studies utilize designs in which participants match faces to other stimuli expressing the same emotion, other tasks require verbal identification of the emotion shown in a facial expression (e.g., choosing from among angry, sad, happy, and neutral labels) and, arguably, most closely approximates the

demands of reading nonverbal social cues when engaging in interpersonal interactions. Second, different stimuli are used, specifically photographs versus schematic drawings of faces, child faces versus adult faces, and prototypical, full intensity expressions and those that vary with regard to intensity of expression. Third, these tasks vary with regard to how many and which emotions are to be identified and, if utilizing forced-choice parameters, which emotional descriptors are provided as choices. Fourth, researchers have also used a variety of methods to calculate discernment accuracy, including a basic count of correct responses, a hit rate (i.e., proportion of correct responses for a given emotion divided by frequency of presentation for that same emotion), and measures that account for a bias to label faces according to a default emotion (e.g., unbiased hit rate, discrimination index). Findings from studies that use simple counts or hit rates may reflect differences in emotion knowledge or likelihood to use certain emotion labels (Smiley & Huttenlocher, 1989), rather than differences in accuracy of facial expression discernment. Despite these methodological differences, some notable trends may be distilled from the existing literature.

Discernment accuracy develops at different rates for different emotions (Camras & Allison, 1985) and evidence suggests that accurate discernment of happiness typically emerges first (Boyatzis, Chazan, & Ting, 1993; Camras & Allison, 1985; Gao & Maurer, 2009, 2010; Vicari, Reilly, Pasqualetti, Vizzotto, & Caltagirone, 2000). Two early studies examining young children's facial expression recognition using a forced-choice task with photographs of children indicate that discernment accuracy for happy facial expressions is better than for anger, and sadness (Boyatzis et al., 1993; Camras & Allison, 1985). Subsequent cross-sectional studies using photographs of adult faces confirm this advantage for accurate discernment of happiness over other emotions (Gao & Maurer, 2010; Gosselin & Larocque, 2000; Mancini, Agnoli,

Baldaro, Ricci Bitti, & Surcinelli, 2013; Vicari et al., 2000) and indicate that 5-year-olds' discernment accuracy for happiness is comparable to 7- to 10- year-old children and adults with little room for further improvement (Gao & Maurer, 2010; Vicari et al., 2000). However, the measures of accuracy used by these studies have typically not accounted for a possible bias to label faces as happy, thereby possibly inflating estimates of accuracy. Additionally, the advantage of happy expressions may be influenced by the fact that happiness is typically the only positive emotion included in studies thereby making discrimination of happiness from other negative expressions easier. However, some studies have included surprise (Boyatzis et al., 1993; Camras & Allison, 1985; Gao & Maurer, 2010; Gosselin & Larocque, 2000) and, although a significant number of surprise expressions are misidentified as happy, happiness is not significantly misidentified as surprise and maintains its high level of accuracy compared to the other expressions (Gao & Maurer, 2010; Gosselin & Larocque, 2000).

Findings regarding the development of discernment accuracy for sad and angry facial expressions are decidedly more mixed, with three possible patterns emerging from the literature: accurate discernment of sadness may develop first, accurate discernment of anger may develop first, or the two may follow a similar developmental course. The two studies of young children's facial affect recognition discussed above found that discernment accuracy for sad expressions was less than for happy expressions, but greater than for angry expressions (Boyatzis et al., 1993; Camras & Allison, 1985). This lag in level of discernment accuracy for angry faces behind happy and sad expressions was also found in a cross-sectional study using photographs of adult faces in a 5- to 10- year-old sample (Vicari et al., 2000). Again, these studies used measures of accuracy that did not account for a labeling bias. Children may use happy and sad labels more often, which may reflect a difference in the acquisition of and familiarity with emotion terms

rather than emotion discernment (Smiley & Huttenlocher, 1989). However, another cross-sectional study used the unbiased hit-rate proposed by Wagner (1993), which accounts for labeling bias, as their measure of accuracy and found discernment accuracy for anger to be weaker than for sadness or happiness (Gosselin & Larocque, 2000), thus supporting the idea that discernment accuracy for sadness develops before discernment accuracy for anger.

Alternatively, a few studies suggest discernment accuracy for angry expressions may develop before discernment accuracy for sad expressions. Gao and Maurer (2010) found that 7-year-olds were significantly less accurate than adults at identifying full intensity sad expressions, but that there were no significant differences in discernment accuracy for angry expressions at full intensity; indeed, all age groups achieved perfect accuracy for anger discernment. In another cross-sectional study, 8-year-olds' discernment accuracy for sadness was lower than discernment accuracy for anger, but improved significantly across middle childhood (Mancini et al., 2013). Another study utilizing child photographs found lower identification accuracy for sad faces compared to angry and fearful faces, but Helmert contrasts were used and thus precluded direct comparison of accuracy for sad faces with accuracy for angry faces (De Sonneville et al., 2002). Although no studies have explicitly reported nonsignificant differences between discernment accuracies for sadness and anger, one study reported accuracy means (calculated using a discrimination index that accounts for labeling bias) that suggest a similar pattern of discernment accuracy across middle childhood for the two emotions (Durand et al., 2007). Thus, there is evidence to suggest that discernment accuracy for angry faces is already at adult-like levels in middle childhood and is better than discernment accuracy for sad faces.

In sum, findings about differences in discernment accuracy for happy, sad, and angry faces do not appear to vary consistently as a function of task structure (e.g., which emotions are

given as choices in labeling tasks) or whether child or adult faces as stimuli. However, studies often vary with regard to more than one methodological characteristic, making systematic comparisons difficult. For example, the few studies that have utilized child faces as stimuli have used simple counts or hit rate to measure discernment accuracy. One consistent weakness of the literature is that few studies have utilized measures of discernment accuracy that appropriately account for the possibility of a labeling bias. This may result in overestimations of how early discernment accuracy for happiness emerges and how much better it is, relative to other emotions; however, some studies using more robust measures of accuracy have yielded similar findings. Using robust methods of calculating accuracy that account for potential labeling biases may be especially necessary to disentangle findings regarding anger and sadness discernment where differences may be smaller and discrimination between expressions more difficult because both are negative emotions.

Despite these mixed findings, most studies indicate that accuracy levels for discernment of full intensity happy, sad, and angry expressions typically reach adult-like levels by the end of middle childhood (Durand, Gallay, Seigneuric, Robichon, & Baudouin, 2007; Gao & Maurer, 2009, 2010; Gosselin & Larocque, 2000; Mancini et al., 2013; Vicari et al., 2000). Thus, it is clear that middle childhood is an important period for the development of facial affect discernment, particularly sadness and anger, and that using a measure of discernment accuracy that accounts for the joint probability both that an emotion is correctly identified (given that it is presented) and that an emotion label is correctly used (given that it is used; Wagner, 1993) is necessary to yield accurate, meaningful results.

Facial expressions encountered in day-to-day interpersonal interactions are often of less than full intensity, and thus examining discernment accuracy for facial expressions across a

range of intensities is more ecologically relevant. As might be expected, discernment accuracy for emotional facial expressions is better with increased intensity of expressiveness (Gao & Maurer, 2009, 2010; Jenness et al., 2015; Montirosso et al., 2010). Accuracy for discerning low intensity emotional expressions (i.e., discernment sensitivity) continues to improve throughout childhood and adolescence (e.g., Montirosso et al., 2010) and varies as a function of the emotion being displayed, such that consistent with the literature on full intensity expressions reviewed above, discernment sensitivity is generally better for happy expressions than for sad or angry facial expressions (Jenness et al., 2015; Montirosso et al., 2010).

The specific patterns of increasing discernment accuracy with increasing expression intensity differed by emotion. In two studies, discernment accuracy for happiness was high at low intensities (Jenness et al., 2015; Montirosso et al., 2010), and increased slightly at medium (Jenness et al., 2015; Montirosso et al., 2010) and high intensities (Jenness et al., 2015; Montirosso et al., 2010), where levels of accuracy were almost perfect. Another study found that accuracy for happy expressions reached a 'ceiling' with less intensity, at approximately 60% intensity (Gao & Maurer, 2010). In a sample of 4-to 18-year-olds, accuracies of anger and sadness discernment were relatively equal and accuracies for both emotions increased with intensity of the expression from low to medium to high (Montirosso et al., 2010). A similar relationship between discernment accuracy and expression intensity was found in a study of 7- to 16-year-olds (Jenness et al., 2015). Discernment accuracies for angry and sad facial expressions were relatively equal at low intensities; however, in this study, discernment accuracy for angry expressions was greater than discernment accuracy for sad expressions at medium and high intensities and anger discernment reached almost perfect accuracy at high intensities (Jenness et al., 2015). Similarly, a third study indicated that accuracy for angry expressions increased from

20 to 50% intensities and reached a 'ceiling' with less intensity, at approximately 55% intensity, whereas discernment accuracy for sadness did not reach perfect levels even at high intensities (Gao & Maurer, 2010). In sum, discernment accuracy for anger and sadness in childhood and adolescence appears to improve linearly with increasing intensity. Discernment accuracy for happiness appears to improve from low to medium intensity after which little change occurs i.e., a negative quadratic pattern of decelerating change, although this may be, in part, because happiness is typically the only positive emotion included allowing for basic discrimination between positive and negative emotions.

Although the wide age ranges (Jenness et al., 2015; Montirosso et al., 2010) and differences in methodological and statistical approaches (Gao & Maurer, 2010) of these studies of less than full intensity emotions preclude conclusions about facial affect discernment in middle childhood, differences in mean discernment accuracy for participants in distinct age groups reported by Montirosso et al. (2010) indicate possible age-related differences in discernment accuracy that highlight middle childhood as a period of development for discernment sensitivity. The discernment accuracy for both low and medium intensity facial expressions (collapsed across emotions) in middle childhood (7- to 9- year-olds and/or 10- to 12-year-olds) was significantly poorer than in adolescence (13- to 15- year-olds and/or 16- to 18-year-olds) but significantly greater than in early childhood (4- to 6- year-olds). These data highlight middle childhood as a period during which discernment accuracy for expressions of low and medium intensities likely improves, and quantifying typical discernment accuracy in middle childhood at low, medium, and high intensities *separately* for happy, sad, and angry expressions will improve understanding of normative socio-emotional development, which may lead to improved methods for facilitating of emotion learning. Additionally, individual

differences in discernment sensitivity and tendencies towards particular errors in emotion expression identification (i.e., misidentification biases) may have profound implications for social behavior. Characterizing normative patterns of facial affect discernment during this period will improve identification of deviant emotion processing that may emerge for individuals and potentially negatively impact their social behavior.

1.3 Facial Expressions as Behavioral Cues

Emotions discerned from facial expressions are thought to trigger approach and avoidance behavior (Marsh, Ambady, & Kleck, 2005; Rotteveel & Phaf, 2004; Seidel, Habel, Kirschner, Gur, & Derntl, 2010). Researchers have examined this idea in adults by comparing reaction times for the initiation of arm muscle extension movements and backward steps, conceptualized as avoidance behaviors, and arm muscle flexion movements and forward steps, conceptualized as approach behaviors, in response to photographs of full intensity facial expressions. In response to angry faces, avoidance behaviors are initiated faster than approach behaviors (Marsh et al., 2005; Rotteveel & Phaf, 2004; Seidel et al., 2010; cf. Wilkowski & Meier, 2010). Approach behaviors in response to happy faces are initiated faster than avoidance behaviors in response to happy faces and approach behaviors in response to angry faces (Rotteveel & Phaf, 2004; Seidel et al., 2010; Stins et al., 2011). In addition, one study had participants report how many steps they would take toward or away from a person displaying each of the facial expressions (Seidel et al., 2010). Participants' report of their behavioral tendencies was congruent with their automatic behavioral responses: they reported they would take more steps toward people displaying happy expressions and more steps away from people displaying angry expressions (Seidel et al., 2010). The response triggered by sad facial expressions appears more complex than those triggered by angry and happy facial expressions.

In response to sad expressions, participants initiated approach behaviors faster than avoidance behaviors; however, their reported behavioral tendencies indicated a preference to avoid those exhibiting sad facial expressions (i.e., more steps away; Seidel et al., 2010).

1.4 Social Information-processing and Children's Social and Psychological Adjustment

Discerning emotion from the facial expressions of others is a key component of encoding and interpreting cues in social situations and likely impacts whether a child chooses to initiate an interaction and whether, within an interaction, a child is inhibited in the expression of his or her thoughts and preferences. Indeed, kindergarteners were more hesitant to pursue a toy after perceiving aggression in a playmate than when the playmate displayed nondistressed affect (Camras, 1977). The reformulated social information-processing model (SIP) provides a framework for understanding how encoding and interpretation of social and situational cues influence children's interpersonal behaviors (Crick & Dodge, 1994). The model comprises six steps (see Figure 1): (1) encoding of cues, (2) interpretation of cues, (3) clarification of goals, (4) response access or construction, (5) response decision, and (6) behavior enactment. Steps 1 and 2 refer to the encoding and interpretation of internal and situational cues, for example misidentifying a neutral facial expression as angry. Steps 4 through 6 involve the generation and evaluation of possible responses and the selection and enactment of a behavioral response, for example avoiding interaction or acquiescing to a peer's request. Additionally, the child's enacted behavior will influence a peer's response, which will affect the child's subsequent encoding of cues and continued cycle of social-information processing (Lemerise & Arsenio, 2000; see Figure 1). This model explains how negatively biased facial affect discernment may prompt the selection and enactment of socially inhibited behaviors.

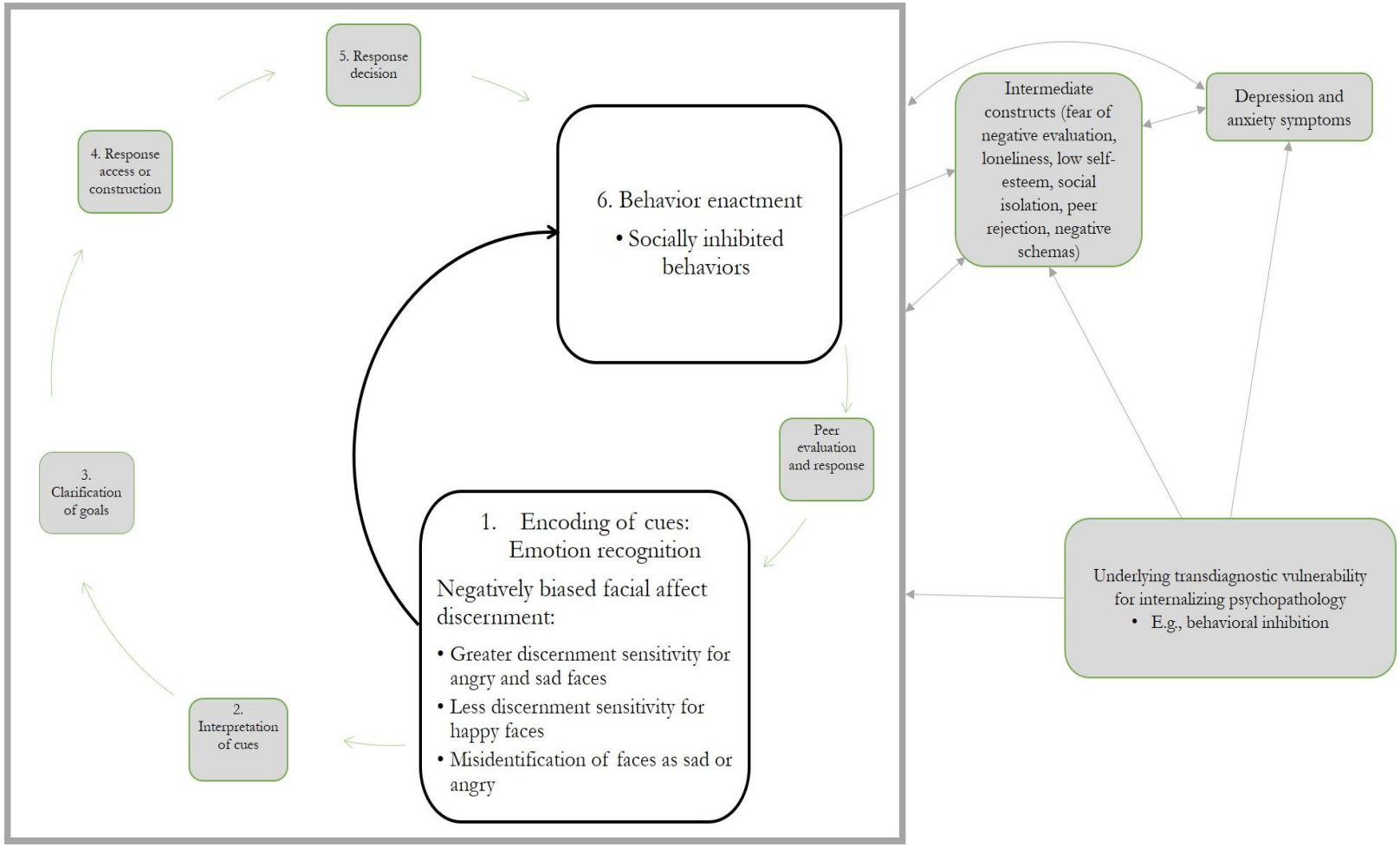

Figure 1.1 Model showing the hypothesized associations between negatively biased facial affect discernment and socially inhibited behavior within a framework of children's social-information processing and developmental psychopathology.

The SIP model is largely based on and has been applied to research on precipitants of aggressive behavior. For example, hostile intent attribution biases precede and exacerbate aggressive social behavior (Crick & Dodge, 1994; De Castro, Veerman, Koops, Bosch, & Monshouwer, 2002; Dodge, Laird, Lochman, & Zelli, 2002), lower discernment accuracy for sad facial affect is associated with higher levels of antisocial behaviors in adolescents (Blair & Coles, 2000), and adolescents with high levels of psychopathic tendencies demonstrate less discernment sensitivity for sad expressions (Blair, Colledge, Murray, & Mitchell, 2001). The few applications of SIP to internalizing problems have yielded evidence of internal and external causal attributions and hostile intent attributions for negative social events and avoidant behavior (e.g., Bell et al., 2009; Luebbe, Bell, Allwood, Swenson, & Early, 2010). For example, critical self-referent causal attributions for ambiguous peer scenarios were related to loneliness, peer rejection, and depression symptoms in kindergarteners and adolescents (Prinstein, Cheah, & Guyer, 2005).

Developmental models of psychopathology assume that social information processing biases (e.g., negatively biased facial affect discernment) shape social behaviors (e.g., socially inhibited behaviors), which then contribute to later development of psychopathology (e.g., Dodge, 1993). However, this assumed link between negatively biased facial affect discernment and social behaviors has not been tested empirically. Rather, studies have focused on how negatively biased facial affect discernment relates directly to internalizing psychopathology.

There is some general evidence to suggest that individuals with internalizing psychopathology exhibit negatively biased facial affect discernment compared to healthy controls. However, findings have been mixed. Some studies have found that, compared to healthy controls who may demonstrate a bias to misidentify facial expressions as happy

(Schepman, Taylor, Collishaw, & Fombonne, 2012), individuals currently experiencing clinically significant mood symptoms and related impairment demonstrate misidentification of facial expressions as negative (typically angry or sad; e.g., Jenness et al., 2015; Schepman et al., 2012). In addition to misidentification, there is some evidence to suggest that individuals with mood and anxiety diagnoses demonstrate greater sensitivity to discern anger and sadness in facial expressions (Joormann & Gotlib, 2006; van Beek & Dubas, 2008) and less sensitivity to discern happiness in facial expression (Joormann & Gotlib, 2006; Simonian, Beidel, Turner, Berkes, & Long, 2001; van Beek & Dubas, 2008; Yoon, Joormann, & Gotlib, 2009) than individuals who do not currently meet criteria for mood or anxiety disorder diagnoses. However, not all studies have found evidence of such biases in individuals with diagnoses of depression and anxiety (e.g., Guyer et al., 2007) and among studies that do find biases, there is some inconsistency regarding the type of bias—misidentification or discernment sensitivity, the specific negative emotion that is preferentially perceived, for example anger or sadness, and whether the specific bias is found in individuals with depression, social anxiety, or both.

In addition to these studies examining negatively biased facial affect discernment in relation to internalizing symptoms and diagnoses, one study of 7-13 year-olds found that young boys at risk for depression by virtue of parental depression display greater discernment sensitivity for sadness than their low risk counterparts (Lopez-Duran, Kuhlman, George, & Kovacs, 2013). This suggests that negatively biased facial affect discernment is not simply a correlate of current internalizing psychopathology, but may represent an early marker of risk for internalizing symptoms. Thus, there appear to be patterns of social information-processing biases related to internalizing psychopathology. Although cognitive-behavioral models of psychopathology typically posit social behavior as an intermediary step between emotion

processing biases and internalizing problems (e.g., Disner, Beevers, Haigh, & Beck, 2011), no research has examined whether negatively biased facial affect discernment is related to social behavior in children.

1.5 Socially Inhibited Behavior

Negatively biased facial affect discernment may increase socially inhibited behaviors, serving as an initial step in the process whereby negatively biased facial affect discernment contributes to the development and maintenance of depression and anxiety. Indeed, overactivation of the behavioral inhibition system relative to the behavioral approach system is posited to underlie internalizing psychopathology (Gray, 1987; Kimbrel, Mitchell, & Nelson-Gray, 2010; Muris, Meesters, de Kanter, & Timmerman, 2005). Although social interactions comprise more complex behaviors than just the basic approach and avoidance body movements investigated in the studies discussed above, tendencies to respond to social stimuli with basic approach or avoidance may underlie more complex *socially inhibited behaviors.*

Socially inhibited behaviors include hovering rather than entering peer groups, avoiding initiation of social interactions, taking a long time to respond to others, and speaking less frequently, particularly with unfamiliar people or in novel contexts (Rubin & Asendorpf, 2014; Rubin, Coplan, & Bowker, 2009). These behaviors are passive in nature, meaning the child fails to express and advocate his or her feelings and beliefs (Deluty, 1981). For example, a child might yield to a friend's request without stating his/her own preference or fail to object when a peer takes an item from the child. Research into precipitants of socially inhibited behavior has focused on broadly defined temperament factors (e.g., behavioral inhibition; Hirshfeld-Becker et al., 2007), biological factors (e.g., frontal EEG asymmetry, cardiac vagal tone; Henderson, Marshall, Fox, & Rubin, 2004; Rubin, Hastings, Stewart, Henderson, & Chen, 1997), early

attachment relationships with caregivers (Calkins & Fox, 1992), and parenting behaviors (e.g., overcontrol; Degnan, Henderson, Fox, & Rubin, 2008). However, these constructs do not fully explain variance in socially inhibited behavior; for example, effect sizes for behavioral inhibition predicting socially inhibited behaviors are generally small to moderate (e.g., Rubin, Burgess, & Hastings, 2002) and there is evidence that these associations are, in fact, moderated by attention bias to angry faces. Early behavioral inhibition was positively related to later social withdrawal only for those youths who demonstrated attention bias to angry facial expressions (Pérez-Edgar et al., 2010; Pérez-Edgar et al., 2011). Surprisingly, despite the salience of facial expressions in social interactions, no research to date has investigated the association between discernment of emotion from facial expressions and socially inhibited behavior in children.

High discernment sensitivity for anger may prompt socially inhibited behaviors, eliciting negative evaluations from others (see Figure 1; e.g., Boivin, Hymel, & Bukowski, 1995; Schwartz, Dodge, & Coie, 1993), and thereby exacerbating fear of negative evaluation and consequently raising social anxiety symptoms to clinical levels. Socially inhibited behaviors may reduce opportunities for positive social interactions and feedback, thus reinforcing internal, stable attributions of interpersonal ineffectiveness posited to contribute to depression (Gladstone & Kaslow, 1995; Joiner & Wagner, 1995; Rudolph, Flynn, & Abaied, 2008). Additionally, interpersonal models of depression suggest that poor quality social relationships and deficient social skills contribute directly to depression (Rudolph, Hammen, & Burge, 1994). Indeed, socially inhibited behaviors are associated with loneliness, low self-esteem, social isolation (Boivin et al., 1995; Hymel, Bowker, & Woody, 1993; Renshaw & Brown, 1993; Rubin, Hymel, & Mills, 1989), and peer rejection and victimization (Boivin et al., 1995; Schwartz et al., 1993), and these social constructs contribute to future anxiety and depression symptoms (Boivin et al.,

1995; Lee & Hankin, 2009; Orvaschel, Beeferman, & Kabacoff, 1997; Sowislo & Orth, 2013; Vernberg, Abwender, Ewell, & Beery, 1992).

Peer relationships gain importance (Rubin, Bukowski, & Parker, 2006), children's social independence increases (Lancy & Grove, 2011), and social evaluative fear increases (Ollendick, King, & Frary, 1989) during middle childhood, which make it a particularly pertinent period for investigating potential precipitants of socially inhibited behavior. Additionally, during middle childhood children become increasingly aware that socially inhibited behaviors violate social norms (Rubin, Hymel, & Mills, 1989), and thus socially inhibited children experience escalating levels of peer victimization and rejection (Rubin, Hymel, Lemare, & Rowden, 1989). Socially inhibited behaviors decrease opportunities for the continued development of age-appropriate social skills (Asendorpf & Meier, 1993) thereby increasing the likelihood that social skill deficits may develop or worsen. Accordingly, models of psychopathology suggest maladaptive social behaviors emerge prior to clinically significant symptoms (Dodge, 1993), and indeed, middle childhood occurs just prior to increases in the rates of social anxiety in late childhood and early adolescence (Schneier, Johnson, Hornig, Liebowitz, & Weissman, 1992) and depression in adolescence (Thapar, Collishaw, Pine, & Thapar, 2012).

Indeed, many psychological interventions for children with depression and anxiety include social skills components (Asarnow, Scott, & Mintz, 2002; Spence, 2003; Spence, Donovan, & Brechman-Toussaint, 2000) that target socially inhibited behavior; for example, children are taught how to respond assertively, initiate friendships, and join in activities with peers (Spence et al., 2000). Behavioral exposure tasks that target social avoidance are active components of cognitive behavioral therapy approaches for treating social anxiety in children (Kendall et al., 2006). Interpretation bias modification paradigms have been developed to reduce

symptoms of anxiety and depression by altering negatively biased interpretation of ambiguous situations (e.g., Grinspan, Hemphill, & Nowicki 2003; Holmes, Lang, & Shah, 2009; Vassilopoulos, Banerjee, & Prantzalou, 2009). However, the results of some studies have been less encouraging (e.g., LeMoult et al., 2017) perhaps suggesting a need to better understand the exact nature of interpretation biases and potential mediating variables that may evidence change before clinical symptoms.

Insight into the relation between negatively biased facial affect discernment and socially inhibited behavior would allow for enhancing and tailoring prevention approaches for internalizing problems during this crucial period in social development just prior to the increases in depression and social anxiety seen in late childhood and adolescence (Schneier et al., 1992; Thapar et al., 2012). For example, improved assessment of subtle aspects of facial expression processing skills may aid in the identification of children at risk for internalizing problems and interpretation bias modification interventions focused on ameliorating negatively biased facial affect discernment may improve the effectiveness of these interventions. Additionally, given that parents and teachers have been found to be poor reporters of children's internalizing symptoms (e.g., Comer & Kendall, 2004), utilizing measures of social behaviors, which may be reported with greater accuracy, would prompt more accurate and timely intervention.

1.6 Overview of Study

1.6.1 Summary and hypotheses.

Some evidence supports age-related increases in discernment accuracy that appear to parallel important developmental shifts in social behaviors and emerging risk for psychopathology during middle childhood. However, existing studies of facial affect discernment accuracy in children and adolescents have utilized samples with wide age ranges

(e.g., Jenness et al., 2015; Montirosso et al., 2010) that preclude the characterization of discernment accuracy for discrete emotions at low, medium, and high intensities in middle childhood. Therefore, the first aim of the study is to compare accuracies of happy, sad, and angry facial expression identification across low, medium, and high intensities in middle childhood to characterize typical discernment accuracy during this developmental period. Evidence suggests that discernment accuracy improves with expression intensity such that little room for improvement of happiness discernment exists after medium intensities, but that even at high intensities discernment accuracy for sad and angry expressions is poorer than for happy expressions (Jenness et al., 2015; Montirosso et al., 2010). The first hypothesis is that (1a) at low intensities, discernment accuracy for happy expressions will be significantly better than accuracy for sad and angry expressions, which will not differ significantly; (1b) at medium intensities, discernment accuracy for happy expressions will be significantly better than accuracy for sad and angry expressions and discernment accuracy for angry expressions will be significantly better than accuracy for sad expressions; and (1c) similarly to hypothesis 1b, at high intensities, discernment accuracy for happy expressions will be significantly better than accuracy for sad and angry expressions and discernment accuracy for angry expressions will be significantly better than accuracy for sad expressions (Jenness et al., 2015). Based on accuracy means reported in previous studies (e.g., Montirosso et al., 2010; Jenness et al., 2015), the second hypothesis is that (2a) discernment accuracy for happy expressions will be significantly better with greater intensity from low to medium (i.e., around 50% of the full intensity) intensities but will not improve significantly from medium and high intensities i.e., a negative quadratic association, specifically a decelerating positive rate of change, (2b) accuracy for sad identification will be significantly better with greater intensity from low to medium to high

intensities i.e., positive linear change, and (2c) accuracy for angry identification will be significantly better with greater intensity from low to medium to high intensities i.e., positive linear change. Characterizing normative levels of discernment accuracy for each of the emotions during middle childhood would improve the identification of deviant emotion processing at a stage when intervention efforts may prove especially effective.

Studies demonstrate that angry facial expressions prompt avoidant muscle movements and self-reported behavioral tendencies, happy expressions prompt approach muscle movements and behavioral tendencies, and sad expressions prompt approach muscle movements but avoidant self-reported behavioral tendencies (e.g., Seidel et al., 2010; Stins et al., 2011). Given emotional expressions encountered during interpersonal interactions are often of less than full intensity, accurate discernment of more subtle emotional faces likely plays a critical role in the enactment of more elaborate interpersonal behaviors, such as initiating or avoiding a social interaction or responding passively or assertively to a conflict (Crick & Dodge, 1994). Socially inhibited behaviors are associated with peer rejection, loneliness, depression, and social anxiety (e.g., Boivin et al., 1995) and there is evidence that individuals with internalizing psychopathology demonstrate greater sensitivity to discern anger and sadness, less sensitivity to detect happiness, and tendencies to misidentify neutral or low intensity expressions as angry or sad (e.g., Jenness et al., 2015; Schepman et al., 2012; Yoon et al., 2009). However, no studies have examined what may serve as the first step in the process that leads from negative patterns of facial affect discernment to internalizing psychopathology, a step at which prevention efforts may be efficacious and help facilitate the development of satisfying peer relationships and social skills that are crucial for healthy socio-emotional development in middle childhood.

Thus, the second, exploratory aim of the study is to determine whether negatively biased facial affect discernment is related to more socially inhibited behaviors in middle childhood. Specifically, the third hypothesis is that (3a) more misidentifications of neutral and low intensity happy or angry faces as sad will be associated with more socially inhibited behaviors, (see Schepman et al., 2012 for depressed children misidentifying faces as sad) (3b) more misidentifications of neutral and low intensity happy or sad faces as angry will be associated with more socially inhibited behaviors (see Jenness et al., 2015 for depressed children misidentifying faces as angry), (3c) higher discernment sensitivity for happy faces will be associated with lower levels of socially inhibited behavior (see Joormann & Gotlib, 2006 for less discernment of happiness in depressed adults), (3d) higher discernment sensitivity for sad faces will be related to higher levels of socially inhibited behaviors (see Lopez-Duran et al., 2013 for greater discernment of sadness in boys at risk for depression), and (3e) higher discernment sensitivity for angry faces will be related to higher levels of socially inhibited behaviors (see Joormann & Gotlib, 2006 for greater discernment of anger in adults with social anxiety).

Methodological considerations.

In order to address both methodological issues of previous research as well as the specific theoretically informed hypotheses of the current study in a feasible manner, the parameters of the facial affect discernment task used in this study are as follows. First, the task will use a forced-choice labeling methodology rather than matching of stimuli. Second, in order to maximize ecological validity, photographs of facial expressions will be used instead of schematic drawings. Stimuli will be of varied expression intensity rather than prototypic single-intensity expressions. Discernment accuracy for anger and sadness may differ depending on whether expressed by a child or adult because of varied exposure. For example, non-parent adults typically restrain their

displays of anger and sadness in public and in front of children, whereas children may be less likely to do so. Children also endorse different display rules regarding the expression of anger and sadness (Zeman & Garber, 1996) may be more likely to experience and express anger than sadness in the context of peer interactions during middle childhood (Underwood, Coie, & Herbsman, 1992). Additionally, because of increased importance of peer relationships during middle childhood, discernment of peers' emotions is most relevant and informative when considering the potential impact of facial affect recognition social behaviors in middle childhood. Thus, although the majority of existing literature on facial affect discernment sensitivity has utilized adult faces (e.g., Jenness et al., 2015; Schepman et al., 2012), this study will utilize child faces. Third, in order to address research questions and maintain a feasible task length happy, sad, and angry facial expressions will be used as task stimuli in this study. Emotion labels will include happy, sad, angry, and neutral. Fourth, Wagner's unbiased hit rate, which takes into account both hit rate and identification errors discernment accuracy, will be used as a measure of discernment accuracy (Wagner, 1993). Thus, differences in discernment accuracy will indeed be due to emotion discrimination ability and not overuse of a particular emotion label, for example labeling all low intensity faces as 'happy.'

Theory and empirical evidence suggest that negative cognitive processes in response to a negative mood provocation (Taylor & Ingram, 1999) are most closely linked to maladaptive outcomes such as depression symptoms (Segal, Gemar, & Williams, 1999). Therefore, children underwent a negative mood induction prior to completing the facial affect discernment task. Socially inhibited behavior is putatively understood to result from conflicting high approach and high avoidance motivations and is conceptually and empirically distinct from social disinterest, which has been defined as a nonfearful preference for solitary activities e.g., playing alone

characterized by low approach and avoidance motivations (Coplan, Prakash, O'Neil, & Armer, 2004). Therefore, a measure of social disinterest will be included as a covariate in analyses in which socially inhibited behavior is the outcome variable.

2 EXPERIMENT

2.1 Participants

Eighty children (52.5% female) participated in this study. Participants had a mean age of 8 years 8 months (SD = 11.2 months; range = 86-131 months). The majority of the children in the sample came from two-parent households (72.5%). The ethnicity of the sample was as follows: 52.5% White not of Hispanic origin, 32.5% African-American, 11.3% biracial/multi-racial, 2.5% Hispanic, and 1.3% Asian-American. The median household income for the sample was $110,000. All caregivers who participated in the visit had completed high school and the majority of caregivers (80%) had at least a college degree.

2.1.1 Recruitment.

Participants were recruited by two methods. (a) Families who consented to being contacted about research participation and whose contact information is maintained in a Subject Pool Database by Georgia State University Department of Psychology faculty were contacted. Seventy-five participants were recruited by this method. (b) Advertisements providing a brief overview of the study and contact information were posted online (e.g., Craigslist) and at appropriate physical locations (e.g., libraries). Five participants were recruited by this method.

2.2 Measures

2.2.1 Demographic information.

Parents reported basic demographic information on a questionnaire developed for the study. Information gathered included child's age, sex, race, ethnicity, and household SES.

2.2.2 Social behavior rating scales.

Social disinterest.

Parents completed complete the *Child Social Preference Scale*, an 11-item parent-report measure of children's social preferences and behaviors (CSPS; Coplan et al., 2004). The *Child Social Preference Scale* yields two empirically derived subscales: Conflicted Shyness and Social Disinterest. The 4-item Social Disinterest subscale was used for this study. An example item is: "My child often seems content to play alone." Parents use a scale ranging from 1 (*not at all*) to 5 (*a lot*) to rate: "How much is your child like that?" for each item. The responses are summed; higher scores indicate more social disinterest. The Social Disinterest subscale has shown good internal consistency (α = .78-81; Coplan et al., 2004). Although the measure was initially validated for use with younger children (3-5 years old; Coplan et al., 2004), comparable psychometric properties (α = .79-80) have been obtained in a sample of 7-8 year olds (Coplan & Weeks, 2010). In the current study the Social Disinterest subscale showed good internal consistency (α = .82). It also has construct validity: children who reported they preferred to play alone or with a teacher rather than with a peer had higher scores on the Social Disinterest scale than children who reported they prefer to play with peers (Coplan et al., 2004), higher scores on the Social Disinterest scale were related to greater teacher-reported asocial behavior with peers and peer exclusion and lower levels of prosocial behavior (Coplan et al., 2004), and higher

mother-rated Social Disinterest scores were associated with higher teacher-rated Asocial Behavior scores (Coplan & Weeks, 2010). The Social Disinterest subscale was used as a covariate in Aim 2 analyses.

Social inhibition.

The *Social Competence Inventory* (SCI; Rydell, Hagekull, & Bohlin, 1997) is a 25-item parent-report measure of measure of children's social skills and behaviors and has been shown to have good psychometric properties in samples of children between the ages of 7-10 years. The SCI yields two empirically derived subscales: Prosocial Orientation and Social Initiative/Withdrawal. The 8-item Social Initiative/Withdrawal subscale was used in this study. Examples of items include: "Spectator while others play" and "Suggests activities to peers." Parents are instructed to consider the behavior of their child over the past three months and rate items using a scale ranging from 1 (*does not apply at all well*) to 5 (*applies very well*). Items are averaged; lower scores typically indicate higher levels of socially inhibited behavior. The Social Initiative/Withdrawal subscale has shown good internal consistency (α = .75 & .76) and good test-retest reliability over a period of one year (r = .79; Rydell et al., 1997). In this study the Social Initiative/Withdrawal subscale showed good internal consistency (α = .82). The Social Initiative/Withdrawal subscale has also shown discriminant validity; significant differences in subscale scores were found among children who were classified as popular, average, or rejected based on peer report of sociometric status (Rydell et al., 1997). Construct validity is indicated by an association between lower scores on the Social Initiative/Withdrawal subscale and more internalizing problems (Henricsson & Rydell, 2004). For ease of interpretation in this study, items scores were reflected, except for those items with reversed wording, and then averaged; thus, *higher* scores indicate higher levels of socially inhibited behavior.

2.2.3 Facial affect discernment.

Children completed a facial affect discernment task that was modeled on tasks used in previous research (e.g., Gibb, Schofield, & Coles, 2008; Jenness et al., 2015). This task yielded one index of facial affect discernment accuracy and two indices of negatively biased facial affect discernment: discernment sensitivity and misidentification bias. All three indices were calculated separately for each emotion (happy, sad, and angry).

Facial affect stimuli.

Color photographs of 8 children (4 male: 4 White, 4 female: 3 White, 1 Black) expressing neutral, happy, sad, and angry facial expressions were drawn from two standardized stimulus sets of children portraying various emotional expressions: the National Institute of Mental Health Child Emotional Faces Picture Set (NIMH—ChEFS; Egger et al., 2011) and the Child Affective Facial Expression (CAFE) set (LoBue & Thrasher, 2014). The photographs chosen were of children aged 5-14 years. The two sets of stimuli had been rated according to two different systems (see Egger et al., 2011; LoBue & Thrasher, 2014 for details). However, both sets did have adults identify the emotion expressed in each photograph using a forced-choice task. The percentage of the norming sample that correctly identified the target emotion of a photograph was was considered when selecting stimuli. Models with ratings of > 80% for each of the four expressions included in this study (neutral, happy, sad, and angry) were chosen. However, for the five models pulled from the NIMH-ChEFS stimuli set, mean intensity ratings among the three emotion expressions (happy, sad, and angry) did not differ significantly, $F(2, 12) = .14$, $p = .87$. Unfortunately the CAFE stimuli set did not provide ratings of the intensity of expression so expression intensity of the three models from the CAFE set is unknown.

Task stimuli were created using WinMorph software Version 3.01 (Kumar, 2002) to morph photographs of each model displaying a neutral facial expression into a photograph of the model displaying a full intensity emotional expression (happy, angry, sad) in 10% increments (e.g., 10% neutral/90% angry; 70% neutral/30% happy) resulting in nine morphed photographs for each model for each emotional expression (happy, angry, sad) as well as a photograph of each model displaying each "pure" expression (neutral, happy, angry, sad) at 100% intensity for a total of 248 photographs (see Figure 2.1 for a schematic). Adobe Photoshop software was used to edit details of morphed stimuli in order to increase quality (e.g., whiten teeth to more closely match the original photograph).

Facial affect discernment task.

The task was presented using E-Prime software Version 2.0 (Psychology Software Tools, 2013) on a Dell computer with a 17" monitor. Participants were seated approximately 50 centimeters from the screen. Instructions were presented on the screen as the researcher explained the task using a script. Each trial began with a fixation cross displayed in the center of the screen for 500ms followed by a black screen for 500ms. Next, a morphed face stimulus appeared in the center of the screen, 5 inches by 7 inches. The participant used a marked key on the computer keyboard to indicate whether the emotional expression was neutral, happy, sad, or angry. The task advanced to the next trial after the participant's response. See Figure 3 for a schematic of the task sequence. For each trial, the child's response and latency to respond (reaction time) were recorded. Before beginning the task, participants completed 4 practice trials with photographs of models not included in the experimental task. The task was presented in two blocks of 124

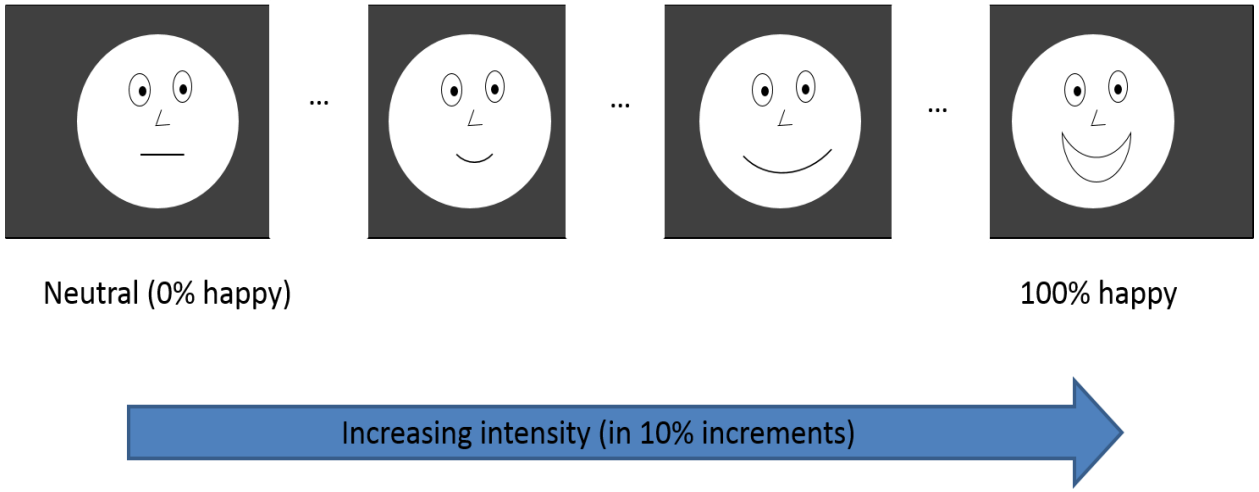

Figure 2.1 Schematic of morphed of facial stimuli.

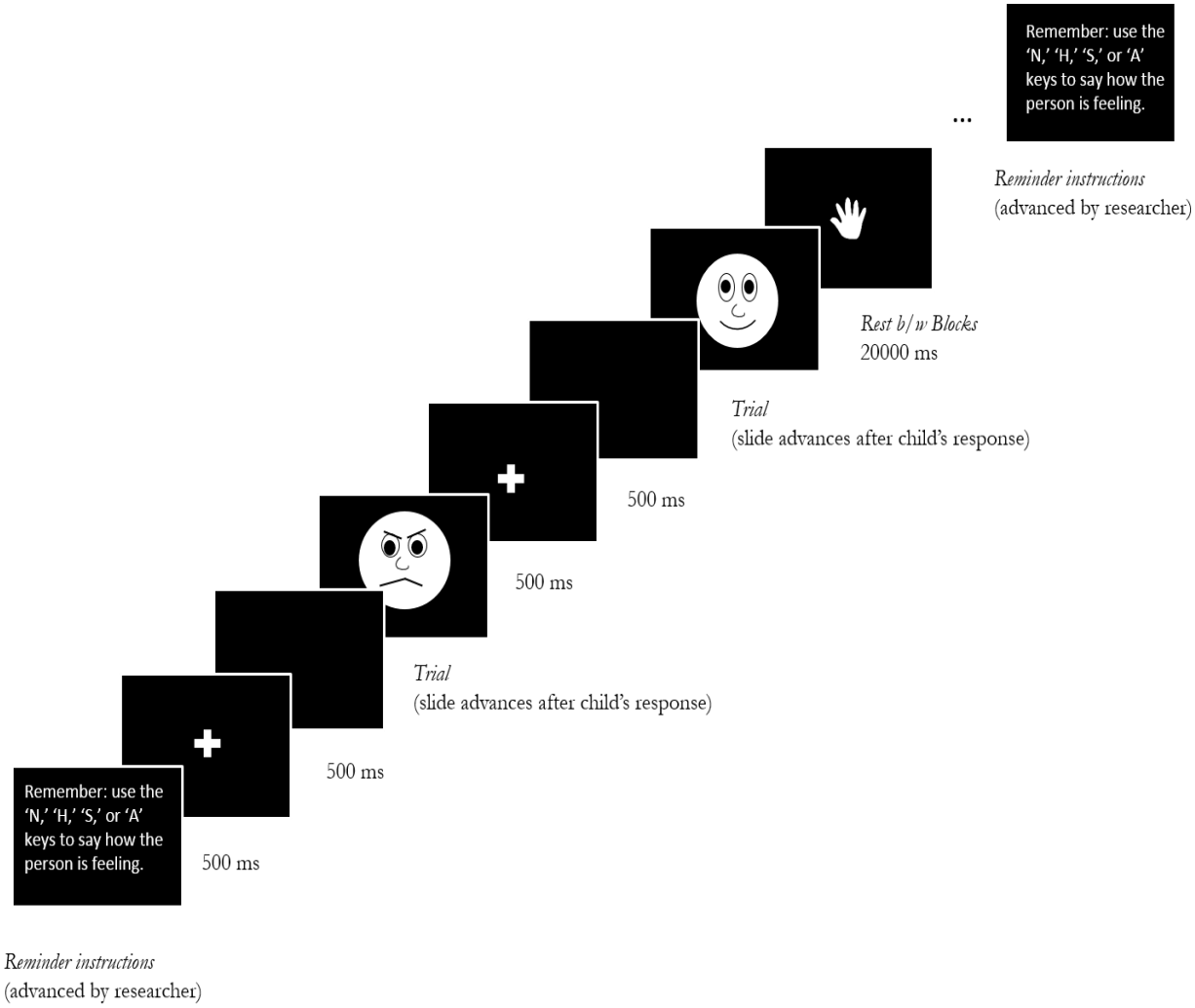

Figure 2.2 Schematic of facial affect discernment task.

stimuli each with stimuli presented in random order without replacement within each block so that each of the 248 stimuli was presented once. The presentation order of the two blocks was also randomly determined. The task took approximately 20 minutes to complete.

Discernment accuracy.

The *unbiased hit rate* ($\boldsymbol{H_u}$) proposed by Wagner (1993) to be "an estimate of the joint probability both that a stimulus is correctly identified (given that it is presented) and that a response is correctly used (given that it is used)" (p. 16) was calculated as an index of discernment accuracy to avoid undue influence of a labeling bias. Thus, differences among discernment accuracy scores for the three emotions may be correctly interpreted as differences due to emotion discrimination ability and not the overuse of a particular emotion label, for example labeling all low intensity faces as 'happy.'

The unbiased hit rate was calculated at each intensity level (10-90%) separately for each emotion according to the following equation:

$$\boldsymbol{H_u} = \frac{\boldsymbol{h}}{\boldsymbol{h} + \boldsymbol{s_1} + \boldsymbol{a_1}} \text{ x } \frac{\boldsymbol{h}}{\boldsymbol{h} + \boldsymbol{s_2} + \boldsymbol{a_2}}$$

where, for a certain target emotion e.g., happy, $\boldsymbol{h}$ represents the number of trials correctly identified as happy; $\boldsymbol{s_1}$ represents the number of happy faces identified as sad, and $\boldsymbol{a_1}$ represents the number of happy faces identified as angry; and $\boldsymbol{s_2}$ represents the number of sad faces identified as happy, and $\boldsymbol{a_2}$ represents the number of angry faces identified as happy. This yielded nine continuous discernment accuracy scores that have a potential range of 0 to 1 for each of the three emotions (happy, sad, and angry). These scores were used to test Hypotheses 2a, 2b, and 2c. Discernment accuracy scores for each emotion were also averaged at low (10-30%), medium (40-60%), and high (70-90%) intensities for use in Hypotheses 1a, 1b, and 1c i.e., three scores for each of the three emotions.

Misidentification bias.

False alarm trials are trials in which the participant identifies the emotional expression on the face as an emotion other than the target emotion. *False alarm* trials include identification of subtle emotional expressions that are more neutral than emotive, e.g., 10% expressiveness. The proportion of false alarms, i.e., the number of false alarm trials divided by the total number of nontarget emotion trials (***F***; Wagner, 1993) was calculated from low (10-30%) intensity emotion and neutral trials separately for each emotion (happy, sad, and angry). This yielded three (happy, sad, and angry) misidentification bias scores on a continuous scale that have a potential range of 0 to 1.

Discernment sensitivity.

Discernment sensitivity is defined as the ability to accurately discern emotion at low intensities; therefore, discernment accuracy averaged across low (10-30%) intensities was used as an index of discernment sensitivity in line with previous studies (e.g., Jenness et al., 2015). Discernment sensitivity was calculated for each emotion separately (happy, sad, and angry).

2.3 Procedure

Children and their parent underwent assent and consent procedures. They were then shown to an adjacent room where the child completed the study procedure. When the child appeared reasonably comfortable with the researcher and setting, parents returned to the first room to complete rating scales and were able to view their child on a television monitor throughout the visit. Children completed a number of tasks not reported on in this study. Then children underwent a negative mood induction and completed the facial affect discernment task. Upon completion of the study procedure, children chose a small gift (value < $5) before rejoining their parent and leaving the laboratory. Each visit lasted approximately 90 minutes.

2.3.1 Mood induction.

Children viewed a negative film clip approximately 3 minutes long (from the film *Stepmom* as used in Joormann, Gilbert, & Gotlib, 2010). After viewing the clip, children were asked to imagine how they might feel in such a situation (Joormann et al., 2010).

2.3.2 Covariates.

Sex has been shown to have a small but significant effect on discernment accuracy for facial affect across childhood (e.g., Mancini et al., 2013; McClure, 2000; Montirosso et al., 2010); however, some studies suggest this effect may be minimal in middle childhood (e.g., Gao & Maurer, 2009, 2010). Although the age range of this study will span only 4 years, some studies have shown age-related improvements in discernment of facial affect across smaller increments in middle childhood (Montirosso et al., 2010). There is some evidence to indicate that emotion recognition is poorer when the perceiver and expresser are of different racial groups and that this effect is lessened when the perceiver has greater exposure to the group of the expresser (e.g., Elfenbein & Ambady, 2002). Thus, children's race may impact their discernment accuracy scores, particularly for the identification of faces that are of a different race than the child's. For example, African American children made significantly more mistakes in the identification of high and low intensity White child faces than did White children (Collins & Nowicki, 2001) and White children made errors for the discernment of specific emotions when presented with White and non-White faces (Gosselin & Larocque, 2000). Therefore, the significance and effect size of associations among sex, age, and child's race and dependent variables were used to guide decisions of inclusion or exclusion of sex, age, and/or child's race as covariates in analyses of Aim 1. As discussed above, research indicates that distinguishing

causes of socially inhibited behavior from social disinterest is important (Coplan et al., 2004) and thus, social disinterest included as a covariate in analyses of the exploratory second aim.

3 RESULTS

3.1 Data Preparation

All analyses were conducted using the statistical package PASW (PASW Statistics 22, Release Version 22.0.0; SPSS, Inc., 2009, Chicago, IL, www.spss.com).

3.1.1 Data cleaning.

The Social Initiative/Withdrawal subscale items and the Social Disinterest subscale items were averaged separately, prorated for missing items, to constitute scores of Socially Inhibited Behavior and Social Disinterest, respectively. Three children were excluded from Aim 2 analyses because more than 2 items (25%) were missing from the socially inhibited behavior scale.

3.1.2 Reducing facial affect discernment data.

Consistent with previous facial affect processing research (e.g., Bradley, Mogg, White, Groom, & Bono, 1999), response latencies of less than 200 ms were considered to be outside the window of conscious responding, and thus an anticipatory response or an 'overflow' response from the previous trial rather than a true response. However, no trial response latencies of less than 200 ms were found in the data. Children in this study were not expected to demonstrate gross deficits in the identification of high intensity emotional expressions. Therefore, we assumed that less than 75% accuracy in identification of 90% intensity expressions across happy, sad, and angry trials was indicative of insufficient engagement in the task (Gibb et al., 2008).

This resulted in one child being excluded from analyses (62.50 % average discernment accuracy across 90% intensity happy, sad, and angry trials).[1]

3.2 Descriptives

Means, standard deviations, and ranges for continuous variables are presented in Table 3.1. The means for discernment accuracy for each emotion followed the expected pattern of being larger with higher intensity. For all three emotions, the range of discernment accuracy scores started with zero indicating that some children did not identify any low intensity expressions as the target emotion. The upper end of the range of discernment accuracy scores for high intensity expressions was 3.14 for all three emotions, which indicates that some children demonstrated perfect accuracy identifying high intensity expressions as the target emotion. The means and range of Social Disinterest scores were comparable to those observed in a study validating the use of the CSPS in middle childhood (*M* = 2.5; range = 1-4.75; Coplan & Weeks, 2010). In this study, children with Social Disinterest scores greater than 1 SD above the mean and Shyness scores less than 1 SD above the mean were classified as 'unsociable;' approximately 12% of the sample was classified as such. In the current sample, a comparable 10% of children met criteria for classification as 'unsociable.' For the Social Initiative/Withdrawal scale, the means and range were also similar to a previous study (*M* = 3.86; range = 1-5; Henricsson & Rydell, 2004). Correlations between continuous variables are displayed in Table 3.2 and are discussed below. For each emotion discernment accuracy of low intensity expressions was positively correlated with medium intensity expressions and discernment accuracy for medium intensity expressions was positively correlated with high intensity expressions, but discernment accuracies for low intensity and high intensity expressions

[1] Results of hypothesis-testing analyses do not differ whether this participant is included or omitted.

Table 3.1 *Descriptive Statistics of Continuous Variables: Means, Standard Deviations, and Ranges*

Variable	*M* (SD)	Range
MisID as Sad	.22 (.21)	0-.92
MisID as Angry	.36 (.26)	0-.78.
Social Inhibition	2.20 (.59)	1-3.63
Social Disinterest	9.97 (3.32)	4-18

	Low Intensity		Medium Intensity		High Intensity	
	M (SD)	Range	*M* (SD)	Range	*M* (SD)	Range
Happy Accuracy	.75 (.31)	0-1.40	2.09 (.33)	1.06-2.73	2.75 (.35)	2.03-3.14
Sad Accuracy	.70 (.34)	0-1.80	1.74 (.32)	.79-2.73	2.37 (.44)	1.41-3.14
Angry Accuracy	.46 (.30)	.00-1.05	1.89 (.35)	.99-2.56	2.55 (.43)	1.57-3.14

Note.
Low Intensity = facial expressions of 10%, 20%, and 30% emotion intensity; Medium Intensity = facial expressions of 40%, 50%, and 60% emotion intensity; High Intensity = facial expressions of 70%, 80%, and 90% emotion intensity. MisID as Sad = Proportion of Neutral trials and 10%, 20%, and 30% Happy and Angry trials identified as Sad. MisID as Angry = Proportion of Neutral trials and 10%, 20%, and 30% Happy and Sad trials identified as Angry. Accuracy = Wagner's unbiased hit-rate, arcsine transformed.

Table 3.2 *Correlations between Continuous Variables*

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
1. Age													
2. Happy Accuracy (Low)	.11	-											
3. Happy Accuracy (Medium)	-.05	.39**	-										
4. Happy Accuracy (High)	-.05	-.09	.36**	-									
5. Sad Accuracy (Low)	.09	.14	.16	.12	-								
6. Sad Accuracy (Medium)	-.12	.17	.34**	.40**	.54**	-							
7. Sad Accuracy (High)	-.01	-.09	.22	.54**	.29**	.56**	-						
8.Angry Accuracy (Low)	-.06	.11	.24*	.27*	.32**	.37**	.15	-					
9. Angry Accuracy (Medium)	-.08	-.01	.32**	.50**	.18	.56**	.56**	.52**	-				
10. Angry Accuracy (High)	-.07	-.04	.17	.54**	.21	.45**	.69**	.18	.60**	-			
11. MisID as Sad	.02	.42**	.21	-.03	.28**	.22	.05	.15	.04	-.06	-		
12. MisID as Angry	.04	.37**	.15	.07	.20	.06	-.09	.14	-.03	-.17	.43**	-	
13. Social Inhibition	-.03	-.06	.04	.15	.10	.29**	.21	.00	.25*	.15	.16	-.07	-
14. Social Disinterest	.17	-.11	-.08	-.09	.07	.05	-.03	-.07	-.14	-.04	-.03	-.09	.04

Note.
*$p < .05$, two-tailed. ** $p < .01$, two-tailed.
Low = facial expressions of 10%, 20%, and 30% emotion intensity; Medium = facial expressions of 40%, 50%, and 60% emotion intensity; High = facial expressions of 70%, 80%, and 90% emotion intensity. MisID as Sad = Proportion of Neutral trials and 10%, 20%, and 30% Happy and Angry trials identified as Sad. MisID as Angry = Proportion of Neutral trials and 10%, 20%, and 30% Happy and Sad trials identified as Angry.

were correlated only for sadness. Misidentification as sad and angry are positively correlated; social inhibition and disinterest are not. In fact, social inhibition was only correlated (positively) with discernment accuracies for medium intensity sad and angry faces.

3.2.1 Child's age.

Participants' age was not significantly correlated with discernment accuracy variables, discernment sensitivity variables, misidentification bias variables, social disinterest or social inhibition (all *p*s > .10). Thus, because correlations with measures of accuracy were nonsignificant and generally small in size, all *r*s< .18 in magnitude, age was not included as a covariate in Aim 1 analyses.

3.2.2 Child's gender.

To examine differences in continuous study variables by gender, 14 *t*-tests were run. Girls and boys did not differ on mean levels of socially inhibited behavior, $t(76) = -.87$, $p = .39$, $d = .18$, social disinterest, $t(76) = .94$, $p = .38$, $d = .21$, or age, $t(77) = 1.26$, $p = .23$, $d = .28$. Girls and boys did not differ on mean levels of most discernment accuracy and misidentification bias variables with the exception that girls' mean levels of discernment accuracy were greater than boys' for Happy Accuracy (High Intensity), $t(77) = -2.60$, $p = .01$, $d = -.59$, and Sad Accuracy (Medium Intensity), $t(77) = -2.38$, $p = .02$, $d = -.54$. Thus, gender was included as a covariate in Aim 1 analyses.

3.2.3 Child's race/ethnicity.

Due to the low number of children in the race/ethnicity groups of Asian (1 child), Hispanic (2 children), and biracial/multi-racial (9 children), these groups were combined into one group that will be referred to as 'Other' for the purposes of analyses. To examine differences in continuous study variables by race/ethnicity, 14 one-way ANOVAs were run. Race/ethnicity

groups did not differ significantly in age, $F(2, 76) = 1.52$, $p = .23$, $n^2 = .06$, social inhibition scores, $F(2, 74) = .08$, $p = .80$, $n^2 < .01$, or social disinterest scores, $F(2, 74) = 1.55$, $p = .22$, $n^2 = .04$.

Most discernment accuracy and misidentification variables did not vary significantly as a function of race/ethnicity (ps > .07; n^2s < .07). However, Sad Accuracy (Low Intensity) $F(2, 76) = 6.27$, $p = .003$, $n^2 = .13$, and Angry Accuracy (High Intensity) $F(2, 76) = 4.38$, $p = .02$, $n^2 = .10$, did vary significantly. Post-hoc contrasts indicated that White/Non-Hispanic children had significantly better discernment accuracy for sad expressions of low intensity and angry expressions of high intensity compared to Black/African American children and children in the 'Other' group. Thus, race was included as a covariate in Aim 1 analyses.

3.2.4 Child's social preferences.

Although social disinterest and social inhibition were not significantly correlated, social disinterest was retained as covariate in Aim 2 analyses for its theoretical importance.

3.3 Data Analysis

3.3.1 Statistical approaches.

Aim 1. The distributions of the discernment accuracy variables, the dependent variables for Aim 1 analyses, were examined using visual inspection of histograms and the Kolmorgorov-Smirnov test of normality. The distributions of many of these variables were significantly different from the normal distribution due to significant skew and kurtosis. The discernment accuracy variables, which are proportions, were arcsine transformed as recommended by Wagner (Wagner, 1993). However, the significant skew and kurtosis was not adequately addressed by this transformation. Therefore, repeated-measures ANOVAs, which presume normal distribution of the dependent variable, are not an appropriate statistical approach.

Generalized estimating equations (GEEs) provide an appropriate statistical approach because they produce efficient and unbiased regression estimates for the analysis of repeated-measures designs with non-normally distributed dependent variables (Ballinger, 2004; Liang & Zeger, 1986; Zeger & Liang, 1986). The Tweedie distribution was chosen because it combines properties of continuous and discrete distributions (SPSS manual). The identity link function was chosen because it can be used with the Tweedie distribution and does not require transformation of the coefficients for interpretation. The type of correlation matrices specified for Hypothesis 1 and Hypothesis 2 are reported below. However, regardless of the type of correlation, GEE models are robust to misspecification of the correlations structure (Zeger & Liang, 1986).

Hypotheses 1a-c were addressed using separate Generalized Estimating Equation models at low, medium, and high intensity with discernment accuracy as the dependent variables and emotion type as 3-level (happy, sad, and angry) within-subjects independent variables. The unstructured correlation matrix was chosen because no specific pattern of correlation was predicted (Ballinger, 2004). Gender and race were included as covariates. Pairwise planned contrasts were used to compare discernment accuracies for happy, sad, and angry faces. The Bonferroni correction was used to adjust *p*-values and control for Type I error due to the multiple contrasts being performed.

Hypotheses 2a-c were addressed using separate Generalized Estimating Equation models for each emotion and with discernment accuracy for facial expressions as the dependent variables and expression intensity as a 9-level (10% increments from 10% through 90%) within-subjects independent variable. The autoregressive correlation matrix was chosen because accuracies for intensity levels close together (e.g., sad discernment accuracy at 20% and 30%)

were thought to be greater than accuracies for intensity levels farther apart (e.g., sad discernment accuracy at 10% and 60%). Gender and race were included as covariates. Polynomial contrasts were used to ascertain the best-fitting associations. The Bonferroni correction was used to adjust *p*-values and control Type I error due to the multiple contrasts being performed. Polynomial effects were interpreted to the highest order that accounted for significant additional variance.

Aim 2 (exploratory). The distribution of socially inhibited behavior, the dependent variable for Aim 2 analyses, was examined using visual inspection and the Kolmorgorov-Smirnov test of normality. Socially inhibited behavior did not differ significantly from a normal distribution. Hypotheses 3a-e were tested using 4 separate multiple linear regressions with social disinterest as a covariate and socially inhibited behavior as the dependent variable. Risk of multicollinearity resulting from common terms comprising the different facial affect variables guided decisions about which independent variables would be tested together. Specifically, hypotheses 3a and 3b were tested using one regression model that included misidentification as sad and misidentification as angry as two independent variables entered in the second step of the model. Hypothesis 3c was tested with one regression model in which discernment accuracy for low intensity happy expressions was the lone independent variable entered in the second step. Hypothesis 3d was tested with one regression model in which discernment accuracy for low intensity sad expressions was entered as an independent variable in the second step of the model. Due to the significant correlation between socially inhibited behavior and discernment accuracy for medium intensity sad faces, discernment accuracy for medium intensity sad expressions was included as an additional independent variable in the second step of the model. Similarly, hypothesis 3e was tested with one regression model in which discernment accuracy for low

intensity angry expressions and discernment accuracy for medium intensity angry faces was entered as an independent variable in the second step of the model.

3.3.2 Testing of GEE assumptions.

Generalized estimating equations assume that observations between clusters are not related i.e., there is no higher level clustering mechanism. The residuals of each GEE model were plotted separately by date of visit (an indication of temporal sequence of data collection) and recruitment source. No patterns were apparent. Generalized estimating equations also assume that ample size is adequately large for asymptotic inference, usually around 50 clusters. In this study, clusters of data are equal to number of participants (n = 79) and thus adequately large.

3.3.3 *Testing of regression assumptions.*

Tolerance values were examined to assess the assumption of lack of multicollinearity in analyses using linear terms for the independent variables. Tolerance values of < .10 (Cohen, West, & Aiken, 2003) were assumed to indicate a potential problem with collinearity. No problems were found.

To check the assumption of homoscedasticity, the standardized residuals were plotted against the predicted values of Y. There were no discernible patterns in any of the plots, therefore constant error variance was assumed. To check for independence of residuals, the residuals of each regression were plotted separately by date of visit (an indication of temporal sequence of data collection). No patterns were apparent. Examination of Q-Q plots of the residuals revealed no notable deviations from the expected linear line, thus indicating normality of residuals. Additionally, Kolmogorov-Smirnov tests of normality were run on the residuals

from each of the regression models. The results indicated that none of the regressions yielded residuals that differed significantly from a normal distribution.

The Cook's D statistic was calculated for the studentized residuals to identify outliers that may exert undue influence on the statistical tests. Cook's D combines information about the residuals and leverage and measures the effect of deleting individual data points. As per the recommendation of Fox (1991), residuals with Cook's D values of greater than 0.055 [calculated as 4/(n-k-1)] were flagged for further examination. DFBetas were then calculated for all flagged residuals. DFBeta is a measure of the difference in the regression coefficients when a particular case is included compared to that particular case being excluded from the analysis. DFBeta values smaller than two indicate the data point was not causing undue influence, and DFBeta values that exceed two indicate the data point has undue influence on the outcome of statistical tests and should be removed (Belsey, Kuh, & Welsch, 1980). No DFBeta values of greater than two were found.

3.3.4 Results of hypothesis testing.

Aim 1.

Hypothesis 1a. This analysis revealed a significant effect of participant child's race on discernment accuracy for low intensity expressions, Wald χ^2 (2, 237) = 7.05, p = .03. Pairwise comparisons of the estimated marginal means using a Bonferroni correction for multiple comparisons indicated that White/non-Hispanic children had higher discernment accuracy for low intensity emotions than children in the 'Other' group, b = .16, p = .03, d = 0.34. Gender was not a significant predictor, Wald χ^2 (1, 237) = 0.10, p = .76. There was a significant effect of emotion on discernment accuracy for low intensity expressions, Wald χ^2 (2, 237) = 50.43, p < .001. Pairwise comparisons of the estimated marginal means using a Bonferroni correction for

multiple comparisons indicated that as hypothesized discernment accuracy for low intensity happy expressions was significantly greater than for low intensity angry expressions, b =.29, p < .001, d = 0.94, but, contrary to the hypothesis, not significantly greater than for low intensity sad expressions, b = .06, p = .64, d = 0.14. Also contrary to the hypothesis, discernment accuracy for low intensity sad expressions was significantly greater than for low intensity angry expressions, b =.23, p < .001, d = 0.74.

Hypothesis 1b. Neither race, Wald χ^2 (2, 237) = 4.24, p = .12, nor gender, Wald χ^2 (1, 237) = 2.42, p = .12, was a significant predictor of discernment accuracy at medium intensity. This analysis revealed a significant effect of emotion on discernment accuracy for medium intensity expressions, Wald χ^2 (2, 237) = 75.26, p < .001. Pairwise comparisons of the estimated marginal means using a Bonferroni correction for multiple comparisons indicated that as hypothesized discernment accuracy for medium intensity happy expressions was significantly greater than for medium intensity angry expressions, b =.36, p < .001, d = 0.58, and for medium intensity sad expressions, b =.20, p < .001, d = 1.10. Also, as hypothesized discernment accuracy for medium intensity angry expressions was significantly greater than for medium intensity sad expressions, b =.16, p < .001, d = 0.47.

Hypothesis 1c. Neither race, Wald χ^2 (2, 237) = 5.87, p = .05, nor gender, Wald χ^2 (1, 237) = 1.91, p = .17, was a significant predictor of discernment accuracy at high intensity. This analysis revealed a significant effect of emotion on discernment accuracy for high intensity expressions, Wald χ^2 (2, 237) = 74.02, p < .001. Pairwise comparisons of the estimated marginal means using a Bonferroni correction for multiple comparisons indicated that as hypothesized discernment accuracy for high intensity happy expressions was significantly greater than high intensity angry expressions, b =.38, p < .001, d = 0.51 and for high intensity sad expressions, b

=.20, $p < .001$, $d = 0.95$ respectively. Also, as hypothesized, discernment accuracy for high intensity angry expressions was significantly greater than for high intensity sad expressions, b =.18, $p < .001$, $d = 0.41$.

Hypothesis 2a. Neither race, Wald χ^2 (2, 711) = 1.51, $p = .47$, nor gender, Wald χ^2 (1, 711) = 0.10, $p = .75$, was a significant predictor of discernment accuracy for happy expressions. This analysis revealed a significant effect of intensity on discernment accuracy for Happy, Wald χ^2 (8, 711) = 1367.93, $p < .001$. Polynomial contrasts of the estimated marginal means using a Bonferroni correction for multiple comparisons indicated a significant linear effect of intensity on discernment accuracy for happy expressions, Wald χ^2 (1) = 476.70, $p < .001$, $b = 2.82$, and a significant quadratic effect of intensity on discernment accuracy for happy expressions, Wald χ^2 (1) = 41.77, $p < .001$, $b = -.80$. Thus, as hypothesized, intensity demonstrates a negative quadratic effect on discernment accuracy for happy expressions with a decelerating positive rate of change. See Figure 3.1 for a plot of the means of discernment accuracy for happy faces across intensities.

Hypothesis 2b. Race was a significant predictor of discernment accuracy for sad expressions, Wald χ^2 (2, 711) = 7.34, $p = .03$. Pairwise comparisons of the estimated marginal means using a Bonferroni correction for multiple comparisons indicated that White/non-Hispanic children had higher discernment accuracy for sad expressions than children in the 'Other' group, $b = .19$, $p = .03$, $d = 0.32$. Gender was not a significant predictor, Wald χ^2 (1, 711) = .09, $p = .76$. There was a significant effect of intensity on discernment accuracy for sad expressions, Wald χ^2 (8, 711) = 499.63, $p < .001$. Polynomial contrasts of the estimated marginal means using a Bonferroni correction for multiple comparisons indicated a significant linear effect, Wald χ^2 (1) = 281.66, $p < .001$, $b = .2.31$, and a significant quadratic effect of intensity on

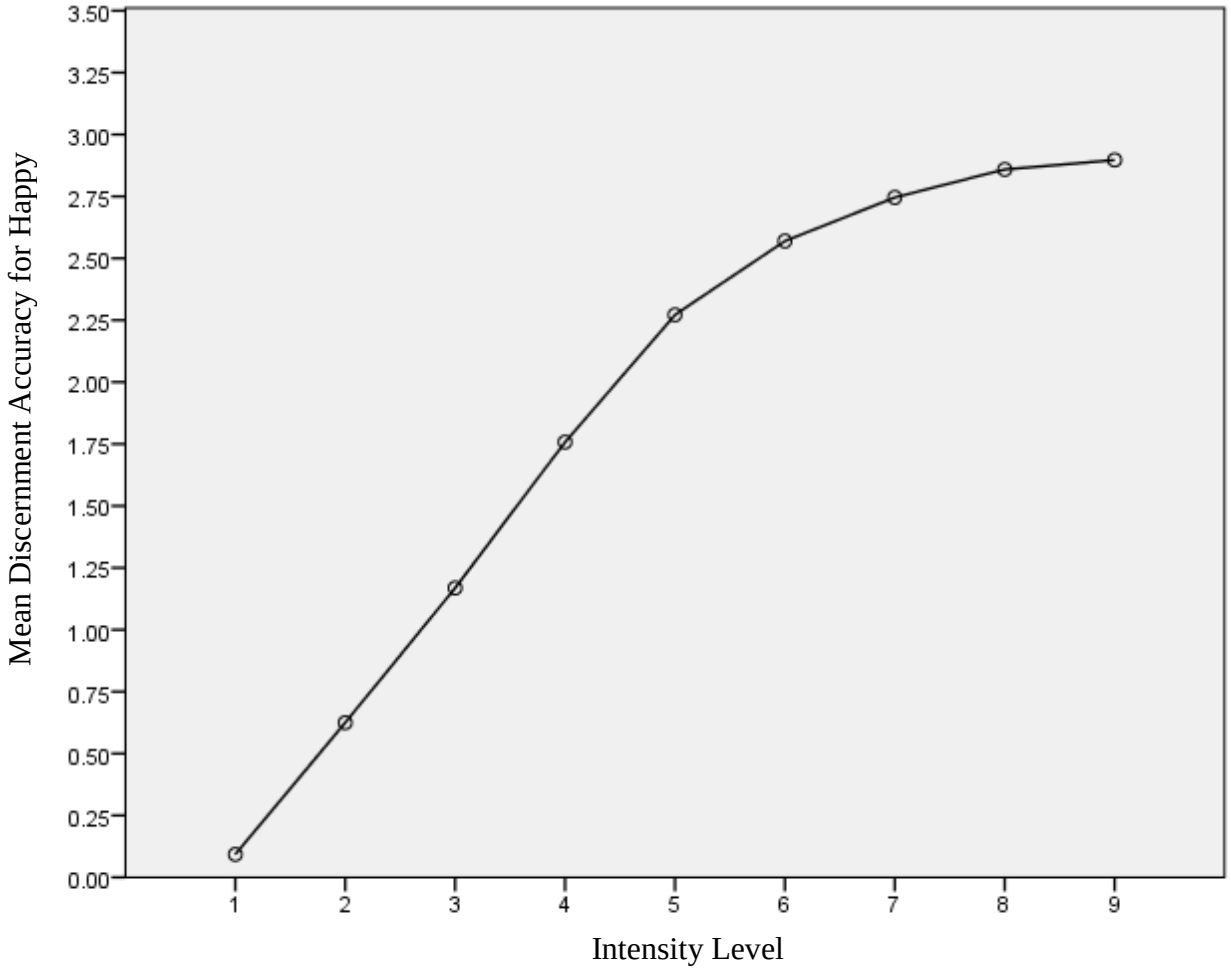

Figure 3.1. Means of discernment accuracy for happy faces plotted at increasing levels of expression intensity (10-90%). Discernment accuracy = Wagner's unbiased hit-rate, arcsine transformed.

discernment accuracy for sad expressions, Wald χ^2 (1) = 8.36, p = .03, b = -.35. Thus, in contrast to the hypothesized linear effect of intensity on discernment accuracy for sad expressions there is a negative quadratic effect with a decelerating positive rate of change. See Figure 3.2 for a plot of the means of discernment accuracy for sad faces across intensities.

Hypothesis 2c. Race significantly predicted discernment accuracy for angry expressions, Wald χ^2 (2, 711) = 18.84, p < .001. Pairwise comparisons of the estimated marginal means using a Bonferroni correction for multiple comparisons indicated that White/non-Hispanic children had higher discernment accuracy for angry expressions than Black/African-American children, b =.10, p < .001, d = 0.10. Gender was not a significant predictor, Wald χ^2 (1, 711) = .04, p = .85. There was a significant effect of intensity on discernment accuracy for angry expressions, Wald χ^2 (8, 711) = 1113.63, p < .001. Polynomial contrasts of the estimated marginal means using a Bonferroni correction for multiple comparisons indicated a significant quartic effect of intensity on discernment accuracy for angry expressions, Wald χ^2 (1) = 9.18, p = .02, b = .32. The linear, Wald χ^2 (1) = 521.66, p < .001, b = .2.87, quadratic, Wald χ^2 (1) = 28.18, p < .001, b = -.65, and cubic, Wald χ^2 (1) = 12.48, p = .003, b = -.40, effects were also significant. See Figure 3.3 for a plot of the means of discernment accuracy for angry faces across intensities.

Aim 2 (exploratory).

Hypothesis 3a and Hypothesis 3b. Results from the regression analyses of socially inhibited behavior on the misidentification of neutral and low intensity (10, 20, and 30%) happy and angry faces as sad and misidentification of neutral and low intensity (10, 20, and 30%) happy and sad faces as angry are displayed in Table 3.3. Social disinterest was not a significant predictor of socially inhibited behavior. Contrary to the hypothesis, neither misidentification of

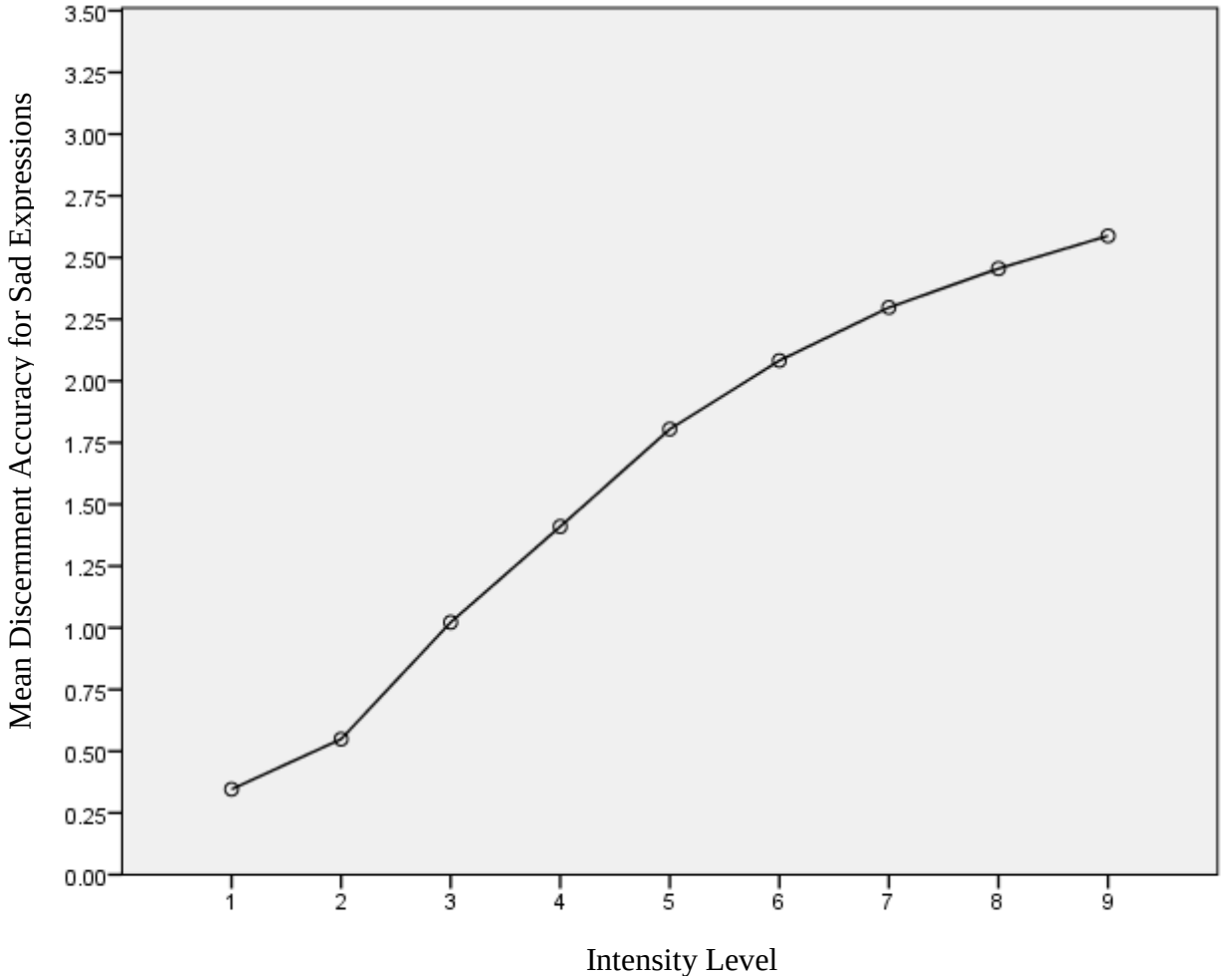

Figure 3.2. Means of discernment accuracy for sad faces plotted at increasing levels of expression intensity (10-90%). Discernment accuracy = Wagner's unbiased hit-rate, arcsine transformed.

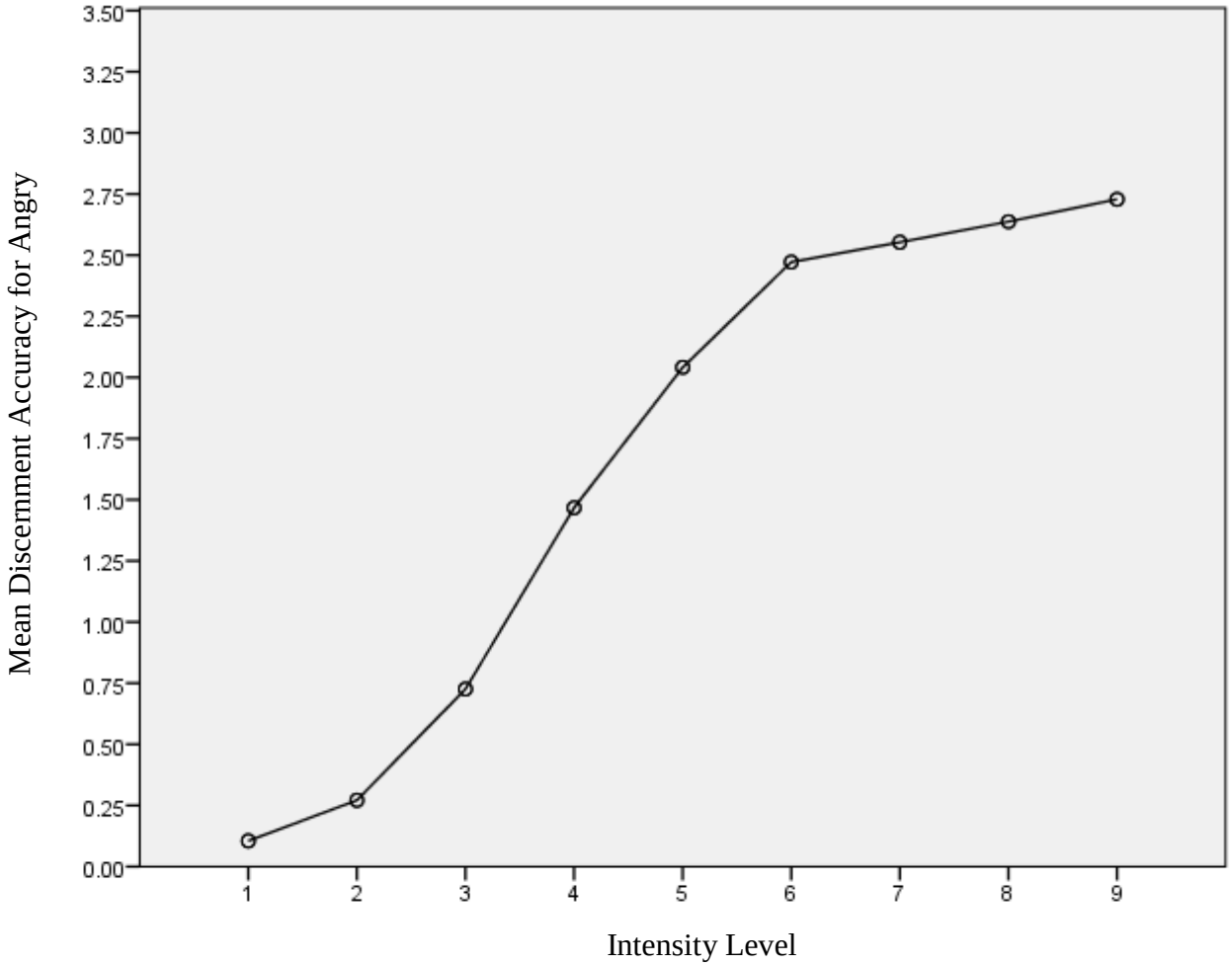

Figure 3.3. Means of discernment accuracy for angry faces plotted at increasing levels of expression intensity (10-90%). Discernment accuracy = Wagner's unbiased hit-rate, arcsine transformed.

Table 3.3 *Hypotheses 3a and 3b: Hierarchical Regression Predicting Social Inhibition from Misidentification as Sad and Misidentification as Angry*

Predictor	ΔR^2	β	*p*
Step 1	.01		.295
Social Disinterest		.12	.295
Step 2	.05		.163
Misidentification as Sad		.22	.08
Misidentification as Angry		-.18	.15

Note. Misidentification as Sad = Proportion of Neutral trials and 10%, 20%, and 30% Happy and Angry trials identified as Sad. Misidentification as Angry = Proportion of Neutral trials and 10%, 20%, and 30% Happy and Sad trials identified as Angry.

faces as sad nor misidentification of faces as angry was a significant predictor of socially inhibited behavior above the effect of social disinterest.

Hypothesis 3c. Results from the regression analyses of socially inhibited behavior on discernment accuracy for low intensity (10, 20, and 30%) happy faces are displayed in Table 3.4. Social disinterest was not a significant predictor of socially inhibited behavior. Contrary to the hypothesis, discernment accuracy for low intensity happy faces was not a significant predictor of socially inhibited behavior above the effect of social disinterest.

Hypothesis 3d. Results from the regression analyses of socially inhibited behavior on discernment accuracies for low intensity (10%, 2%0, and 30%) and medium intensity (40%, 50%, and 60%) sad faces are displayed in Table 3.5. Social disinterest was not a significant predictor of socially inhibited behavior. Discernment accuracy for low intensity and medium intensity sad faces accounted for an additional 7% of the variance in socially inhibited behavior above the effect of social disinterest. Contrary to the hypothesis, discernment accuracy for low intensity sad faces was not a significant predictor of socially inhibited behavior above the effect of social disinterest. Discernment accuracy for medium intensity sad faces significantly predicted socially inhibited behavior.

Hypothesis 3e. Results from the regression analyses of socially inhibited behavior on discernment accuracies for low intensity (10, 20, and 30%) and medium intensity (40%, 50%, and 60%) angry faces are displayed in Table 3.6. Social disinterest was not a significant predictor of socially inhibited behavior. Discernment accuracy for low intensity and medium intensity angry faces accounted for an additional 9% of the variance in socially inhibited behavior above the effect of social disinterest. Contrary to the hypothesis, discernment accuracy

Table 3.4 *Hypothesis 3c: Hierarchical Regression Predicting Social Inhibition from Happy Discernment Accuracy*

Predictor	ΔR^2	β	*p*
Step 1	.014		.295
Social Disinterest		.12	.295
Step 2	.005		.556
Happy Discernment Accuracy (Low Intensity)		-.068	.556

Note. Low Intensity = facial expressions of 10%, 20%, and 30% emotion intensity. Discernment accuracy = Wagner's unbiased hit-rate, arcsine transformed.

Table 3.5 *Hypothesis 3d: Hierarchical Regression Predicting Social Inhibition from Sad Discernment Accuracy*

Predictor	ΔR^2	β	*p*
Step 1	.01		.295
Social Disinterest		.12	.295
Step 2	.07		.055
Sad Discernment Accuracy (Low Intensity)		-.09	.522
Sad Discernment Accuracy (Medium Intensity)		.31	.022

Note. Low Intensity = facial expressions of 10%, 20%, and 30% emotion intensity; Medium Intensity = facial expression of 40%, 50%, and 60% emotion intensity. Discernment accuracy = Wagner's unbiased hit-rate, arcsine transformed.

Table 3.6 *Hypothesis 3e: Two Hierarchical Regressions Predicting Social Inhibition from Angry Discernment Accuracy*

Predictor	ΔR^2	β	*p*
Step 1	.014		.295
Social Disinterest		.12	.295
Step 2	.09		.029
Angry Discernment Accuracy (Low Intensity)		-.15	.225
Anger Discernment Accuracy (Medium Intensity)		.35	.008

Note. Low Intensity = facial expressions of 10%, 20%, and 30% emotion intensity; Medium Intensity = facial expression of 40%, 50%, and 60% emotion intensity. Discernment accuracy = Wagner's unbiased hit-rate, arcsine transformed.

for low intensity angry faces was not a significant predictor of socially inhibited behavior above the effect of social disinterest. Discernment accuracy for medium intensity angry faces was a significant predictor of socially inhibited behavior.[2]

In summary, discernment accuracy for happy expressions was generally superior to accuracy for sad and angry expressions and discernment accuracy for angry expressions was generally superior to accuracy for sad expressions. However, at low intensity, discernment accuracies for happy and sad expressions did not differ significantly, but discernment accuracies for sad and angry expressions were significantly different. Discernment accuracies for happy expressions and sad expressions both improved significantly with greater intensity from low to medium intensities and evidenced a decelerating positive rate of improvement from medium and high intensities i.e., a significant negative quadratic association. Discernment accuracy for angry expressions also improved significantly with greater intensity; however, the improvement followed a complicated quartic pattern.

Neither misidentification of neutral and low intensity faces as negative nor discernment sensitivity for low intensity happy expressions was significantly associated with socially inhibited behavior. Partial support for hypotheses regarding higher discernment sensitivity for negative facial expressions related to more socially inhibited behavior was found. Although neither discernment accuracy for low intensity sad faces nor discernment accuracy for low intensity angry faces was significantly related to socially inhibited behavior, higher discernment sensitivity for medium intensity sad faces and higher discernment sensitivity for medium intensity angry faces were both significantly related to more socially inhibited behavior.

[2] Omitting social disinterest from regression models of Aim 2 did not notably impact the significance or effect size. Inclusion of age, gender, or race as covariates in the first step of any of the regression models of Aim 2 did not notably impact the significance or effect size.

4 DISCUSSION

Children's ability to discern emotion from the facial expressions of others is crucial to adaptive social functioning (Edwards, Manstead, & Macdonald, 1984; Philippot & Feldman, 1990, Izard et al., 2001) and tends to be better for positive versus negative emotions and for expressions of high emotive intensity versus subtle expressions (e.g., Gao & Maurer, 2010; Vicari et al., 2000). Facial affect discernment is thought to undergo considerable development during middle childhood (Montirosso et al., 2010), which is a period when social interactions with peers become more complex and children typically experience growth in emotional intimacy and emotional support in interpersonal relationships and independence in initiating social interactions (Lancey & Grove, 2011; Rose & Asher, 2000; Rose-Krasnor, 1997; Rubin, Bukowski, & Parker, 2006; Sroufe et al., 1999). However, surprisingly little empirical work has addressed children's ability to discriminate subtle expressions of happiness, sadness, and anger in other children's faces and whether children with negative discernment biases tend to be more socially inhibited from these developmentally appropriate peer interactions. The aims of this study were to characterize facial affect discernment for happy, sad, and angry children's facial expressions across a range of intensities and explore relations among aspects of negatively biased facial affect discernment and socially inhibited behavior in middle childhood.

4.1 Differences in Discernment Accuracy by Emotion and Intensity

The first aim of this study was to understand children's ability to discern other children's happiness, sadness, and anger as they are expressed across a range of emotive intensities as are present in social encounters. Children were more accurate in discerning happiness than sadness and anger in the faces of other children except at subtle intensities, when children's accuracy in discerning happiness and sadness was comparable.

Regarding the generally superior discernment accuracy for happiness, peer social interactions typically center on positive activities such as playing and children are socialized to regulate negative emotions in peer contexts (Zeman & Garber, 1996; Zeman & Shipman, 1997), which likely results in higher proportions of happy expressions compared to expressions of sadness and anger being displayed in peer interactions. Children are therefore likely to have many more opportunities to encounter, discern, and respond to happiness versus sadness or anger in other children. Additionally, happy faces evoke stronger activation in emotion-processing areas of children's brains than do angry and sad faces, a difference that is not observed in adults (Todd, Evans, Morris, Lewis, & Taylor, 2011), which may help explain why children do not appear to need much expressive intensity to accurately recognize happiness in other children. However, high intensity of happy facial affect may impact other interpersonal factors such as feelings of positive empathy, emotional contagion, and arousal in the perceiver (Hess & Blairy, 2001).

Children were also more accurate in discerning other children's anger than sadness, except when displayed subtly. The potential for social and even physical detriment in the face of a peer's anger make superior discernment of clearly emotive angry expressions versus sad expressions advantageous and this finding is in line with previous research (e.g., Gao & Maurer, 2010). Children's discernment of subtle displays of sadness was more accurate than their discernment of subtle displays of anger. Children generally did not "miss" subtle anger, that is label the expressions as neutral, but rather tended to misidentify subtly angry faces as happy or sad. Children may experience anger more intensely than sadness in peer interactions (Morris, Silk et al., 2011) and, although they may be socialized to suppress expressions of anger or frustration (Zeman & Garber, 1996; Underwood, 1997), children's abilities to regulate their

emotions are still developing (Zeman & Shipman, 1997). Therefore, children may be able to suppress only less intense expressions of anger (Underwood, 1997), providing fewer opportunities for their peers to be exposed to and recognize facial expressions of subtle anger (Hubbard, 2001) than subtle sadness.

Alternatively, children may have more trouble understanding the reasons for subtle anger in peers and be more likely to blame themselves, which would make acknowledging and labeling a peer's emotion as anger more threatening and provoke a greater emotional response in the observing child. Thus, children may be unintentionally motivated to attribute subtle expressions, the emotion of which they are uncertain, to less threatening emotions such as sadness and happiness, in an attempt to avoid potentially threatening interpersonal interactions and enable regulation their own emotional responses. This has implications for understanding the elements of peer interactions with which children struggle at this age. If children are not responding to mild expressions of anger in the expected manner, it may be due to lack of accurate emotion recognition rather than lack of empathy or defiance (Dodge, Laird, Lochman, & Zelli, 2002). It may be prudent to consider the subtlety of emotional expression and accuracy of emotion recognition when trying to understand children's socio-emotional interactions with peers and intervening to enhance emotion recognition skills or mediate disagreements between peers. If subtle anger is not accurately perceived and responded to, children may resort to more intense expressions of anger and aggressive behaviors. Additionally, if children are not accurate in their perceptions of subtle anger, they miss opportunities to practice prosocial and assertive behaviors when they are likely to get an appropriate response. Instead, they may only practice prosocial and assertive responding when the peer's anger is more intense and prosocial or assertive behaviors may be ineffective or poorly received. Encouraging children to consider other aspects

of emotional expression such as voice prosody, body language, and situation knowledge may help increase children's accurate discernment of subtle anger and facilitate skilled interpersonal functioning.

Unlike happiness and anger, even at high intensities, children's ability to discern sadness in other children's facial expressions does not appear fully developed in middle childhood. This appears to be due to 'missing' sadness, that is labeling it as 'neutral, rather than misidentifying sadness as happiness or anger. It appears that high emotive intensity in facial displays of sadness is not sufficient to ensure high levels of discernment. Again, additional affective information such as tone of voice, body posture, and contextual information may be needed to improve children's ability to discern peers' sadness. A lack of sensitivity to perceive sadness, relative to happiness and anger, in other children may result from incongruence between children's affective displays of sadness and how they label their own affect. In a study of emotion display rules, more children identified the social norm that they "should not express sadness" compared to anger and the authors suggest that children may not feel comfortable acknowledging their sadness in peer contexts for fear of appearing vulnerable or feeling embarrassed (Zeman & Shepman, 1997). Thus, when experiencing sadness in social interactions, children may say that they are 'fine' or 'okay' despite actually feeling and looking sad. Children may override their knowledge of what the nonverbal cues signify if they learn others are uncomfortable discussing sadness and even learn to identify peers' sad facial expressions with terms such as 'fine,' 'okay,' and 'neutral' as they develop awareness that one's inner and outer emotional states may differ (Denham, 2007). This has potentially negative implications for children's social interactions during a time when peer relationships are increasing in emotional depth (Rose & Asher, 2000) and accurate emotional understanding likely plays a key role in strengthening these relationships.

If children are not emotionally sensitive to peers expressing sadness, they will miss opportunities to act prosocially, which may damage relationships or impede the deepening of these relationships. On the other hand, less sensitivity to discern sad expressions in peers could be adaptive. Children who do not have the skills to respond to peers' sadness may experience personal distress in the presence of another's sadness (Eisenberg, Fabes, Murphy et al., 1996; Eisenberg & Spinrad, 2006); thus, less sensitivity to discern peers' sadness may be protective for some.

In sum, consistent with previous research that use photos of adults' facial expressions (e.g., Gao & Maurer, 2009; 2010), this study showed that children are generally better able to recognize happiness than anger or sadness in other children during middle childhood. Differences in children's ability to discern sadness compared to anger in other children appears due to distinct causes—lack of sensitivity to emotion in faces expressing sadness and inaccurate identification of anger as happiness or sadness. These divergent sources of error suggest differences in children's exposure to subtle emotions of other children as well as differences in how children may express and label their own subtle emotions within peer contexts. Thus, distinct approaches for understanding normative development of discernment for anger versus sadness and enhancing development of related socio-emotional processes such as empathy are warranted. The findings of the current study also suggest that considering expressions across a range of intensity is important because there are shifts in relative accuracies of emotions and lack of consideration of intensity may partially explain previous mixed findings regarding the relative superiority of discernment accuracy for anger and sadness.

4.2 Negatively Biased Facial Affect Discernment and Socially Inhibited Behavior

Emotion recognition is an important socio-emotional skill that is related to better social skills and lower levels of problematic social behavior (Edwards, Manstead, & Macdonald, 1984; Philippot & Feldman, 1990; Izard et al., 2001; Goodfellow & Nowicki, 2009), and negatively biased facial affect discernment (lower sensitivity to discern happiness, greater sensitivity to discern anger and sadness, and more misidentifications of expressions as angry or sad) has been found in individuals experiencing depression and social anxiety (e.g., Joormann & Gotlib, 2006, Jenness et al., 2015; Schepman et al., 2012) as well as children at risk for developing depression (Lopez-Duran et al., 2013). Although models of psychopathology suggest that maladaptive social behaviors emerge prior to clinically significant symptoms (Dodge, 1993), no studies have investigated associations between maladaptive behaviors and negatively biased facial affect discernment prior to the emergence of clinically impairing symptoms. Therefore, the second, exploratory aim of the study was to determine whether negatively biased facial affect discernment is related to more socially inhibited behaviors in middle childhood.

4.2.1 Misidentification errors are not associated with socially inhibited behavior.

Socially inhibited behavior was not related to children's errors in facial affect discernment in this study. The bias to misidentify facial expressions as negative found in previous studies of clinically depressed adolescents (Jenness et al., 2015) may be the result of state-dependent correlates of a depressive episode such as impaired concentration rather than a risk factor, such as socially inhibited behavior, that appears before the development of a future depressive episode. Indeed, in the Jenness et al. (2015) study, only adolescents with a current diagnosis of depression, but not those adolescents who had experienced a depressive episode in the past but were not currently depressed, misidentified happiness and sadness as anger. An

additional explanation may be that misidentification of facial expressions as negative may be the result of a general hostile attribution bias, which is related to aggressive and externalizing behavior (e.g., Hall, 2006).

4.2.2 Low sensitivity to discern happiness is not associated with socially inhibited behavior.

According to Coplan et al. (2013), socially inhibited behavior is found in children characterized as *shy* and children characterized as *avoidant* (Coplan et al., 2013) and though the behavioral inhibition system (BIS) is highly activated during social situations in both shy children and avoidant children, activation of the behavioral approach system (BAS) is high in shy children and low in avoidant children during social encounters (Coplan et al., 2006). This suggests that socially inhibited behavior may be more closely related to the BIS rather than the BAS. If sensitivity to discern happiness is related to approach behaviors rather than avoidance behaviors (Seidel et al., 2010) this may explain why sensitivity to discern happiness was not related to socially inhibited behavior in this study.

Another explanation for the lack of the association between sensitivity to discern happiness and socially inhibited behavior is that reward processing of social cues, such as a peer smiling, may differ across children and influence the degree to which social interactions are reinforcing (Caouette & Guyer, 2013; Morgan, Olino, McMakin, Ryan, & Forbes, 2013). Thus, differences in reward processing of social cues may moderate associations between discernment sensitivity for happy facial expressions and socially inhibited behavior such that higher discernment sensitivity for happiness would only be associated with less socially inhibited behavior for children who experience positive social cues as highly reinforcing. In sum, investigation of potential moderating factors may elucidate an association between sensitivity to

discern other children's happiness and less socially inhibited behavior that was not apparent in the current study.

4.2.3 Discernment sensitivity for negative faces and socially inhibited behavior.

Children who were more sensitive to other children's sadness and anger were more socially inhibited, which is consistent with findings in adults who report that they would take more steps away from angry and sad faces (Seidel et al., 2010) and fits within the SIP model of children's social adjustment. Previous studies have found that similar negative biases at the encoding stage, such as sensitivity to discern sadness and fear in facial expressions (Vanhalst, Gibb, & Prinstein, 2017) and negative biases at the interpretation stage, such as critical self-referent causal attributions for ambiguous peer scenarios (Prinstein, Cheah, & Guyer, 2005) are related to loneliness, which can be an outcome of socially withdrawn behavior (Boivin, Hymel, & Bukowski, 1995; Renshaw & Brown, 1993). The current findings fill in a gap in the literature, linking negative biases at the encoding stage i.e., discernment sensitivity for sad and angry facial expressions, to the enactment of social behavior i.e., socially inhibited behavior, which likely precedes more distal outcomes such as loneliness.

Children who are more sensitive to discerning sad and angry expressions may perceive more instances of peers disliking them or judging their social behavior poorly, feel more vulnerable to being rejected by those peers, and subsequently withdraw socially. A recent study of young adolescents found that greater self-reported shyness was related to the adolescents' lower estimates of the likelihood that a peer with a negative facial expression liked him or her; this association was mediated by rejection sensitivity for expressions of anger and disgust (Kokin, Younger, Gosselin, & Vaillancourt, 2016).

Children's ability to discern very subtle expressions of sadness or anger was not related to socially inhibited behavior but may be related to less overt social processes, such as empathy and attunement in relationships. Children expect negative interpersonal consequences from peers in response to the expression of negative affect (Zeman, Penza, Shipman, & Young, 1997; Zeman & Garber, 1996) and may make efforts to suppress expressions of anger and sadness to avoid these negative consequences when their arousal and emotion intensity is low and they can regulate their affect successfully. Thus, only children who are highly attuned to the other child, for example in very close relationships may perceive these subtle expressions of negative affect.

Our task forced children to make labeling decisions regarding the emotion displayed in subtle expressions, which may not occur in natural settings. In real-life interactions, children who encounter very subtle emotional cues in a peer and are uncertain of how the peer is feeling may wait for additional information or an escalation of emotion cue intensity before making a decision about how to respond, for example whether or not to approach the peer and thus these subtle expressions of facial affect may not be acted upon if they do not intensify and become clearer. In sum, subtle sad and angry facial expressions during peer interactions may occur at low frequencies and be received with such uncertainty that they do not prompt changes in observable behavior.

Implications for the development of psychopathology.

Although discernment sensitivity for sad and fearful facial expressions was associated with loneliness in the study of adolescents discussed above, it is worth noting that discernment sensitivity was not significantly related to symptoms of social anxiety and depression in that study (Vanhalst, Gibb, & Prinstein, 2017). This suggests that discernment sensitivity for negative emotions may not confer direct risk for psychopathology. The risk may begin with a

genetic vulnerability that unfolds through complicated developmental cascades involving mediating and moderating factors (e.g., genetics, parental psychopathology, family and peer relationships; Lau et al., 2009), wherein elevated levels of depression and anxiety symptoms appear later and only for certain children under certain conditions (Masten & Cicchetti, 2010). Children who had a maternal history of depression and were homozygous for a specific polymorphism of the oxytocin receptor gene that has been linked to empathic concern (G allele; Smith, Porges, Norman, Connelly, & Decety, 2014) demonstrated greater discernment sensitivity for sadness compared to children with no maternal history of depression and/or were carriers of the A allele of the oxytocin receptor gene (Burkhouse et al., 2016). The current study suggests that this sensitivity to discern negative emotions may then result in socially inhibited behaviors. These socially inhibited behaviors may, in turn, limit children's opportunities to learn adaptive ways of interacting with peers, which reinforces passive and avoidant behaviors, impedes social skill development, and prompts peer victimization (Boivin et al., 1995; Schwartz et al., 1993), leading to loneliness low self-esteem (Hymel, Bowker, & Woody, 1993; Renshaw & Brown, 1993; Rubin, Hymel, & Mills, 1989), and heightened risk for anxiety and depression (Lee & Hankin, 2009; Orvaschel, Beeferman, & Kabacoff, 1997; Sowislo & Orth, 2013; Vernberg, Abwender, Ewell, & Beery, 1992).

Implications for prevention and intervention work.

This study shows that higher discernment sensitivity for anger and sadness is related to socially inhibited behavior during middle childhood, which is the developmental period just prior to dramatic increases in clinically significant social anxiety and depression, suggesting middle childhood may be an ideal time for prevention efforts. In this study, misidentification of facial expressions as sad or angry was not related to socially inhibited behavior, which suggests that

interventions aimed at reducing mislabeling of these emotions from facial expressions may not reduce socially inhibited behavior. For children who are sensitive to discerning others' negative facial expressions, there may be additional benefit to addressing the assumptions and cognitive distortions children may have about the meaning and outcome of others' sad and angry expressions. For example, children may blame themselves for others' sadness or anger (Burgess, Wojslawowicz, Rubin, Rose-Krasnor, & Booth-LaForce, 2006), catastrophize consequences for interpersonal conflict (Schofield, Coles, & Gibb, 2007), and experience low self-efficacy regarding his/her ability to repair rifts in relationships or comfort sad or angry peers (Wichmann, Colan, & Daniels; 2004). Additionally, training children to use other cues (e.g., tone of voice, body language, content of verbal communications, situational or contextual cues) in addition to facial expressions to gauge the extent of another child's negative emotion may help shift the focus from negative facial expressions and minimize reactions based on relatively mild sad or angry expressions. If future studies support discernment sensitivity to negative faces as disproportionately high compared to discernment sensitivity for happy faces in children prone to socially inhibited behavior, interventions that improve sensitivity to discern happy faces may balance out a child's overall perception of social interactions.

4.3 Limitations

There are limitations of the study that bear discussion and suggest important future directions of study. First, like most previous studies, we included only one positive expression, happiness, and one positive answer choice, 'happy.' This could have inflated differences between accuracy for happiness and the negative emotions. However, two previous studies showed that happiness is not significantly misidentified as surprise, another positive expression, and maintains its high level of accuracy compared to other expressions when surprise is included

in the task as both an additional expression and answer choice (Gao & Maurer, 2010; Gosselin & Larocque, 2000). Second, the face stimuli used in this study were artificially constructed using software from posed expressions of neutral and prototypical expressions. Therefore, the ecological validity of these variations in expression intensity and how these expressions would relate to real social interactions is not known. Additionally, there may be behavioral differences in how a child interacts with and is able to discern affect from a child's face during a face-to-face interaction versus a photograph. For example, socially inhibited behavior is related to shyness (Rubin & Asendorpf, 2014) and shy children may avoid eye contact and looking directly at peers' faces when interacting in real life (Rubin, Bukowski, & Parker, 2006) and thus may be have low sensitivity to discern emotion in the moment. Third, the study was cross-sectional and correlational in nature, thus conclusions about the direction of the association between discernment sensitivity for sad and angry expressions and socially inhibited behaviors cannot be drawn. For instance, the association between discernment sensitivity for negative facial expressions and socially inhibited behavior could be due to common underlying factors, such as temperamental factors like behavioral inhibition, that account for the shared variance between the two. Fourth, due to the exploratory nature of the hypotheses of Aim 2, a number of regression models were calculated and this may have resulted in increased Type I error.

4.4 Summary and Future Directions

In conclusion, the results of this study show that in middle childhood, children are generally best at discerning happiness, then anger, with the exception of subtle expressions for which discernment of anger lags. Generally, increased intensity of facial expressions improved discernment accuracy. However, very emotive expressions provide little advantage over those of average emotive intensity. These findings provide a more nuanced understanding of children's

recognition of subtle emotion in other children and suggest children's ability to discern sad and angry facial expressions can be improved during middle childhood, which has implications for improving complex aspects of social interaction such as perspective-taking and empathy. There are a number of important next steps that are suggested in order to build upon the understanding of facial affect discernment in middle childhood and to improve the ecological validity of these findings. Emotion labeling and intensity rating data should be collected from samples of adolescents and adults to ensure that low and medium intensity faces are of comparable signal strength across the emotions. Additional emotions such as fear, disgust and surprise as well as additional label choices should be included to allow for understanding the development of discernment accuracy in middle childhood more completely. Indeed, there is some evidence that children may misidentify sad expressions as disgust (Gao & Maurer, 2010), which could have detrimental implications for interpersonal interactions. Altering aspects of the paradigm, for example having children to generate verbal labels for facial expressions rather than forcing them to choose from a specific set of labels, would provide information about children's ability to discern emotion in a more ecologically valid manner.

Alternate paradigms that measure discernment sensitivity using short video clips of facial expressions morphing from neutral to a full intensity emotion have participants indicate when they believe they are able to discern an emotion and then indicate which emotion they have perceived. This type of task could provide information about how much intensity children are likely to look for before making an emotion judgment and purposefully acting in a social situation. Studies could also systematically incorporate other emotion cues such as tone of voice and body posture to test whether a particular type of emotion signal may be more or less useful for improving discernment accuracy of certain emotions when facial expressions are subtle. For

instance, children appear to detect sadness more accurately than happiness or fear from voices (Nelson & Russell, 2011). Knowledge about how to teach children to best incorporate various emotion cues to enable more accurate discernment of subtle emotions would be helpful for parents, teachers, and other caregivers seeking to enhance children's emotional competence and, would have important effects on children's social competence. A child's decision to offer comfort and support in response to perceived sadness or attempt assertive or reparative behaviors in response to perceived anger, would be received very differently depending on how accurately the original emotion was discerned (SIP; Lemerise & Arsenio, 2000).

Another interesting future direction of study would be to compare children's discernment accuracy for emotional expressions of various intensities of unfamiliar children with those of familiar peers to help understand the impact familiarity plays on the ability to discern subtle emotion (Herba et al., 2008). In middle childhood, as children gain more independence and participate in an increasingly wide range of social activities, relative weaknesses to accurately discern emotion in unfamiliar children versus familiar peers would have distinct implications for social functioning.

Last, given the significant effect of participant child's race/ethnicity on some aspects of discernment accuracy, future studies should explore these effects in relation to the race/ethnicity of the child expressing emotion to better understand potential in-group and out-group differences in emotion discernment accuracy that may play an important role in understanding social dynamics (Elfenbein & Ambady, 2003; Tuminello & Davidson, 2011).

Greater discernment sensitivity for typical sad and angry expressions was related to more socially inhibited behavior in middle childhood. These findings suggest a number of interesting future directions regarding social behaviors that may mediate the relationship between biased

emotion processing and depression and social anxiety in childhood and adolescence. Future studies should integrate measurement of discernment sensitivity with measurement of social behavior using tasks that have the participant child view and provide emotion labels for photographs of children displaying facial expressions of varying intensities and then have the participant child choose children from the photographs with whom they would want to be assertive or whom they would like to approach for an activity.

Additionally, studies could utilize ecological momentary assessment methodology that enables real-time assessment of social cue perception and enactment of social behaviors. Peer interactions could be set up in a laboratory and data could be collected in real time using technology fitted to the participant child that takes pictures of a peer's facial expressions as they interact and allows the participant child to immediately indicate the emotion they perceive in the peer's face. The interactions could be recorded and later coded for inhibited, passive, and avoidant social behaviors that could be time-synced to the perception of affect in the peer by the participant child. The photographs of the peer's expression could be coded for emotion and expression intensity.

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APPENDICES

Appendix 1 Child Social Preference Scale

Please answer the items on this page about the behavior of your child by *circling* one of the numbers following each item. We know that no item will apply to the child in every situation, but try to consider his/her usual or general behavior. Please answer all questions--there are no right or wrong answers.

	How much is your child like that? Not at All ← → A Lot				
1. My child often seems content to play alone.	1	2	3	4	5
2. My child seems to want to play with other children, but is sometimes nervous to.	1	2	3	4	5
3. My child is just as happy to play quietly by his/herself than to play with a group of children.	1	2	3	4	5
4. My child is happiest when playing with other children.	1	2	3	4	5
5. My child will turn down social initiations from other children because he/she is 'shy'.	1	2	3	4	5
6. My child often approaches other children to initiate play.	1	2	3	4	5
7. My child 'hovers' near where other children are playing, without joining in.	1	2	3	4	5
8. My child rarely initiates play activities with other children.	1	2	3	4	5
9. If given the choice, my child prefers to play with other children rather than alone.	1	2	3	4	5
10. My child often watches other children play without approaching them.	1	2	3	4	5
11. Although he/she appears to desire to play with others, my child is sometimes anxious about interacting with other children.	1	2	3	4	5

Scoring (simply add items); ***Social Disinterest items****:* 1, 3, 4 (reverse-scored), 9 (reverse-scored)

Appendix 2 Social Competence Inventory

This questionnaire contains statements describing children's ways of behaving. Most statements describe children's strengths and skills in relating to other children and adults.

Please respond to each statement as follows:

If you believe that the statement applies very well to this child, circle “5”.

If you feel that the statement applies rather well to this child, circle “4”.

If you feel that the statement does not apply very well to this child, circle “2”.

If you believe that the statement does not apply at all to this child, circle “1”.

If you feel that the statement sometimes applies and sometimes doesn't apply to this child, circle “3”.

When responding to each statement, please consider the behavior of the child in question during the past three months. When reading "adults" or "other children/peers" in the statements below, we ask you to refer to adults and children outside of the child's family.

	Does Not Apply At All Well	Does Not Apply Very Well	Applies Sometimes	Applies Rather Well	Applies Very Well
1. Tries to comfort a peer who is upset, not feeling well, or has been hurt.	1	2	3	4	5
2. Often suggests activities and games to play with peers.	1	2	3	4	5
3. Is withdrawn with peers.	1	2	3	4	5
4. Is able to interpret (“decode”) another child’s feelings, if he/she is happy, angry, or sad	1	2	3	4	5
5. Is hesitant with peers.	1	2	3	4	5
6. Is more often a spectator than a participant while others play.	1	2	3	4	5
7. Is good at preventing conflicts.	1	2	3	4	5
8. Is shy/hesitant with unfamiliar adults.	1	2	3	4	5
9. Is able to give and take in social interactions.	1	2	3	4	5

	Does Not Apply At All Well	Does Not Apply Very Well	Applies Sometimes	Applies Rather Well	Applies Very Well
10. Tends to be dominated by peers.	1	2	3	4	5
11. Often helps peers, e.g., to clean up, search for lost items, or fix something that is broken.	1	2	3	4	5
12. Is often able to find solutions or compromises when involved in a conflict.	1	2	3	4	5
13. Is often a leader in games/activities.	1	2	3	4	5
14. Gives compliments to peers (on their ideas, appearance, actions).	1	2	3	4	5
15. Is able to sympathize with peers.	1	2	3	4	5
16. Usually shares/lends his or her belongings	1	2	3	4	5
17. Tries to intervene in peers' quarrels/conflicts.	1	2	3	4	5
18. Invites shy children to participate in play.	1	2	3	4	5
19. Shows generosity towards peers.	1	2	3	4	5
20. Is easily influenced by and shares peer's happiness and good mood.	1	2	3	4	5
21. Demonstrates helpfulness/altruism toward others, both children and adults.	1	2	3	4	5
22. Often criticizes peers.	1	2	3	4	5
23. Is helpful toward adults.	1	2	3	4	5
24. Easily makes contact with unfamiliar children.	1	2	3	4	5
25. Plays and cooperates well with peers.	1	2	3	4	5

Scoring: Items are averaged

Socially Inhibited Behaviors: 2, 3 (reverse-scored), 5 (reverse-scored), 6 (reverse-scored), 8 (reverse-scored), 10 (reverse-scored), 13, 24