EVIDENCE OF EMOTION KNOWLEDGE IN DOWN SYNDROME

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ABSTRACT

Emotion knowledge was examined in 19 children and adolescents with Down syndrome (DS) who were individually matched to typically developing (TD) children of equivalent mental age (3 - 6 years). The ability to identify emotions from facial cues and social context was measured. This study improved upon past research by assessing emotion knowledge without a verbal narrative of the social context (minimizing language ability from interfering with emotion judgments), by using more engaging video stimuli, and by simplifying response demands.

Children viewed videos created for this study that included three types of emotion cues: face only (only the protagonist's facial expressions were shown), context only (the protagonist acted out action sequences, but his face was blurred), and context plus face (actions and facial expressions were visible). An exploratory fourth video type (incongruent) was included in which the protagonist's facial expressions contradicted what would be expected from the context. Children responded by pointing to a schematic face of a happy, sad, or fear expression. Static photographs of facial emotion expressions were also presented to follow previous DS studies.

Results indicated that the participants with DS performed as well as the TD participants on every measure of emotion knowledge. Additional analyses compared DS and TD participants' performance on the static vs. dynamic expressions, emotion expressivity, empathic behaviors, and accuracy for each emotion expression. Still, there were no group differences in level of emotion knowledge or its related skills. This study underscores the importance of using developmentally sensitive measures when studying special populations like DS.

LIST OF ABBREVIATIONS AND SYMBOLS

ANOVA	Analysis of variance
AWMA	Automated Working Memory Assessment
CA	Chronological age
CBQ	Children's Behavior Questionnaire
DANVA2-CF	Diagnostic Analysis of Nonverbal Accuracy2-Child Facial Expressions
DET	Differential Emotions Theory
DS	Down syndrome
EJT	Emotion Judgment Test
ID	Intellectual disability
IQ	Intelligence quotient
MA	Mental age
PPVT-4	Peabody Picture Vocabulary Test, Fourth Edition
TD	Typically developing
Cohen's *d*	Measure of effect size

F	Fisher's F ratio
Fisher's LSD	Fisher's least significant difference
Hu	Unbiased hit rate
M	Mean
n	Sample size for group
p	Probability associated with the occurrence under the null hypothesis
r	Pearson product-moment correlation
R^2	Coefficient of determination
SD	Standard deviation
SE	Standard error
t	Computed value of t-test
α	Cronbach's index of internal consistency
Δ	Change
η_p^2	Partial eta squared
$<$	Less than
$=$	Equal to

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INTRODUCTION

Down syndrome (DS) is the most common chromosomal abnormality as well as the most common known genetic cause of intellectual disability (ID). The cognitive profile of individuals with DS shows a pattern of relative strength in visuospatial skills and receptive vocabulary and relative weakness in expressive language, language comprehension, and auditory short-term memory (Chapman & Hesketh, 2000). A particularly unique characteristic of people with DS is their level of sociability. They are often viewed by others as more outgoing, affectionate, adept at understanding others, and happier than people with other causes of ID (Gibbs & Thorpe, 1983). Because of this 'friendly stereotype', it long has been assumed that people with DS possess relatively intact skills surrounding emotions, and for many years, researchers overlooked this topic of study. However, recent emerging evidence suggests that emotion understanding, or emotion knowledge, may be impaired in this population (for a review, see Cebula & Wishart, 2008; Wishart, 2007). If individuals with DS do have impaired skills related to emotion knowledge, then more researchers should investigate the extent of this impairment, with the ultimate goal of finding ways to strengthen their emotion knowledge. This should, in turn, help people with DS appropriately engage in meaningful interactions to form friendships and working relationships that will facilitate their quest for independent living. In this vein, the purpose of the present study was to examine emotion knowledge in DS from a broad lens, potentially to identify both areas of relative strength and weakness in related skills.

Emotion Theories

The study of emotions has a vast history, dating from the writings of philosophers such as Plato, Descartes, Darwin, and Wundt to more recent theories of Ekman, Izard, Lazarus, Saarni, and Solomon, to name a few. Regardless of perspective, a commonality among all is that emotions are core to human experience and behavior. These theories diverge at seeking to explain what causes the experience of emotions, how we interpret them, and how they affect our behavior.

One of the more prominent sets of theories, Differential Emotions Theory (DET, sometimes referred to as Discrete Emotions Theory), provides a broad framework for researchers to assess the development of emotions and emotion understanding. DET has its roots in Darwinism as far as explaining the basic, innate essence of emotional experience, and much of the theory's components were informed by the work of Silvan Tomkins, then expanded by Paul Ekman and Carroll Izard (Izard, 1991, 2007, 2011). Central to DET is that there are discrete basic, innate emotions. Within DET, there is a lack of clarity surrounding which emotions should be considered basic, particularly those that are considered to be more social emotions (i.e., contempt, shame, and guilt) and do not have easily recognizable facial expressions. However, all would agree that happiness (or joy), sadness, anger, fear, and disgust make the list. Also, neurological evidence has supported the notion of such discrete emotions at the biological level (e.g., Davidson, Saron, Senulis, Ekman, & Friesen, 1990; Vytal & Hamann, 2010). Although DET states that emotions are discrete, it does recognize that they co-exist in an organized system (Izard, 1991, 2007, 2011).

Another key aspect of DET is that basic emotions are independent of cognition. There is a cognitive component to emotion, but there are non cognitive components as well. Specifically,

emotions have neural, affective, and cognitive components. According to DET, the neural basis of emotion encompasses neurotransmitters and networks of the brain that mediate the evaluation of emotional stimuli. The affective component consists of sensory and perceptual processes that trigger or evaluate emotions (e.g., pain, fatigue, or even another emotion). Finally, the cognitive component refers to the thought processes that both trigger and evaluate emotions (e.g., anticipation, appraisal, or attribution).

Yet another important element of DET is the universality of emotion experience and expression (Ekman, 1973, 1984; Izard, 1971). Those supporting this view contend that facial expressions of emotion are automatic, and we possess innate links between specific facial expressions and specific feelings; any dissociation between the two must be learned. While sometimes there are cross-cultural differences in the causes of specific emotions, the feelings evoked and expressed span all cultures (Denham, 1998; Ekman, 1984). The idea of universality of emotion expression also implies universality of interpreting or recognizing facial expressions of these emotions. However, there are opposing views concerning the universality of emotion recognition. For instance, Nelson (1987) contended that there is not sufficient empirical support for innate understanding of emotions; instead, infant studies have merely demonstrated infants' discrimination among expressions, which may be separate from the ability to connect those expressions to others' mental states. Others, such as Harris and Saarni (1991) and Gnepp (1991), have proposed that emotions are a byproduct of social experiences, without which they would be meaningless. Modulating each extreme view, theorists such as Russell (1991) have stated that we have a universally innate system for distinguishing positive versus negative emotions, but our social experiences are crucial to developing specific emotions within valence. A more recent meta-analysis by Elfenbein and Ambady (2002) examined emotion recognition studies and found

support for the claim of universally recognizable emotions. However, they also found specific factors that influenced recognition accuracy levels: ethnic ingroup versus outgroup, majority versus minority groups, and level of exposure to diverse cultures.

Although other perspectives have their allure, it seems that DET may be the most encompassing theory upheld by research of how we experience and develop understanding of different emotions. Accordingly, it is readily applicable to DS, the population of interest in the present study, a group for which the emotion system has been thought to be intact, despite cognitive impairments. For these reasons, DET was used as the primary foundation for the present study. Remember that DET argues for a set of organized yet discrete innate, basic emotions that are universally experienced, expressed, and recognized. Further, there are both cognitive and non cognitive components to emotion. However, the present study primarily focuses on the more cognitive components of emotion, as this is where the majority of the research lies (Izard, 1991). It also allows for the investigation of the degree to which the cognitive impairments associated with DS extend to emotion understanding. A final aspect of DET that was incorporated into the present study is the importance of facial expressions in communicating one's emotions.

Although DET recognizes the role of social context in emotion recognition, it does not emphasize socialization experiences as a function of emotion understanding. However, emotion understanding does include knowledge of which emotions are appropriate for specific contexts. Thus, findings from other theorists, particularly those of Saarni and Gnepp, who highlighted the role of social context in emotion knowledge, also were used to inform the design of this study. By taking information from both perspectives, this study can examine emotion skills in DS much more globally.

Development of Emotion Knowledge

From what constitutes an emotion to what causes an emotion, the development of emotion knowledge helps us gain insight into ourselves as well as the social world around us. It is an important socio-cognitive factor in child development, and it aids children in understanding and successfully interacting with others in order to form meaningful social relationships. Emotion knowledge is a broad term that encompasses many skills, particularly the ability to understand the differences between internal emotional states, symbolically represent those states in cognition, identify causes of emotions, recognize emotion expressions in others, and label those expressions (Izard et al., 2011; Morgan, Izard, & King, 2010; Mostow, Izard, Fine, & Trentacosta, 2002). Young infants show signs of emotion recognition, and in the preschool years, emotion knowledge develops rapidly. For instance, performance on emotion recognition tasks dramatically increases between the ages of three and six years (Denham, 1998; Denham & Couchoud, 1990b; see Gross & Ballif, 1991, for a review).

Related to children's development of emotion knowledge are characteristics of the family environment, particularly those of the parents. As previously mentioned, socialization is an important process for developing emotion knowledge, and some theorists have gone so far as to explain the sheer function of emotions in terms of socialization. For instance, Saarni stated that emotion understanding cannot develop at all without the familial and cultural contexts (Saarni, 1999). Much empirical support for this has come from studies of parental roles in the early development of emotion knowledge (Denham, 1998; Denham & Grout, 1993; Denham, Mitchell-Copeland, Strandberg, Auerbach, & Blair, 1997).

Parents serve as models of what emotions to express and when these expressions are socially appropriate, and they respond to their children's expressions of emotions within the

familial context. Saarni (1999) also recognized that this is a bi-directional relation. A child's temperament (e.g., Rothbart & Bates, 1998) and own emotion skill set (e.g., Feldman, Philippot, & Custrini, 1991) influence his or her parents' behavior, while parents' behavior, family structure, and disciplinary practices influence the child's actions. Studies by Denham and her colleagues have also demonstrated this effect proposed by Saarni (1999). They examined preschoolers' emotion knowledge and related it to social competence, peer likeability, and prosocial behavior. They found that children with these better emotional and social outcomes also had mothers with more positive expressions, who talked about emotions, and who responded supportively to their children's emotion expressions (Denham & Grout, 1993; Denham et al., 1997). Furthermore, Gottman, Katz, and Hooven (1997) proposed the idea of parental "meta-emotion" and showed that it could predict children's social skills up to three years later. They suggested that parents who act in ways that promote their children's development of emotion understanding aid in their children's more general social and cognitive development as well. This idea has been upheld in the literature. For example, a recent study found that maternal "emotion-related social behaviors" predicted children's later emotion understanding, even after accounting for language skills (Warren & Stifter, 2008). The broader message from these exemplars and other related studies is that there are many factors affecting young children's development of emotion knowledge, and the development of this skill is also important in facilitating a number of positive social and cognitive behavioral outcomes.

In terms of outcomes, children's emotion knowledge is related to their social competence and academic success (Denham & Brown, 2010; Izard et al., 2001). As early as the preschool years, greater emotion knowledge is related to higher ratings of both peer and teacher likeability and more frequent prosocial responsiveness to peers (Denham, McKinley, Couchoud, & Holt,

1990). Preschoolers' emotion knowledge has been shown to predict a global measure of social competence in kindergarten (Denham et al., 2003; Denham, Zoller, & Couchoud, 1994) as well as positive and negative social behaviors in third grade (Izard et al., 2001). Additionally, emotion knowledge augments successful initiation of peer relationships, an important aspect of social competence for young children (Parker & Gottman, 1989).

There are multiple reasons why emotion knowledge plays such an important role in developing behaviors that lead to social competence. First, this relation can be explained by social information processing theories. For instance, the Lemerise and Arsenio (2000) model proposed that emotion knowledge directly contributes to the ability to accurately interpret information in the social context, subsequently leading to more accurate evaluation of social information and more adaptive behavioral responses. This fits with Crick and Dodge's (1994) well-established theory that social cognition guides goal-directed social behavior, and social behavior is the basis on which others evaluate their peers. More specifically, in a given situation, emotion knowledge provides children with a set of skills to attend to relevant social and emotional cues, interpret them in terms of another's intentions, evaluate possible behavioral responses against one's own goals, and decide on a goal-directed behavioral response that is most appropriate for the current context. Here, social cognition is the channel through which emotion knowledge exerts its influence.

A second explanation for the impact of emotion knowledge on social competence, consistent with the social information processing perspective, comes from Denham's work on emotion knowledge in younger children. Denham and colleagues (1990) have proposed that if a child mistakenly interprets his or her social partner's expression of displeasure for pleasure, then that child may continue to engage in the behavior that is causing the social partner's displeasure,

which could result in the social partner's dislike of the child. Conversely, if a child accurately interprets his or her social partner's expression, he or she will be able to respond appropriately and increase the chances of forming a positive relationship with the social partner. This was also evidenced by Barth and Bastiani's (1997) finding that preschoolers who mistakenly interpreted angry facial expressions in their peers at the beginning of the school year showed negative social behavioral outcomes by the end of the school year.

A third explanation for the relation between emotion knowledge and social competence is through the mediating role of emotion regulation (Izard et al., 2011). According to Saarni (1999), children who have problems regulating their own emotions may interpret a situation in a biased manner, and they may have trouble selecting the appropriate goal that takes into account the social context. This is what Crick and Dodge (1994) referred to as "preemptive processing". This was also reflected in Denham's theoretical model of emotional experience (Denham, 1998), which explained that when children correctly recognize emotions in themselves, they engage in cognitive appraisals that will lead to successive changes in goal-directed behavior. While intact self-regulation allows children to behave in socially acceptable ways, dysregulation can cause socially undesirable behaviors such as anger outbursts, temper tantrums, or simply ineffective communication of one's feelings, a skill that is also crucial to successful interactions (Denham, 1998; Jones & Raag, 1989; Malatesta, Culver, Tesman, & Shepard, 1989). Further, Denham posited that children who tend to display negative affect such as sadness or anger not only decrease their chances of being well-liked by others, but also they miss opportunities to attend to the emotional needs of others and act in empathic or prosocial ways.

In sum, emotion knowledge is a paramount set of skills in children that influences social competence. Its influence can be direct, through social information processing, or indirect,

through emotion regulation and expression. Thus, deficits in emotion knowledge can lead to ineffective processing of social cues and inappropriate emotional displays.

Emotion Knowledge in DS

Given that emotion knowledge is such a critical factor in developing and maintaining meaningful relationships, it is important to understand how it develops in individuals with ID, or more specifically, those with DS. Adequately developing emotion knowledge should help those with DS successfully interact with others and form lasting friendships, which can be particularly problematic for adolescents with ID (Brantley, Huebner, & Nagle, 2002) in general as well as those with DS (Carr, 1995; Jobling, Moni, & Nolan, 2000). Successfully interacting with others should also help people with DS connect to their social environment, enabling them to learn more, obtain and maintain jobs, and ultimately achieve a level of independence they may not otherwise experience.

Research on relevant topics in DS points to both similarities and differences between infants or young children with DS and those with typical developmental patterns. First, research on social information processing in DS as it relates to emotion knowledge is sparse. In one study, infants with DS showed fewer signs of fear than typically developing (TD) infants in the classic visual cliff paradigm (Cicchetti & Sroufe, 1978). In another study, infants with DS showed the same decrease in looking and smiling behaviors when their mothers' faces ceased to display emotional expressions using the still face paradigm (Moore, Oates, Hobson, & Goodwin, 2002). However, they differed from the TD infants in that they showed fewer signs of distress during this phase of the still face study. In yet another study, infants with DS showed smiling and laughing behaviors to the same social stimuli that elicit these behaviors in TD infants, although the developmental pattern of these behaviors was delayed in the DS group (Cicchetti & Sroufe,

1976). Furthermore, these affective behaviors were related to cognitive developmental level in the DS group, suggesting a relatively intact integration of affective and cognitive development in infants with DS when interpreting social information. From these studies, the research on social cognition and emotion knowledge in DS is rather inconclusive.

Second, in terms of emotion regulation, researchers have found that infants with DS show less distress than TD infants in response to separation from their mothers during Ainsworth's strange situation paradigm (Thompson, Cicchetti, Lamb, & Malkin, 1985; Vaughn et al., 1994). In terms of emotion expressiveness, research is also sparse. However, a few studies have examined this. For instance, Kasari and her colleagues found that young children with DS and TD children spent similar amounts of time expressing emotions in a play situation, although the DS children changed their expressions more often, and their facial expressions were overall less intense (Kasari, Mundy, Yirmiya, & Sigman, 1990). Also of relevance is the finding that infants with DS have less readily interpretable vocalized expressions of emotions than TD infants (Carvajal & Iglesias, 2006). However, as previously stated, there is little research to inform us about factors related to emotion regulation and expression in DS.

Third, there is a body of research devoted to exploring DS individuals' abilities to understand emotion expressions of others. Infants with DS show interest in people over objects and engage in mutual gaze with their caregivers, although this develops more slowly than in TD infants (Berger & Cunningham, 1981). By approximately 1 year of age, while TD infants are exploring their broader environment, infants with DS show increased looking times at their caregiver's face (Carvajal & Iglesias, 2000). These are relevant behaviors because they allow for processing of their caregiver's facial information, such as emotion expressions. Furthermore, another study demonstrated that children with DS can respond in prosocial ways to a situation in

which an examiner pretends to be hurt; however, this response was not accompanied by empathic facial expressions that were seen in the TD children (Kasari, Freeman, & Bass, 2003). Although these studies are relevant to learning about emotion knowledge in DS, they are also limited in what they can tell us about the development of emotion knowledge in DS.

To date, the few research groups who have studied emotion knowledge in DS more directly, in terms of their ability to understand others' emotions, have focused primarily on facial emotion recognition skill (Hippolyte, Barisnikov, & Van der Linden, 2008; Williams, Wishart, Pitcairn, & Willis, 2005; Wishart, Cebula, Willis, & Pitcairn, 2007; Wishart & Pitcairn, 2000; see Kasari, Freeman, & Hughes, 2001 for an exception), presumably because this is a skill that develops early in TD children, with rapid development between 3 and 5 to 6 years. Thus, tasks that measure facial emotion recognition are appropriate for the mental ages (MAs) of the participants with DS, which were typically in the 3 to 6 year range in these studies. Additionally, these facial emotion recognition tasks are not usually high in the cognitive demands placed on auditory working memory or language processing, both of which are known relative weaknesses in individuals with DS (see Moore, 2001). The tasks used in these studies employed a facial emotion matching paradigm in which participants were required to match static photographs of children or adults expressing emotions to a target photograph of an emotion expression. They also included some form of a control task in which participants matched static photographs to a target on facial identity. Chronological age (CA) widely varied across the samples; however, all but one study (Hippolyte et al., 2008) focused on children or early adolescents with DS. The mean MA of the TD comparisons fell within the 3 - 6 year range for each study. In one of the studies (Wishart & Pitcairn, 2000), MA was not reported. However, the TD comparison group was in the 3 to 6 year CA range. Although a variety of methodological designs was employed in

these studies, there has been a consistent finding that individuals with DS exhibit significantly lower performance than MA or skill matched TD children on facial emotion matching tasks, while they perform at the same level of the comparison group on control facial identity matching tasks (Hippolyte et al., 2008; Williams et al., 2005; Wishart et al., 2007; Wishart & Pitcairn, 2000; see Turk & Cornish, 1998 for an exception).

Emotion Knowledge and Social Context: TD Children

While the ability to accurately interpret others' facial emotion expressions is undoubtedly a crucial component in judging others' emotions, this skill does not suffice in many social situations. Particularly, situational knowledge is also an important factor (Bretherton, Fritz, Zahn-Waxler, & Ridgeway, 1986; Denham & Couchoud, 1990b; Morgan et al., 2010). A basic knowledge of situations that commonly evoke certain emotion expressions can guide one's interpretation of others' emotions and lead to appropriate reactions. Situational information can provide additional cues for judging emotion, and sometimes it can serve as the sole indicator of emotion. This is particularly beneficial in situations in which the social partner masks his or her true feelings with a differing facial expression (Ekman, Friesen, & Ellsworth, 1982; Gnepp, 1983). Reflecting on the social information processing perspective, the role of social context is also highlighted. Some theorists have gone so far as to say that the social context is necessary for understanding emotions. For instance, Gnepp (1991) stated that emotions are determined by one's appraisal of a situation, and we need situational information to understand another's emotions. According to her, situations are "not defined by time, but by our perception of them as unitary elicitors of our reactions" (Gnepp, 1991, p. 153). For all of these reasons, it is apparent that social context is also an important factor in making judgments about the emotional states of others.

There is abundant evidence from earlier research that young TD children can attend to the social context to infer others' emotions (Borke, 1971; Gnepp, 1983; Greenspan, Barenboim, & Chandler, 1976; Gross & Ballif, 1991; Reichenbach & Masters, 1983; Ribordy, Camras, Stefani, & Spaccarelli, 1988; Wiggers & van Lieshout, 1985). This has been shown with a variety of methodologies. For instance, Borke (1971) assessed emotion situation knowledge by showing children pictures of a character with a blank face and narrating a story about the character. Then, children were asked to indicate which face the character should have. Children as young as 3 years were able to accurately respond to this task, though they also produced more errors than slightly older 8-year-old children. A similar study conducted by Kurdek and Rodgon (1975) found that children in kindergarten through sixth grade showed the ability to make emotion judgments from drawings of a child in emotion eliciting situations, and accuracy increased linearly with age.

While young children can behaviorally respond in meaningful ways to these kinds of situation only tasks, Gnepp (1991) pointed out that this does not give us much insight into the cognition behind this behavior. In other words, children could successfully complete this type of task by using either of two approaches: "projection" or "stereotypy", terms used by Chandler and Greenspan (1972) to describe such strategies. Children utilizing the projection strategy use their own personal experiences to respond based on how they would feel in that situation. Alternatively, children using stereotypy make gross generalizations across all people and respond based on a common emotion evoked from the given situation. As Gnepp (1991) mentioned, these tasks are not particularly good at differentiating between "projection" and "stereotypy" strategies. Regardless of strategy, they have shown that young children can use situational information to judge others' emotions.

Although young children can use situational information to judge others' emotions, reliance on this skill increases with age (Borke, 1971; Denham & Couchoud, 1990a; Hoffner & Badzinski, 1989; Reichenbach & Masters, 1983; Wiggers & van Lieshout, 1985). This was often termed 'social sensitivity' in the older research, presumably due to children's growing amount of experience in social situations. Many studies have measured children's social sensitivity, or reliance on social context, by using pictures (Borke, 1971; Gnepp, 1983; Hoffner & Badzinski, 1989; Kurdek & Rodgon, 1975), videos (Wiggers & van Lieshout, 1985), or oral stories (Reichenbach & Masters, 1983) of a protagonist in various situations (i.e., a child at a birthday party). The protagonist then expresses an emotion incongruent with the situation (i.e., a child at a birthday party expressing a sad face) and children are asked to respond about how the protagonist feels. If a child uses contextual information to make the judgment, then the response would be congruent with the situation. Conversely, if a child uses the protagonist's facial expression to make the judgment, then the response would be incongruent with the situation.

Most of these studies have found that older children tend to rely more heavily on the situation, while younger children use facial expressions to guide their judgments (Borke, 1971; Camras, 1986; Gnepp, 1983; Hoffner & Badzinski, 1989; Kurdek & Rodgon, 1975; Wiggers & van Lieshout, 1985; see Reichenbach & Masters, 1983, for an exception). Although sample ages varied in the studies, it seems that the general shift to greater reliance on the situation occurs in first grade children (approximately 7 years old), and situation reliance continues to increase throughout childhood. It is worth noting that in many of the above mentioned studies measuring emotion situation knowledge in TD children, verbal narration was used to describe the context, either to complement the pictures or videos, or as the sole descriptor (Borke, 1971; Denham & Couchoud, 1990a; Greenspan et al., 1976; Kurdek & Rodgon, 1975; Reichenbach & Masters,

1983; Ribordy et al., 1988; Wiggers & van Lieshout, 1985). It is possible that some of the age related differences in reliance on situational information could be due to language skill differences. It may be that the younger children relied more on faces in making judgments because this judgment required fewer language demands.

As previously stated, although younger children tend to rely on the facial expression in making emotion judgments when given a choice, it seems that they are capable of accurately using the social context in their judgments (see Camras, 1986; Gross & Ballif, 1991). This has been demonstrated further by masking the facial expression and forcing the child to rely on context (Borke, 1971) and by showing both the face and the situation, then prompting the child to report from memory what emotion was expressed in the situation (Gnepp, 1983).

Emotion Knowledge and Social Context: Individuals with DS

Very little is known about emotion situation knowledge in DS. It is possible that individuals with DS can successfully use situational information to interpret others' emotions. Because context provides additional cues that can be used in judging others' emotions, this may be one method of compensation for poor facial emotion recognition skills. Also, individuals with DS of an older CA have more experience in social situations than their MA matched peers, which may facilitate the use of a context-based strategy. However, it is also possible that individuals with DS do not process social information in a way that allows them to benefit from these social cues.

Only two known studies have begun to address this question (Kasari et al., 2001; Turk & Cornish, 1998). Turk and Cornish's (1998) study was designed to measure emotion skills in children with fragile X syndrome, another genetic cause of ID. However, they included comparison groups of children with DS and TD children. They assessed emotion situation

knowledge by showing children drawings of faceless characters in various contexts. The examiner told the children what was happening in each story and asked them to point to the schematic drawing of the facial expression matching the story. Children also completed other related emotion knowledge tasks. The group with DS scored lower than the fragile X and TD groups on the context-based emotion task, but the only significant difference was between the DS and TD groups. It is important to note that the details of the stories used in this task were provided via narration. This may have put the group with DS at a disadvantage due to their known impairment in linguistic processing.

Kasari and colleagues (2001) tested emotion situation knowledge in a sample of young children with DS using Denham's (1986) affective knowledge test, commonly known as the puppet interview. This is one of the most common paradigms for assessing emotion situation knowledge in TD children. At the beginning of the puppet interview, children are asked first to name expressions from schematic drawings of faces (expressive), then to point to schematic faces from emotion labels provided by the examiner (receptive). Finally, faceless puppets are used to act out a series of vignettes. The examiner narrates each story and makes a facial expression for the puppet. The vignettes consist of actions leading to an emotion expression which could be predicted by the context (i.e., going to a birthday party and expressing happiness). After each vignette, the child is asked to attach the correct schematic face to the puppet.

Kasari et al. (2001) found that at an MA of 3 years, children with DS performed as well as TD children on all three tasks (schematic emotion labeling, schematic emotion recognition, and emotion context), although both groups made many errors. Follow-up studies revealed that at the MA of 4 years, children with DS showed significantly lower accuracy than the TD group

for the emotion labeling and emotion context tasks, suggesting a developmental lag in these skills. Once again, more developed language skills are required for successful completion of such tasks. The authors included a measure of language ability, the Reynell Developmental Language Scales (Reynell, 1977), and showed that although the group with DS had lower language scores than the TD group, the group difference was not significant. However, they still discussed the auditory linguistic mode of presentation of the stories as a possible reason for low performance from the group with DS. Thus, both studies that have measured emotion situation knowledge in DS have used tasks which heavily rely on auditory linguistic processing, a well-documented weakness in DS.

Present Study

The main purpose of this study was to further understanding of the emotion recognition deficit in children and adolescents with DS by measuring this skill using a language-free presentation of context. Vignettes were presented in the form of brief video clips instead of pictorial drawings because it is likely that videos would be more engaging for all participants. Also, videos provide more realistic depictions of events and facial expressions that are dynamic, increasing the richness of the information presented. The increased amount of emotion cues could facilitate judgment, especially for the group with DS.

Measuring Emotion Recognition Skills

Because there was no such video in the emotion knowledge literature that fit the needs of this study, one was created. Drawing from the standard paradigm in the TD literature, the video consists of brief vignettes in which the actor depicts simple sequences of actions and/or emotion expressions. In order to assess whether participants have the ability to use context to make emotion judgments, some videos depict the context with the face digitally masked (context only).

In order to compare this directly with the ability to use facial expressions to make emotion judgments, other videos show only the facial expressions without context (face only). A third type of video shows both the context and the face, allowing for overall richer cues (context plus face). A fourth video type shows facial expressions that are incongruent with expectations based on the situational information. For these trials, participants could use either situational or facial expression cues to make the emotion judgment. The inclusion of the incongruent videos should demonstrate which of the cues the participants choose to use when presented with conflicting information. To more closely follow prior DS studies, another emotion task was included with face only static photographs as stimuli.

Because the use of four different emotions across all four video types and static photographs may produce a number of videos that exceeds the attentional capacity of the participants, only three basic emotions were used in this study: happiness, sadness, and fear. Following Gnepp's (1983) design, anger was excluded. In the present study, the rationale for this was threefold: (1) in preschoolers, the ability to recognize others' expressions of anger develops around the same time as, or only slightly after, the recognition of sadness (Denham, 1998; Gross & Ballif, 1991); (2) in the approach-avoidance model, happiness is considered a positive approach emotion, sadness is considered a negative approach emotion, and fear is considered a negative avoidance emotion (Silberman & Weingartner, 1986). Thus, different types of emotions were represented. Anger, however, is less clear, as individual differences may dictate whether it is an approach or avoidance emotion (Harmon-Jones & Allen, 1998); and (3) although fear develops later than the other basic emotions, it is thought that those with DS process it fundamentally differently (Williams et al., 2005); thus, it was important to keep fear as one of the emotions in the videos.

Hypotheses

In line with prior literature, it was expected that individuals with DS would show decreased performance in the face only static photos compared to TD MA matched peers. This would replicate previous findings by demonstrating that those with DS have a deficit in facial emotion recognition.

To understand the extent of this deficit (i.e., whether or not it extends to processing contextual emotion information), the following hypotheses were developed. They are presented as competing hypotheses because any of the following combinations of results was possible, and there was not clear evidence from the literature to predict one over the other.

Competing hypotheses.

1. Individuals with DS are able to use contextual information in isolation to judge emotions of others. If this hypothesis is supported, then participants with DS would perform at their developmental level (comparable to MA matched peers) on the context only videos, while showing decreased performance on the face only videos compared to MA matched peers. This would suggest that the emotion recognition deficit in DS is *specific* to processing facial emotion expressions.
2. Individuals with DS are not able to use contextual information in isolation when judging others' emotions. If this hypothesis is supported, participants with DS would exhibit lower performance than the TD group not only on the face only videos but also on the context only videos. This would suggest that the emotion recognition deficit in DS extends to a more *global* deficit in emotion information processing.
3. Individuals with DS need multiple cues to judge others' emotions. Support for this hypothesis would show lower performance in the DS group compared to the TD group on

both context only and face only videos, but equal performance between groups on the context plus face videos. This would suggest that the facial emotion recognition deficit that is seen in DS is due to the *limited amount of cues* provided in face only tasks.

Exploratory hypothesis. If individuals with DS can use context to judge emotions, then it is possible that they rely on context even when the face is present. The inclusion of incongruent videos should demonstrate whether or not they choose this strategy when there are conflicting cues. If they do choose this strategy, then the hypothesis that contextual information aids individuals with DS in making emotion judgments would be supported.

Related skills. To more fully understand emotion knowledge in DS, the present study included some additional measures that may explain individual differences in emotion knowledge. These are emotionally expressive behaviors (specifically related to the current emotions of interest: happiness, sadness, and fear) and empathic behavior. As discussed in the section on the development of emotion knowledge, these variables are related to measures of emotion knowledge in TD children. However, it is unknown whether individuals with DS show the same relational patterns among such variables. Additionally, because the stimuli used in the present study are nonverbal and visually presented in sequential fashion, visuospatial skills could also explain differences in performance. Thus, a measure of spatial sequential memory span was also included.

Study Implications

If children and adolescents with DS can use context to judge emotions in others, then we will be able to identify an area of relative strength in their emotion knowledge. Knowing whether or not they strategically rely on context will help with efforts in training programs targeted toward emotion skills. However, if individuals with DS cannot use context successfully in

emotion judgments, then we will understand the extent of their emotion knowledge deficit in a broader sense. The reason for their poor facial emotion recognition skills may stem from a broader inability to understand emotions in a social context. Regardless of the findings, this study's results will aid in understanding emotion knowledge in DS and directing efforts toward social skills training for these individuals. With the inclusion of additional measures that may relate to emotion knowledge in DS, this study also has the potential to help explain what causes individual differences in the development of this skill in those with DS.

METHOD

Participants

A total of 27 children and adolescents with DS along with 42 TD preschoolers participated in this study. In the DS group, 19 of these scored within the accepted range of mental age (MA) on the PPVT-4, and all 19 met other study criteria. In the TD group, 39 participants scored within the accepted MA range, and 3 others did not complete the testing battery due to refusal or scheduling conflicts. Thus, the final full sample included 19 participants with DS and 36 TD participants.

Most of the participants with DS came from the University of Alabama Intellectual Disabilities Participant Registry, and some were referred to this study after completing other studies. TD participants were recruited from local preschool classrooms.

Participation criteria included a PPVT-4 MA between 3 and 6 years. This MA range was chosen because it is the range in which emotion knowledge develops rapidly in TD children, and it follows the extant literature on this topic. Other criteria included the use of hearing, vision, simple speech, and hand/arm motor skills in daily functioning. These criteria ensured that participants could hear task instructions, see the stimuli, and provide single-word as well as pointing responses. Although participants were not required to be highly verbal, they were required to possess the receptive language ability to understand basic instructions presented orally by the experimenter. We relied on parental judgment about these skills when screening potential participants. An additional criterion for participation was the absence of a diagnosis of

an autism spectrum disorder, as reported by the parent or teacher. The reason for this exclusionary criterion was that research suggests atypical development of emotion knowledge in individuals with autism spectrum disorders (see Harms, Martin, & Wallace, 2010 for a review) which could potentially act as a confounding variable. A CA between 6 and 18 years was an additional criterion for the DS participants. For all participants, parental consent along with child assent was obtained before official enrollment in the study.

Group-level matching. Participants who met inclusionary criteria were 19 with DS and 36 TD. See Table 1 for means and standard deviations of sample descriptives. An independent samples *t*-test showed that there was no significant difference in PPVT-4 MA between the group with DS and the TD group, $t(53) = 0.42$, $p = .67$. The distribution of MAs was also similar in each group (DS 3.17 - 6.67, *Median* = 4.58; TD 3.17 - 6.67, *Median* = 4.71). Thus, the participants were considered matched on MA at the group level. See Table 1 for means and standard deviations.

In this sample, the TD preschool children ranged in age from 2.50 to 5.58 years. The group with DS had an older CA (6.67 - 18.42 years), but they were equivalent to the TD group on PPVT-4 MA. PPVT-4 standard scores ranged from 80 to 131 in the TD group and from 20 to 85 in the group with DS (Table 1). In terms of other demographics, the two groups were similar in sex (TD 58% male; DS 63% male) and race (TD 78% Caucasian-American, 11% African-American, 11% Other; DS 79% Caucasian-American, 5% African-American, 11% Hispanic-American, 5% Other). They were also similar in annual household income level (TD *M* = $106,750; *SD* = 50,026; DS *M* = $101,324, *SD* = 59,606).

Individual-level matching. The larger TD sample allowed for enough participants to be individually matched to the DS participants based on MA. First, PPVT-4 MA was calculated for

each of the 19 participants with DS. Next, for each DS participant's MA, an equivalent PPVT-4 MA was found from the TD sample, creating a pair of participants matched on MA. For some DS participants, an exact match was not possible; in these cases, the closest possible match was used (within approximately 2 or 3 months). These matches were balanced such that in one pair, if the DS participant had a slightly higher MA than the TD participant, then the next pair would include a TD participant who had a higher MA than the DS participant by a similar margin. This matching procedure resulted in 19 pairs matched on MA (Table 1). This individual-level matching allowed for increased power to detect an effect in the main analysis because diagnosis (DS vs. TD) could be considered a within-subjects factor. However, in certain secondary analyses, such as correlations, including the larger full sample of TD participants would provide for more power. Thus, the full sample was used for such analyses. To be clear, the description for each analysis in the Results section includes which matched sample (group-level or individual-level) was used.

In the matched pairs sample, the TD children ranged in age from 2.50 to 5.58 years, and their PPVT-4 standard scores ranged from 80 to 131. They were 79% male; 74% were Caucasian-American, 16% African-American, 5% Hispanic-American, and 5% Other. Their average annual household income was $106,750 (*SD* = 50,026). Demographics of the DS group were the same in both types of matched samples because the same 19 participants were included.

Table 1

Means and Standard Deviations (SD) of Sample Descriptives

	DS *n* = 19		TD Individual Matched *n* = 19		TD Group Matched *n* = 36	
	Mean	SD	Mean	SD	Mean	SD
Chronological Age	11.44	3.64	3.86	0.85	3.81	0.77
PPVT-4 - Mental Age	4.66	1.09	4.65	0.98	4.78	0.97
PPVT-4 - IQ	48.89	17.15	111.26	13.23	114.39	11.29

Design

To test the three competing hypotheses, this study utilized a 2 (Diagnosis) X 3 (Video Type) within-subjects design, with Diagnosis (DS vs. TD) as a within-subjects factor using the individual-level matched pair sample. Emotion Content (Video Type: context only vs. face only, vs. context plus face) was also a within-subjects factor.

Measures

Emotion Judgment Test (EJT; Approx. 15 min total). The main purpose of the EJT was to measure participants' ability to identify one of three basic emotions (happiness, sadness, or fear) from emotions expressed by a protagonist in brief video clips. This task was designed specifically for this study. Aspects of its design came from Denham's puppet interview (Denham, 1986), and the format of different video types came from classic studies on the role of social context in emotion knowledge in the TD literature (Gnepp, 1983; Hoffner & Badzinski, 1989; Reichenbach & Masters, 1983; Wiggers & van Lieshout ,1985). The EJT was piloted with participants similar to those in the present study sample. See Appendix A for data from the piloting phase.

Brief video clips (5 - 10 seconds each, depending on video content) depicted a protagonist acting out a sequence of actions and/or making facial expressions. The same male child actor played the protagonist in each clip, although there was sometimes another actor included to depict certain events. It should be noted that the face of the other actor was never visible. Elements of the protagonist's wardrobe changed from scene to scene so that participants would not falsely believe that the video consisted of one continuous sequence of events in which emotions experienced in one scene affected those in the following scene. For all videos, there was no verbal language. Thus, participants were forced to rely on visual processing to understand their content.

There were three main types of videos that differed on which information was included within each clip: context only, face only, and context plus face. In the context only condition, the protagonist portrayed a sequence of actions, and his facial expressions were digitally masked. In the face only condition, the protagonist was standing against a neutral background; he began with a neutral face and formed an emotion expression using only his face. In the context plus face condition, the protagonist portrayed a sequence of actions, and his face displayed an emotion expression in reaction to the event. Each video type contained six video clips expressing three basic emotions (happiness, sadness, and fear) two times each. In order to keep the length of exposure to the emotion expressions consistent across video types, each video was set so that the expression was held for exactly two seconds. See Table 2 for a list of each video clip's content.

A fourth video type, incongruent videos, presented both the social context and the facial expressions. The protagonist portrayed a sequence of actions that commonly evokes one of three basic emotions (happiness, sadness, or fear), but his expression did not match the emotion depicted by the event (Table 2). Each emotion was depicted twice in the context and twice in the

expression, for a total of six videos of the incongruent type. The context and expression never matched within a video clip for these videos. Emotion expressions were also held for two seconds in this video type.

Table 2

List of EJT Vignettes and Emotion Expressions by Video Type

Vignette	Emotion	Vignette	Emotion
Context Only		*Context plus Face*	
Sees a spider	Afraid	Blows out candles on a cake	Happy
Opens a birthday present	Happy	Crawls up a ladder into a dark attic	Afraid
Balloon floats away	Sad	Gets a balloon	Happy
Soccer ball is stuck in a tree	Sad	Watches his dad leave with a suitcase	Sad
Sees a snake in the grass	Afraid	Looks at the ground from high platform	Afraid
Gets an ice cream cone	Happy	Lays in bed sick with a fever	Sad
Face Only		*Incongruent*	
None	Sad	Gets a first place medal	Sad
None	Happy	Opens dark closet and hears a monster	Sad
None	Afraid	Blows bubbles	Afraid
None	Sad	Spills milk all over his snack	Happy
None	Afraid	Gets a shot from the doctor	Happy
None	Happy	Drops ice cream scoop on the ground	Afraid

Development of video content. For the videos containing situational information (context only, context plus face, and incongruent), vignettes consisted of situations that commonly evoke a particular emotion. Most of these vignettes were taken from ones reported in prior studies that were rated to reliably evoke certain emotions in children (Borke, 1971; Denham, 1986; Gnepp, 1983; Hoffner & Badzinski, 1989; Kurdek & Rodgon, 1975). Some of the vignettes were adaptations of those used in previous studies so that they could be depicted more clearly, and a few were new scenarios devised for this study.

All videos were piloted with adult "experts" who identified both the situational and emotional content of each video with at least 90% accuracy. Although TD adults were able to

understand each of the vignettes, it was possible that children with DS may not possess the same capability to interpret content of each video clip. To find out, a survey was distributed to parents of children with DS who fit the CA criterion of the present study. In the survey, parents were asked to respond with 'yes' or 'no' to the question, "If your child watched a video *without any words* of another child in the following situations, could s/he understand what was happening?" The situations listed in the survey came from the original set of vignettes used in the videos for this study. Possible alternative vignettes were also included in the survey in case some items needed to be replaced.

Parents of 10 children with DS (5 - 12 years old) responded to the survey. One of these children had a diagnosis of an autism spectrum disorder and communicated primarily in sign language, while another child was adopted and had been living with the family for less than one year. Data about these two children were excluded because the children did not fit the sample of interest in the present study. Thus, the final sample consisted of parents of 8 children with DS (Mean CA = 9.05 years). Overall, parents said 'yes' to most of the scenarios listed, although there were some scenarios for which several parents responded with 'no'. Only scenarios for which no more than one parent responded with 'no' were included in the final set. This resulted in the replacement of two vignettes from the original set. Note that the vignettes presented in Table 2 are from the final set.

Administration of the EJT. Administration of the EJT included two parts: Schematic faces and Video emotion recognition. Each is described in detail below.

Schematic faces. This aspect of the EJT came from the structure of Denham's puppet interview (Denham, 1986). Schematic faces are commonly used in emotion recognition studies, and they are recommended for use in samples of nonverbal or young children, as they are

considered more simplistic and easier to identify than photographed faces (MacDonald, Kirkpatrick, & Sullivan, 1996).

In the first part, participants were asked to first *generate* (expressive) then *point to* (receptive) emotions from schematic drawings of faces. In the *generative* phase, schematic faces of three basic emotions (happiness, sadness, and fear) were placed in front of the participant in random order. The experimenter pointed to the faces one at a time and asked the participant "What is this face?", recording the participant's verbal response. Then, to begin the *pointing* phase, the experimenter shuffled the faces and placed them in front of the participant in a different order. This time, the participant was asked to point to each emotion after the experimenter provided the emotion name. After the first attempt, the experimenter corrected the participant for any emotions he or she incorrectly identified, the faces were shuffled, and the participant had another chance to point to each emotion named by the experimenter. The same procedure was repeated a third time. The repetitions allowed for a training phase in this task.

For the *generative* phase, one raw point was given for accurately naming each emotion. Due to the phrasing of the question ("What is this face?") and the fact that no choices were provided (free response), the response "smile" was counted as correct for happy, and the response "frown" was counted as correct for sad.

Although the *generative* score was useful for group comparisons, it was not included in the criterion score for the EJT because it required verbal responding. In the criterion score, one point was awarded for accurate *pointing* to each emotion face, each of three times. This yielded a total raw score out of nine (three possible points per emotion). A criterion of at least two out of three points per emotion was required for administration of the video emotion recognition portion of the EJT. This criterion was set because participants used the schematic faces to

indicate their responses in the video emotion recognition. Higher total scores on schematic faces indicate greater ability to match emotion labels with schematic faces.

Video emotion recognition. At the beginning of this task, participants were told that they were about to see a movie about a boy named Charlie and that they would be asked to tell the examiner how Charlie felt. Videos were presented on a standard laptop computer screen. For all video types, a blank screen appeared after each clip, and participants were asked first to tell the experimenter how Charlie felt from a list presented orally ("happy", "sad", or "scared"). Then, the participants were asked to identify how Charlie felt by pointing to one of the schematic faces used earlier. The requirement of a verbal response allowed for a broader measure of emotion knowledge that includes emotion labels, while the inclusion of a pointing response allowed for a language-free mode of responding. Responses were recorded by the examiner and, when present, a second scorer. Short breaks were given between blocks as needed to avoid fatigue.

Presentation of the three main video types (context only, face only, and context plus face) was counterbalanced across participants. All trials within one condition were shown before proceeding to the next condition, thus utilizing a block design. This was to decrease possible participant confusion from switching unnecessarily between video types. Within each block (video presentation type), each of the six videos was presented in a fixed random order. Also to prevent confusion, the fourth video type, incongruent, was always presented last, as this task was exploratory and more complex than the others.

While the experimenter served as the primary scorer, a second scorer observed some of the testing sessions and independently scored the verbal and pointing responses. There was a second scorer for approximately one-third of the participants, and there were only two discrepancies (two items), both of which were resolved after talking it over with the

experimenter post-session. In both cases, the discrepancies were due to the second scorer having trouble hearing/seeing the participant's response, not from misinterpretation of an ambiguous response.

In the three main video types (context only, face only, and context plus face), one point was awarded for correctly labeling and one point for correctly identifying the depicted emotion, for a total of two possible points per video. For the verbal responses, "smile" and "frown" were sometimes given instead of "happy" and "sad"; these were counted as incorrect because the experimenter specifically asked participants "How does Charlie feel?", and smile and frown are not feelings. Also, the examiner provided participants with verbal choices after each trial, and "happy" and "sad" were the terms used by the examiner. Raw scores were calculated for each subtest. Additionally, as suggested by Wagner (1993), unbiased hit rates (Hu scores) were calculated by applying statistical transformations to correct for patterns of guessing. Higher scores in the context only task indicate participants' ability to use contextual information to identify emotions. Higher scores in the face only task reflect the ability to identify emotions expressed in dynamic faces. Higher scores in the context plus face task reflect participants' ability to judge emotions in a more realistic setting in which both the context and the facial expression are displayed. Internal consistency reliability of the overall EJT (across the three video types) in the full TD sample was α = .81, and reliability was α = .87 in the DS sample.

The incongruent task yielded a valence score on a scale from -12 to +12. For each video, if participants responded based on the *facial expression,* they were given one negative point (-1) for accurately naming and another negative point (-1) for accurately pointing to the *facial expression*. However, if participants responded based on the *social context,* they were given one positive point (+1) for accurately naming and another positive point (+1) for accurately pointing

to the emotion depicted by the *context* in each video. If participants responded incorrectly, they were given a zero for that item. This scoring system yielded a total score ranging from -12 (always responded with facial expression) to +12 (always responded with context). The sole purpose of the valence score was to differentiate response types on a common scale; thus, the assignment of negative numbers to face responding and positive numbers to context responding was arbitrary. If participants did not consistently choose one strategy (face vs. context), or if they did not respond with much accuracy, their scores were close to zero.

Static Faces (Approx 5 min). This measured participants' ability to identify one of three basic emotions (happiness, sadness, or fear) from still photographs of children's facial expressions. This additional face only task was formatted in parallel to the videos described above (i.e., 6 trials, 2 per emotion) but instead used static photographs of facial expressions. This task was included to allow a comparison of presentation type (static image vs. video) of the facial emotion recognition tasks. Also, it uses the same type of stimuli (static photos) as previous studies of facial emotion recognition in DS (Hippolyte et al., 2008; Williams et al., 2005; Wishart et al., 2007; Wishart & Pitcairn, 2000). In case there was differential performance across types of stimuli for the DS group, it was useful to have a task with stimuli comparable to previous studies when interpreting results of this study.

A subset of photographs was taken from the Diagnostic Analysis of Nonverbal Accuracy 2-Child Facial Expressions (DANVA2-CF; Nowicki & Carton, 1993), a well-established measure that has been used in both typical and atypical child samples. The DANVA2-CF consists of 24 photographs of various children's faces expressing happiness, sadness, anger, and fear. There were two reasons for including only a portion of the DANVA2-CF photographs in this study: (1) the DANVA2-CF includes expressions of anger, which was not an emotion of

interest in this study, and (2) due to limited testing time for participants, it was important to keep the number of trials to a minimum. Six photos (2 per emotion) of happy, sad, and afraid faces were chosen to keep consistency with the video facial emotion recognition task. Similar to the video task, participants viewed each photo, one at a time, and they were asked, "How does this child feel - happy, sad, or afraid?" A verbal and pointing (to schematic face) response was solicited for each photo. This was consistent with the presentation of the video face only task in the EJT, and it also followed the instructional guidelines provided by the authors of the DANVA2-CF, who specified that the task be forced choice and suggested placing the choices in front of participants as needed. Also like the EJT, a second scorer independently scored the verbal and pointing responses for approximately one-third of the sessions, and there were no inter-scorer discrepancies. One point was awarded for a correct verbal response along with one point for accurate pointing. Raw scores out of 12 possible points as well as Hu (unbiased hit rate) scores were used. Higher scores indicate greater ability to recognize emotion expressions from pictures of faces.

The reported internal consistency of the DANVA2-CF is good, with Cronbach's alphas of .74 for adult raters, .76 for fifth graders, .71 for third graders, and .70 for first graders. Further, test-retest reliability over a period of two months was .88 for adults and .79 for third graders. The authors of the DANVA2-CF also provided norms from an aggregate of studies using the DANVA2-CF with participants spanning 3 years to 99 years of age.

Peabody Picture Vocabulary Test, Fourth Edition (PPVT-4; Dunn & Dunn, 2007; 15-20 min). This measure was used to assess participants' verbal ability and match the groups on this criterion. Although it is a measure of language ability, more specifically it measures receptive vocabulary, a skill that is usually intact (relative to developmental level, or MA) for

individuals with DS (Chapman, Schwartz, & Kay-Raining Bird, 1991). Thus, this measure is a particularly good estimate of general ability level for participants with DS.

The PPVT-4 consists of a series of illustrations arranged on a page. Each child was asked to select the picture that best represented the word spoken by the examiner. Raw scores were calculated by subtracting the number of errors from the child's ceiling score. Standard scores, growth scores, and age equivalents were calculated by using the norms provided by the publisher. Higher scores indicate greater receptive vocabulary and higher MA. Internal consistency reliability for the PPVT-4 is .94, and reported test-retest reliability is .93. It is standardized for ages 2.5 years through 90 years and older.

Corsi Block-Tapping Task (Corsi Task; Approx 5 min). The Corsi Task was used to measure spatial sequential memory span. The purpose of the task in this study was to include a measure of a visually based ability that may be correlated with outcomes on the EJT video emotion recognition, because the EJT seems to rely on visuospatial memory in order to follow the sequence of actions in the videos. It is possible that performance on the EJT was related to, or dependent on, visuospatial memory.

Variations of the Corsi Task have been used in a plethora of research studies over the years, and its use is also common in samples of DS with characteristic MAs and CAs that are similar to those in the sample of this study (Frenkl & Bourdin, 2009; Hick, Botting, & Conti-Ramsden, 2005; Jarrold & Baddeley, 1997; Laws, 2002; Vicari, Carlesimo, & Caltagirone, 1995). Although there is not a standard mode of administration, procedures in prior studies followed those first described by Milner (1971); thus, this study utilized a similar format. Following Milner's description, nine cube-shaped blocks were mounted on a board in a non-symmetric display (positions outlined by Milner), and the experimenter tapped a sequence of

blocks at a rate of one block tap per second. Then, the participant was required to imitate the tapped sequence in the same order as the experimenter. After four practice trials with feedback, the experimenter initiated the test trails. The number of blocks per sequence began with one block and increased incrementally until the participant's block span could be determined or the maximum number of blocks per sequence, nine blocks, was reached.

This study used block-tapping sequences outlined in the Block Recall subtest of the Automated Working Memory Assessment (AWMA; Alloway, 2007). The AWMA's Block Recall was normed for children as young as 4 years, but this study sample included 3-year old TD children and older DS participants with an MA of 3 years. For this reason, the administration of the Corsi Task was modified to accommodate slightly younger children. One modification was to use a board similar to the studies described above to tap out the sequences. This was in lieu of the computerized version of the AWMA that would have required the use of a mouse to click on the blocks in the sequences. Also, the scoring procedure was modified slightly. Following the previous study that used a DS sample most similar to this study (Jarrold & Baddeley, 1997), four trials were administered at each sequence level. If the participant passed at least three of the four trials at a given level, administration proceeded to the next sequence level. Administration ended once the participant failed two or more trials within a sequence level and all four trials were given at that level.

Two scores were yielded: a raw score and a spatial span. The raw score equals the total number of trials passed out of a possible 36. The spatial span is the highest sequence level at which three or more trials were passed; thus, spans could range from 1-9. Higher scores indicate greater spatial sequential memory ability.

Children's Behavior Questionnaire (CBQ; Rothbart, Ahadi, Hershey, & Fisher, 2001). This is a parent questionnaire that is often used to assess individual differences in young children's temperament. Only certain relevant subscales were used in this study: *Smiling and Laughter, Sadness,* and *Fear*. These three subscales correspond with the three emotions of interest in this study and produced a measure of children's emotional expressivity within the family. The CBQ is validated for children aged 3 to 7 years, although it has also been used in older children with ID (Klein-Tasman & Mervis, 2003; Nygaard, Smith, & Torgersen, 2002). Nygaard and colleagues used the CBQ in a large-scale study of individuals with DS of CAs and MAs similar to the sample in the present study, and they reported a mean internal consistency reliability score of the CBQ in the DS sample that was only slightly lower than that of their MA matched TD child sample. Thus, there was sufficient justification for use of the CBQ with an older sample of individuals with DS in this study.

Questions on the CBQ asked parents to respond to statements on a 7-point Likert scale ranging from 1 ("extremely untrue of your child") to 7 ("extremely true of your child"). In the three subscales of interest, statements included descriptions of specific emotions that may be exhibited in response to certain experiences, and parents were asked to mark whether or not they were true of their child within the last six months. Many of the emotion experiences described in these three subscales of the CBQ are similar to the video vignettes used in the EJT in this study. There are 12-13 statements per subscale of the CBQ, for a total of 37 statements across the three subscales. Reported internal consistency reliability varies by subscale and age; the mean internal consistency reliability alpha is .74 (Rothbart et al., 2001). Specifically, reported reliability alphas for the subscales of *Smiling and Laughter, Sadness,* and *Fear,* are .78, .70, and .70, respectively. Higher scores on *Smiling and Laughter, Sadness,* and *Fear* indicate children's greater behavioral

displays of happiness, sadness, and fear, respectively, as reported by the parent. Scores on the CBQ were considered by individual subtest as well as an aggregate measure of emotional expressivity, and they were included as possible correlates of emotion knowledge scores from the EJT.

A measure of *Empathy* from Rothbart et al.'s CBQ packet was also used in this study. This consisted of an additional 14 items also on the 7-point Likert scale described above. Items on the *Empathy* measure are designed to assess the degree to which children exhibit emotions corresponding to others around them. Empathy is relevant to this study, as there is a suggested link between empathy and emotion recognition (Carr & Lutjemeier, 2005), and it has been proposed that the ability to interpret others' emotions is necessary for vicarious feeling, a defining component of empathy (Eisenberg & Strayer, 1987; Izard et al., 2001; Tonks et al., 2008). The reported internal consistency alpha of *Empathy* is .80, and it is positively correlated to relevant dimensions of temperament on the CBQ (Rothbart et al., 2001). Higher scores on this measure indicate higher levels of parent-reported empathic behavior displayed by the child. *Empathy* scores were included as possible correlates of emotion knowledge as measured by the EJT.

Demographic form. A demographic form was used to obtain additional information about the child participant and his or her family. Relevant demographic information included children's gender and ethnicity, parents'/caregivers' education level, family income, number of siblings in the family, and adoption status. It was important to find out whether or not the child was adopted, and if so, when he or she was adopted, because this could affect the course of emotional development. All demographic information was gathered from the parent, usually at the same time as consent.

Procedure

Participants were tested individually by an examiner in a private room, sometimes with a second examiner observing and acting as a second scorer on the EJT and Static Faces. The full purpose of the study was disclosed to the participants before testing began. After obtaining both parental consent and child assent, the examiner administered the PPVT-4. If the participant did not meet the study criterion on this measure (MA of 3 - 6 years), then testing was discontinued. If the participant qualified to continue in the study, then the examiner administered the EJT, Static Faces, and the Corsi Task.

Testing occurred in one session or across two sessions on different days as needed. The ability to complete the tasks in one session varied from participant to participant, and accommodating these needs would more likely ensure that general fatigue due to testing remained consistent across participants. During the testing session(s), parents completed the CBQ and Demographic Form. If testing took place in a school without the parent, then the CBQ and Demographic Form were completed along with the consent form in a packet sent to the parent prior to testing.

At the end of the session(s), participants were given the opportunity to ask additional questions about the study and provide feedback about participation. They were thanked and offered a small prize.

RESULTS

Some analyses used the full sample of TD and DS participants matched at the group level, while others utilized the sample of individual-level matched pairs. Decisions about which sample to use depended on which would afford the greatest power to detect an effect in a given analysis. The description for each analysis below includes which matched sample was used.

Preliminary Analyses

Schematic faces. To ensure that participants understood the schematic faces used in the EJT, scores from the *pointing* phase of schematic faces were analyzed. Mean proportion scores were 97.68 (*SD* = 6.94) for the DS participants and 100.00 for the TD participants. Almost all participants in both groups had perfect scores.

Scores from the *generative* phase of schematic faces were considerably lower (DS *M* = 66.79, *SD* = 22.34; TD *M* = 68.58, *SD* = 20.79). However, in the *generative* phase, participants were required to verbally generate the emotion label without any feedback, while the *pointing* phase included feedback for training purposes as well as the provision of forced-choice pointing responses.

Proportion scores and Hu scores for emotion knowledge measures. Mean proportion and Hu scores for the EJT and Static Faces are presented in Table 3. Overall, participants' Hu (unbiased hit rate) scores were lower than their proportion scores. However, analyses conducted with proportion scores and Hu scores yielded the same patterns of results. So, for all reported

analyses, proportion scores were used because they are more commonly reported in the literature and more readily interpretable.

Table 3

EJT, Static Faces: Mean Proportion Scores and Mean Hu Scores

	Proportion Scores	Hu Scores
DS (*n* = 19)		
EJT Context only	74.56	65.79
EJT Face only	88.16	83.74
EJT Context plus face	85.09	80.24
Static Faces	71.71	58.74
TD (*n* = 19)		
EJT Context only	64.91	51.33
EJT Face only	84.65	78.11
EJT Context plus face	84.65	77.46
Static Faces	69.08	55.95

Static Faces. To replicate prior studies, a face only emotion recognition measure with static photographs as stimuli was also included in this study. It was hypothesized that participants with DS would score lower than TD participants on the face only photos. However, a 2-tailed paired samples *t*-test (using the individual-level matching) showed that there was no significant difference between DS (M = 71.71, SD = 16.70) and TD (M = 69.08, SD = 18.13) scores, $t(18) = 0.43$, $p = .67$, Cohen's $d = .10$. Thus, this hypothesis was not supported.

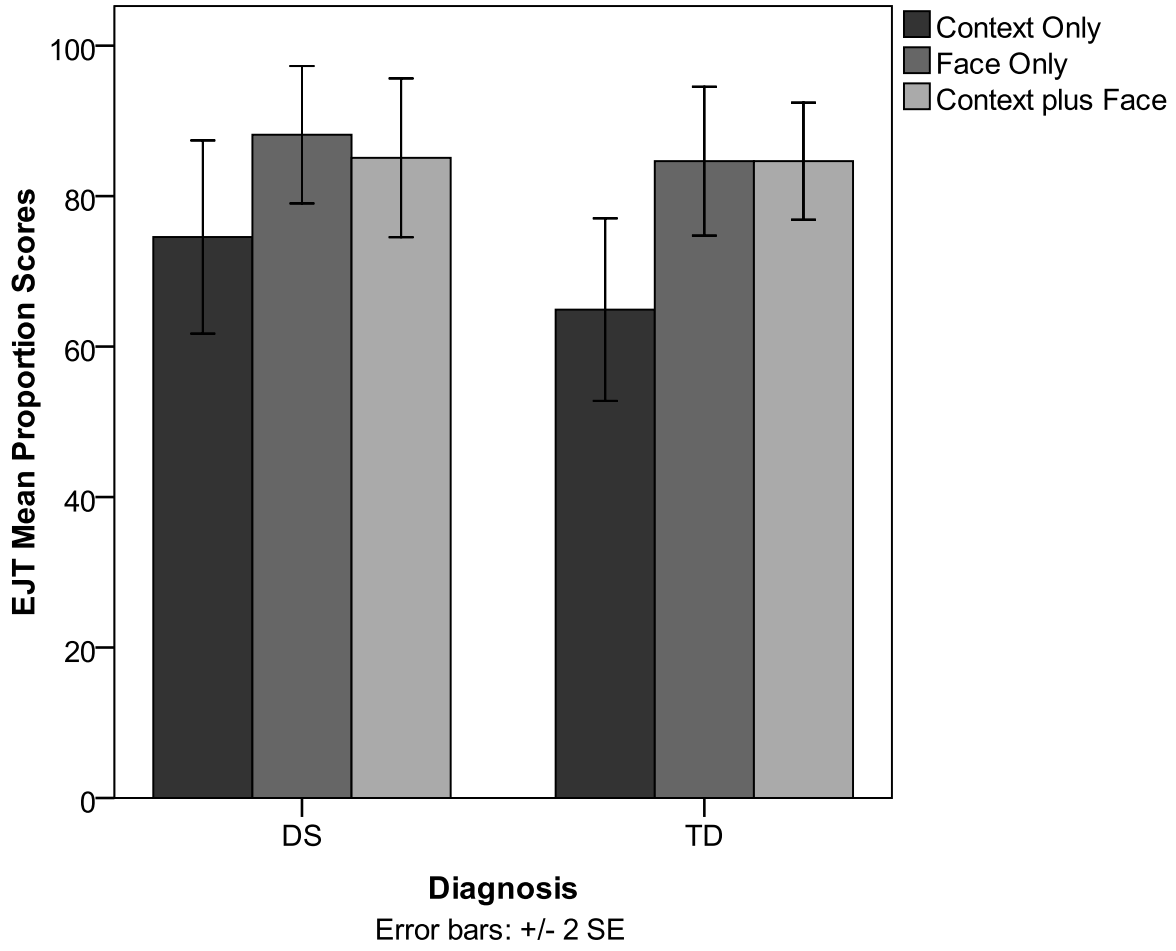
Corsi Block-Tapping Task. The group with DS had higher raw scores on the Corsi Task (M = 12.16, SD = 3.17) than the individually matched TD group (M = 8.79, SD = 2.94). A 2-tailed paired samples *t*-test revealed that this difference was statistically significant, $t(18) = 3.76$, $p = .001$, Cohen's $d = .86$.

Primary Analysis

A 2 X 3 within-subjects ANOVA was used to test the general hypothesis of an interaction between Diagnosis (DS vs. TD) and Emotion Content (context only vs. face only vs. context plus face). Diagnosis was within-subjects because the paired samples were used, and Emotion Content was a repeated measures factor. The ANOVA revealed no significant main effect of Diagnosis, $F(1, 18) = 0.61$, $p = .45$, $\eta_p^2 = .03$. However, there was a main effect of Emotion Content, $F(2, 17) = 20.37$, $p < .001$, $\eta_p^2 = .71$. Fisher's LSD *post hoc* pairwise comparisons revealed that for all participants, accuracy for context only videos ($M = 69.74$) was significantly lower than that of face only ($M = 86.40$) or context plus face ($M = 84.47$) videos. There was no significant Diagnosis X Emotion Content interaction, $F(2, 17) = 0.50$, $p = .62$, $\eta_p^2 = .06$, failing to support any of the competing hypotheses. Mean accuracy scores by diagnosis and by video emotion content are shown in Figure 1.

Figure 1

EJT Scores by Emotion Content



In sum, none of the hypotheses was supported because participants with DS showed similar performance to the TD participants on static photographs and all video types. These findings contradict this study's expectations based on previous studies. Thus, a closer look at the data was necessary to determine whether there were more subtle group differences that could explain the results. In the sections below, potential explanations to the group similarity in emotion knowledge are provided and tested. These include: static vs. dynamic expressions,

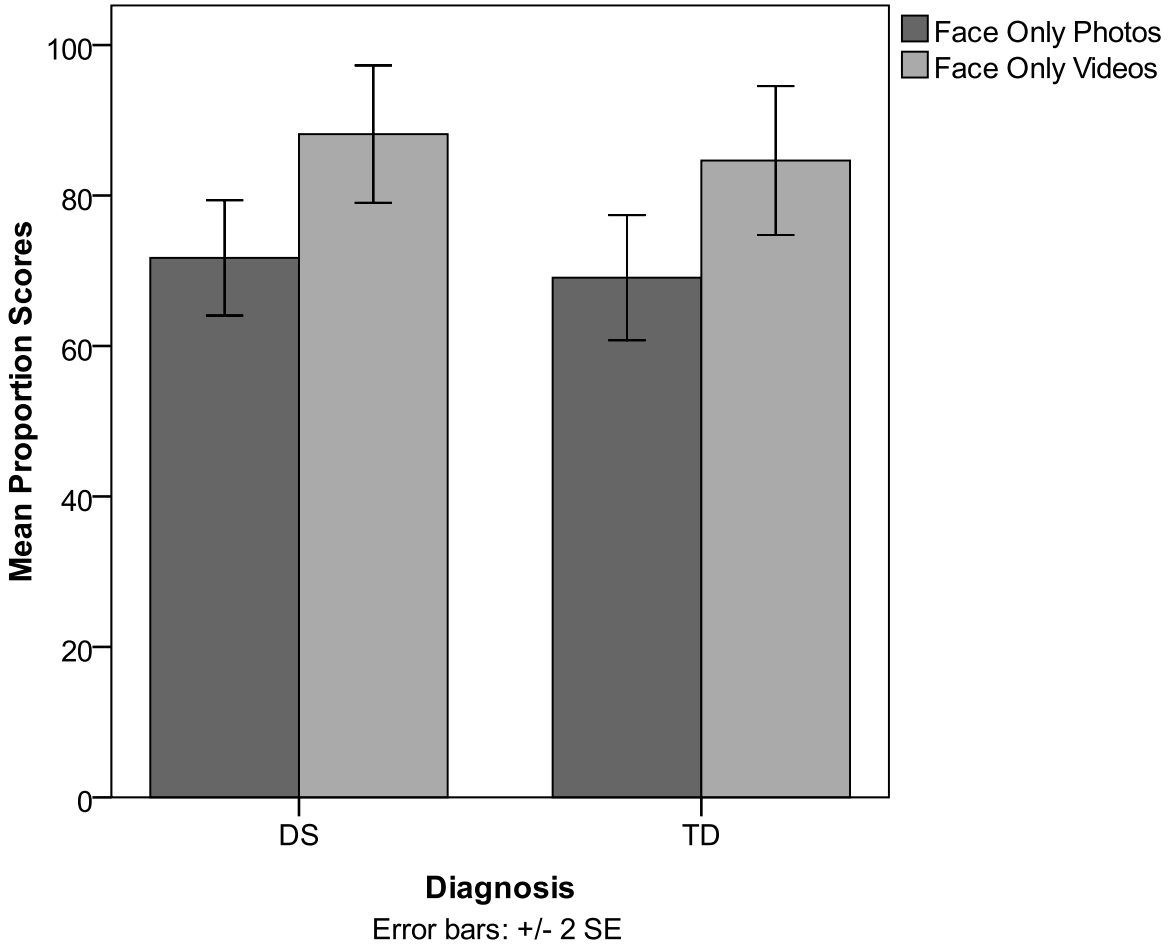
incongruent video scores, Corsi Task group differences, group correlations with other measures, and analysis by emotion on the EJT.

Testing Alternative Explanations to Group Similarity

Static vs. dynamic expressions. It was possible that the DS and TD participants differed in their facial recognition performance by presentation type (static photos vs. dynamic videos). To test this possibility, a 2 (Diagnosis: DS vs. TD) X 2 (Presentation Type: static vs. dynamic) repeated measures ANOVA was conducted for the face only stimuli. Diagnosis was a within-subjects factor because the paired samples data set was used, and Presentation Type was a repeated measures factor. Mean accuracy scores by diagnosis and by presentation type are presented in Figure 2. Results showed no main effect of Diagnosis, $F(1, 18) = 0.29$, $p = .60$, $\eta_p^2 = .02$. There was a main effect of Presentation Type, $F(1, 18) = 35.92$, $p < .001$, $\eta_p^2 = .67$, such that overall, participants displayed lower performance on static photographs ($M = 70.40$) than dynamic videos ($M = 86.40$). However, the interaction between Diagnosis and Presentation Type was not significant, $F(1, 18) = 0.02$, $p = .90$, $\eta_p^2 = .001$. This ruled out the possibility of group differences in performance on face only stimuli by mode of presentation.

Figure 2

Facial Emotion Recognition Scores: Static Photos vs. EJT Videos



Face only videos and static photos marginally significantly correlated in the DS group, 1-tailed Pearson's $r(17) = .35$, $p = .07$. Also, as expected, this correlation was significant in the TD group, 1-tailed Pearson's $r(17) = .70$, $p < .001$. These analyses used the paired samples data set to be consistent with the ANOVA presented above.

Incongruent video scores. Since both groups of participants were able to successfully judge emotions from the context only and face only videos, it was appropriate to explore their performance on the incongruent videos. It was possible that, when given a choice, the two groups

relied on different cues (context or face) to make emotion judgments. For each group, a 2-tailed one sample *t*-test was used to compare scores to zero to find out if participants consistently and accurately used the context (positive score) or face (negative score) in their judgments. The individual-level matched sample was used because this was the sample used in the primary EJT analysis.

In the DS group, participants' scores were significantly different from zero, $t(18) = -9.12$, $p < .001$. Their mean score was -8.05 ($SD = 3.85$), indicating their tendency to rely on facial expressions to make their judgments. The TD participants also relied on facial expressions ($M = -6.63$, $SD = 4.51$), as their scores also significantly differed from zero, $t(18) = -6.41$, $p < .001$. A 2-tailed paired samples *t*-test was conducted to test whether the two groups significantly differed in their incongruent video scores. Results revealed no significant difference between these scores, $t(18) = 0.89$, $p = .38$, Cohen's $d = .20$, indicating that the groups were similar in the degree to which they relied on facial expressions.

For further interpretation, scores on the incongruent videos were converted into frequencies with which participants accurately responded to the face or context or provided an inaccurate response. For the DS group, 80.70% of responses were consistent with the face, 13.60% with the context, and 5.70% were inaccurate responses. Similarly, for the TD group, 71.49% of responses were consistent with the face, 16.23% with the context, and 12.28% were inaccurate responses. There was nearly 100% agreement between participants' verbal and pointing responses to the incongruent videos.

Corsi Task group differences. The DS group had significantly higher Corsi Task scores than the TD group. This was not surprising because spatial memory is a relative strength in individuals with DS. However, because the EJT videos required visuospatial processing and the

ability to follow a sequence of actions visually, the DS group may have shown similar performance to the TD group on the EJT not because they had similar emotion skills but because they had better spatial sequential memory. In other words, it was possible that the group difference in Corsi scores could explain why the two groups achieved similar scores on the EJT. This was further corroborated by significant correlations between the Corsi Task and overall EJT scores in both groups (see section on Group correlations with other measures: Emotion knowledge and spatial memory).

To test this, hierarchical linear regression was used to determine if there was a significant effect of diagnosis (DS vs. TD) on overall EJT scores after controlling for variance explained by Corsi scores. The full sample was used in this analysis, and all assumptions of regression were met. As expected, Corsi explained a significant amount of variance in overall EJT in the first step, $F(1, 51) = 10.55$, $p = .002$, $R^2 = .17$. In the second step, Diagnosis did not explain a significant amount of variance in overall EJT scores, $F(1, 50) = 1.69$, $p = .20$, $\Delta R^2 = .03$. Thus, after controlling for Corsi scores, there was still no significant difference in EJT performance between the DS and TD participants.

Group correlations with other measures. Although performance on the emotion knowledge measures was equivalent in both groups, it was possible that emotion knowledge correlated with different skills in each group. To test this, Pearson's *r* bivariate correlations were calculated separately for each group. To achieve maximum power, the full sample (TD $n = 36$; DS $n = 19$) was used for these analyses. Also to increase power, 1-tailed tests were used; this was acceptable because all correlations were expected to be in the positive direction.

Emotion knowledge, MA, and CA. In the TD participants, both MA and CA were significantly correlated with overall EJT scores as well as with each video type (Table 4). This is

not surprising, considering that MA and CA were also highly correlated with each other, $r(34) = .63$, $p < .001$.

In the participants with DS, overall EJT scores (across all 3 types) significantly correlated with MA but only marginally correlated with CA. However, correlations were different by video type. Specifically, EJT context only scores significantly correlated with CA and only marginally correlated with MA, while EJT face only scores as well as context plus face scores correlated with MA (marginally significant for face only) and not with CA. Table 4 shows correlation coefficients and tests of significance.

The difference between correlation coefficients across the two groups was largest for the EJT and CA correlation. This difference was tested statistically via *r* to *Z* transformations (Cohen, Cohen, West, & Aiken, 2003). This comparison was not significant, $Z = 1.67$, $p = .10$. Because the largest difference between coefficients was not significant, it could also be concluded that the other differences in correlations between groups were not significant.

Table 4

Correlations between EJT Videos and Mental Age (MA), Chronological Age (CA)

	EJT Total	Context Only	Face Only	Context plus Face
TD ($n = 36$)				
MA	.58**	.70**	.41**	.28*
CA	.72**	.73**	.62**	.45**
DS ($n = 19$)				
MA	.49*	$.36^{m}$	$.37^{m}$	.49*
CA	$.38^{m}$	.46*	.31	.15

Note: $^{m}p \leq .09$, one-tailed. *$p < .05$, one-tailed. **$p < .01$, one-tailed.

Emotion knowledge and emotion expressivity. The CBQ was included to determine whether parent reports of their children's emotion expressivity were related to the children's

emotion knowledge on the EJT. Specifically, it was expected that this may be true for the group with DS, and it may help explain which skills develop along with emotion knowledge within this population.

However, CBQ total scores (aggregated across *Smiling and Laughter*, *Sadness*, and *Fear* subtests) only marginally significantly correlated with overall EJT scores in the TD group (Table 5). When analyzed by EJT video type, CBQ scores only significantly correlated with context plus face.

Additionally, there was a marginally significant correlation between the CBQ *Empathy* subtest and overall EJT scores. Specifically, CBQ *Empathy* marginally correlated with face only and context plus face, but did not significantly correlate with context only scores.

In the group with DS, CBQ total scores were significantly correlated with overall EJT scores. Analysis by EJT video type revealed that the CBQ was only significantly correlated with context only scores.

There was also a significant correlation between the CBQ *Empathy* subtest and context only scores in the DS group. However, CBQ *Empathy* was not significantly correlated with the other video types or with overall EJT scores.

Although there were some differences in the patterns of correlations across the two groups, these differences were subtle. Table 5 shows the correlation coefficients and tests of significance for both groups. Additionally, it should be noted that the two participant groups showed similar scores for the CBQ total, $t(18) = 0.81$, $p = .43$, Cohen's $d = .19$, and for the CBQ *Empathy*, $t(18) = 0.17$, $p = .86$, Cohen's $d = .04$. Two-tailed paired samples *t*-tests utilizing the matched pairs sample were conducted for these two tests of group difference in order to increase power to detect an effect.

Table 5

Correlations between EJT Videos and CBQ (Total Emotion Expressivity, Empathy)

	EJT Total	Context Only	Face Only	Context plus Face
TD (n = 36)				
CBQ Total	.25[m]	.13	.22	.33*
CBQ Empathy	.26[m]	.21	.24[m]	.23[m]
DS (n = 19)				
CBQ Total	.41*	.43*	.26	.31
CBQ Empathy	.29	.49*	.01	.14

Note: [m]$p \leq .09$, one-tailed. *$p < .05$, one-tailed. **$p < .01$, one-tailed.

Emotion knowledge and spatial memory. The Corsi Block-Tapping Task, a measure of spatial sequential memory, was included in this study because the video stimuli in the EJT are visual in nature, and in the context only as well as context plus face videos, they require the ability to follow a sequence of events to comprehend the full vignettes. It was predicted that Corsi scores would correlate with EJT scores in both groups of participants.

Results indicated that in the TD group, Corsi scores significantly correlated with overall EJT scores. Analysis by video type revealed that Corsi scores were significantly correlated with context only and face only and marginally correlated with context plus face.

In the DS group, Corsi scores were also significantly correlated with overall EJT scores. However, closer inspection revealed that Corsi scores were significantly correlated with context only scores, marginally significantly correlated with face only, and did not significantly correlate with context plus face.

See Table 6 for correlation coefficients and tests of significance for each group. Again, there were only subtle differences in correlation patterns between the DS and TD participants.

Table 6

Correlations between EJT Videos and Corsi Raw Scores

	EJT Total	Context Only	Face Only	Context plus Face
TD (*n* = 36)				
Corsi	.42**	.37*	.46**	.25[m]
DS (*n* = 19)				
Corsi	.48*	.57**	.38[m]	.21

Note: [m]$p \leq .09$, one-tailed. *$p < .05$, one-tailed. **$p < .01$, one-tailed.

EJT accuracy by emotion. A final way in which the two groups could show different patterns in emotion performance is their accuracy scores by emotion. To test this, Hu scores were calculated for each participant separately for happy, sad, and afraid trials. Because there were only two emotions per video type, emotion accuracy scores were pooled across video types for the two groups. Hu scores were used because they take into account the number of times a participant responds to each emotion overall in relation to how many items for which the participants gives an accurate response for each emotion. A 2 (Diagnosis: DS vs. TD) X 3 (Emotion: happy vs. sad vs. afraid) ANOVA was conducted with Diagnosis as a within-subjects factor (using the paired samples data set) and Emotion as a repeated measures factor. There was no significant main effect of Diagnosis, $F(1, 18) = 1.02$, $p = .33$, $\eta_p^2 = .05$. There was a marginally significant main effect of Emotion, $F(2, 17) = 3.52$, $p = .05$, $\eta_p^2 = .29$, such that overall, participants had marginally significantly lower scores for the sad trials ($M = 66.30$) than happy ($M = 75.97$) or afraid (76.06) trials. However, there was not a significant Diagnosis X Emotion interaction, $F(2, 17) = 0.11$, $p = .90$, $\eta_p^2 = .01$. Thus, there were still no differences between the DS and TD participants when EJT accuracy was examined by emotion. The reported statistics from this analysis utilized Hu scores; however, the same pattern of results was found

when mean proportion scores were used. Table 7 displays mean Hu scores and mean proportions by emotion for each group.

Table 7

EJT by Emotion: Mean Proportion Scores vs. Mean Hu Scores

	Happy	Sad	Afraid
DS			
Proportion scores	84.65	72.81	90.35
Hu scores	80.41	69.15	80.20
TD			
Proportion scores	81.58	67.98	84.65
Hu scores	71.54	63.45	71.92

DISCUSSION

The goal of this dissertation was to measure emotion recognition, or the ability to judge others' emotions, in individuals with DS. It examined emotion recognition from the social context presented visually rather than linguistically and from facial expressions presented dynamically. Videos were used instead of pictorial drawings or still photos because they should be more engaging and provide more realistic depictions of events. The increased number of emotion cues provided in the videos should increase the study's ecological validity. In these manners, the present study improved upon previous research on emotion recognition in DS.

Summary of Findings

The participants with DS performed similarly to the TD participants on the measure of facial emotion recognition from static photographs, suggesting that both groups of participants are similar in their facial emotion recognition ability. This finding did not support the hypothesis that the TD group would outperform the DS group. Also, it conflicts with the existing literature's findings that TD participants tend to perform better on facial emotion matching tasks than MA or skill matched DS participants (Hippolyte et al., 2008; Williams et al., 2005; Wishart et al., 2007; Wishart & Pitcairn, 2000).

However, the task used in this study varied from those in prior studies in subtle ways that may have made a difference in performance, particularly for the group with DS. First, the task utilized child faces instead of adult faces. It could be that children with DS are better at recognizing emotions from faces of other children than of adults, but this has not been directly

compared. Second, the photographs in this study were in color rather than the black-and-white ones used in other studies, and they were presented on a computer screen, possibly making the task more engaging for participants than tasks used in prior studies. Third, the task instructions in the present study were presented with simple, minimal language, and participants were asked to respond in a way that placed limited demands on them (pointing to a schematic face instead of matching a second photograph to the first). These modifications may have made a difference in participant performance, especially for the DS participants, who are known to have problems engaging in tasks in an experimental setting (see Cebula & Wishart, 2008) and struggle with linguistic task demands (see Moore, 2001). It should be noted that the prior studies did control for task demands by including control facial identity matching tasks with similar stimuli (Hippolyte et al., 2008; Williams et al., 2005; Wishart et al., 2007; Wishart & Pitcairn, 2000). Their participants with DS were able to succeed on the control tasks, suggesting that the task demands alone were not too high. However, this did not account for the possibility that when a greater cognitive load was placed on participants (i.e., by asking them to make an emotion judgment), the other tasks demands in combination with the emotion processing may have become too much for the participants with DS. Regardless of explanation, it can be concluded that in this study, the participants with DS performed at their developmental level on facial emotion recognition.

Not only did the participants with DS perform at their developmental level on the static photographs, but they also performed consistent with their TD counterparts on facial emotion recognition from the face only videos. This was not predicted by any of the three competing hypotheses in this study, but it could be explained (at least partially) by the task modifications in this study that were described above.

The main analysis of this dissertation examined the effect of Diagnosis on emotion recognition from the dynamic videos by Emotion Content in a within-subjects design. There was no main effect of Diagnosis, nor was there an interaction between Diagnosis and Emotion Content, indicating that the participants with DS showed equivalent performance to the TD participants on all types of emotion videos (context only, face only, and context plus face). Again, this finding did not support any of the three competing hypotheses, which all assumed poor performance by the DS group on the face only stimuli. Not only were there no statistically significant differences between the two groups in emotion recognition performance, but the effect sizes for the statistical tests of group difference on all the emotion measures were very small, and the mean scores were very similar. So, it can be confidently concluded that the DS and TD participants displayed equivalent performance on these measures.

There was a main effect of Emotion Content such that both groups of participants scored lower on context only than face only or context plus face videos. This further speaks to the two groups' similarities, and it makes sense given their young age (or MA). Preschool aged children tend to rely heavily on facial expressions to make emotion judgments (Camras, 1986; Gnepp, 1983; Wiggers & van Lieshout, 1985), so they would be expected to perform better on videos in which they could see the child's face. Further, in the incongruent videos, the participants demonstrated their preference of using facial cues over social context to make emotion judgments, also supporting this idea. While they were expected to be able to successfully complete the context only videos (and they did), the lack of facial information along with the deviation from what children are familiar with (context without a face), could have made the context only videos more challenging for the TD preschool aged participants. In this study, the DS participants performed at their MA on the emotion tasks, so it also makes sense that their

performance would follow the same pattern of face only and face plus context videos over the context only ones.

Explaining Performance in the DS Participants

The unexpected equivalent performance on the emotion tasks across groups called for further investigation into why this was the case. To do this, first it was necessary to rule out possible confounding factors or other potential alternative explanations to group similarity. This led to a closer inspection of each group to determine whether there were more subtle differences between the groups than what was captured by the primary analysis of the data that could explain the similarity in emotion knowledge task performance. This involved: (1) testing for a group difference on static vs. dynamic facial expressions to determine if the type of stimuli made a difference in their facial emotion recognition performance; (2) testing for a group difference in their performance on the incongruent videos to find out on which cues (context or face) each group relied; (3) accounting for the group difference in spatial sequential memory to determine whether there was a differential group performance on the emotion videos; (4) examining the relation between emotion knowledge and other related skills to determine whether they differed by group; and (5) analyzing video performance by emotion to compare group performance.

Upon such in-depth analyses, the two groups continued to look similar in their emotion knowledge. The mean accuracy scores for dynamic and static facial expressions were similar across groups, and both groups judged the dynamic expressions from the videos with significantly greater accuracy than the static expressions from the photographs. Though the TD literature is mixed on whether there is an advantage for emotions expressed dynamically (Fiorentini & Viviani, 2011; Kessler, Doyen-Waldecker, Hofer, Hoffmann, Traue, et al., 2011; Nelson & Russell, 2011; Wehrle, Kaiser, Schmidt, & Scherer, 2000), the evidence suggests that

individuals perform at least as well on judging dynamic faces as static faces and often show better performance on dynamic over static faces. The common explanation given is that dynamic facial expressions provide more information than static expressions; also, dynamic expressions are closer to real-world, everyday experiences. Regardless, this was yet another way in which the two groups showed similarities in this study.

Both groups also performed comparably on the incongruent videos, relying on facial expressions to judge the protagonist's emotions when presented with conflicting cues. Additionally in the incongruent videos, both groups of participants accurately used facial expressions to the same degree when making emotion judgments from the conflicting cues. Furthermore, although the participants with DS had significantly higher scores than the TD participants on the measure of spatial sequential memory, when variance due to spatial memory was controlled, there was still no significant effect of group on performance on video emotion recognition. Finally, there were no statistically significant differences between the DS and TD participants in their correlation patterns between emotion knowledge and related skills such as emotion expressivity, empathic behavior, or general developmental level.

When accuracy by emotion across video types was examined, there were no group differences. Interestingly, both groups of participants were somewhat less accurate on the sad trials than on the happy or afraid trials. While it may be surprising that their accuracy was lower for sad expressions than from fearful ones, both fear and sadness are negatively charged expressions and can be confusing. Furthermore, although it would be expected that the children would have a harder time discriminating fearful facial expressions, the opposite could be true for the social context. It could be that the contextual display of fear is more salient than that of sadness, thus easier to identify. If this was the case, the context only videos may have boosted

overall fear scores. However, this cannot be determined because this analysis pooled performance across the video types. Each video type contained such few trials per emotion that analysis by emotion and by video type would not be very useful in this study. Again, the most important finding was that the groups were similar in their accuracy by emotion.

After careful inspection, it can be concluded that the participants with DS in this sample displayed emotion knowledge on par with their TD counterparts of a similar developmental level. Furthermore, it should be noted that the participants in each group were carefully matched (individually matched to each other based on MA), so findings cannot be explained by discrepancies in general developmental level.

Emotion Knowledge in DS and Theories of Emotional Development

This overarching finding of intact emotion knowledge relative to developmental level in children and adolescents with DS has exciting implications. It suggests that individuals with DS possess the basic ability to interpret others' emotions from their facial expressions and from the social context. Thus, any trouble they may exhibit with emotion skills in daily life may be due to other information processing factors, not the core ability to understand basic emotions. In other words, findings from this study suggest that, within the constraints of DS itself, emotions seem intact at the basic level in this population. This fits well with Differential Emotions Theory (DET), which posits that basic emotions are innate, independent of cognition, and universally experienced and expressed (Izard, 1991, 2007, 2011). The present study proposes that individuals with DS possess an intact emotion system despite cognitive impairments, which is in line with DET's separation of emotion and cognition. This study also supports the universality aspect of basic emotions from DET by extending the idea of discrete emotion processing to an

atypical population of children with DS. In these ways, this dissertation provides strong support for the DET theory of emotional development from the TD literature and further applies it to DS.

Although the present study's results are not in line with what was expected from the extant literature on emotion recognition in DS, they do fit with the broader literature on social cognition in DS. Dating back to the 1970s, there have been scattered infant studies examining aspects of early emotional development in DS. Together, most of these studies have provided evidence that infants with DS show typical patterns of development of early social abilities which are thought to serve as precursors to higher order social cognition (see Cicchetti & Beeghly, 1990, for a review). These include showing unique interest in social stimuli (Berger & Cunningham, 1981; Cicchetti & Sroufe, 1976), appropriate expressive behaviors in reaction to such stimuli (Cicchetti & Sroufe, 1976; Moore et al., 2002), and social imitation (Heimann, Ullstadius, & Swerlander, 1998; Hodapp et al., 1992). However, these studies have also evidenced that while such skills may follow a typical developmental pattern, some of these processes may be delayed in infants with DS (Berger & Cunningham, 1981; Carvajal & Iglesias, 2000; Cicchetti & Sroufe, 1976). Regardless, they have demonstrated that individuals with DS do possess early social abilities which afford them the opportunity to develop more complex social skills such as understanding emotions. To this end, they give some credibility to this study's findings of emotion understanding in DS that is intact for their MA.

Further Interpretations of Study Findings

This dissertation was innovative because it was one of the first studies to comprehensively examine emotion recognition skills in individuals with DS utilizing a methodology that more purely measured these skills without the confounds of language and auditory processing difficulties. Although none of the study's original hypotheses was supported,

the main objective of this study was still achieved. The emotion recognition deficit in DS that has been proposed in the literature was examined more closely and not upheld. Specifically, when stimuli were presented in a more engaging manner using a language-free presentation of context, individuals with DS were able to successfully complete the task. Thus, this study highlights the importance of taking special consideration of measurement issues when designing tasks for atypical populations such as those with DS.

One potential difference between the DS and TD groups in the present study is in the use of visuospatial processing to perform on certain tasks. As mentioned above, the DS group displayed greater spatial sequential memory than the TD group. This finding was not surprising because spatial memory is a relative strength for individuals with DS, and prior studies have consistently found that children with DS perform either at or slightly above their MA on such tasks (see Frenkel and Bourdin, 2009). When variance due to spatial sequential memory was controlled, there was still no group difference in overall emotion knowledge. Although not directly tested in this study, it is quite possible that the group with DS performed so well on the context videos because they utilized their strength in spatial sequential memory to process the action sequences, allowing them to make emotion judgments, while the TD participants did not have this same advantage. This does not change the fact that participants with DS exhibited basic emotion recognition ability, but it does point to possible subtle differences in how they processed the tasks. The main conclusion is that the DS participants showed emotion recognition equivalent to the TD participants.

Although this conclusion of no emotion recognition deficit in DS is promising, it should be interpreted with caution. The individuals with DS were matched to TD children based on MA. So, while there was no specific impairment in emotion knowledge, individuals with DS

performed at their developmental level, not necessarily at their chronological age level. In fact, the participants with DS were much older than the TD participants, with many more years of life experience that could contribute to their repertoire of emotion knowledge. Although there was no CA matched sample in this study to which we could compare the participants with DS, it is likely that they would have outperformed the DS group. However, this cannot be firmly concluded without the inclusion of such a sample. In line with the idea that the individuals with DS performed at their MA level, they showed preferential use of facial expressions over the social context in their judgments of the incongruent videos. Not only was this the same pattern displayed by TD children in this sample, but also it is the pattern shown by TD children in many prior studies in contrast to a greater reliance on the social context seen in children of the same CA as this DS sample (Borke, 1971; Camras, 1986; Gnepp, 1983; Hoffner & Badzinski, 1989; Kurdek & Rodgon, 1975; Wiggers & van Lieshout, 1985).

Implications for Social Skills Training for Individuals with DS

There are many early intervention programs for young children with DS that historically have focused heavily on speech/language and motor skill development, as these are known areas of delay in DS (see Spiker, 2011 for a review). The primary goal of these programs has been to improve physical and cognitive functioning in young children with DS to afford them the ability to function more adaptively in school and meaningfully participate in society. While verbal communicative skills are important for those with DS, nonverbal skills are also important in communication, and training in this area could also facilitate the development of language skills (Fidler, 2006; Wishart, 2001).

Specifically, emotion knowledge, a grossly understudied topic in DS, is a very important nonverbal social skill that has substantial implications. Emotion knowledge aids in the successful

initiation of peer relationships, an important aspect of social competence for children (Lemerise & Arsenio, 2000; Parker & Gottman, 1989). In TD preschoolers, well-developed emotion knowledge is associated with greater social competence in kindergarten (Denham et al., 2003; Denham et al., 1994) and in third grade (Izard et al., 2001), as well as with higher peer and teacher likeability ratings (Denham et al., 1990) and academic achievement (Denham & Brown, 2010; Izard et al., 2001). Social competency and academic achievement are also important for children with DS. Thus, emotion knowledge is worthy of attention in this population, and the present study was an important first step in this endeavor.

According to this dissertation's results, children with DS may have intact basic emotion recognition abilities relative to their developmental level. If so, these could be used as building blocks to further develop even more complex social skills in training programs for this population. This is important because such basic emotion recognition ability has been strongly linked to greater social competence (Izard et al., 2001), peer and teacher likeability (Denham et al., 1990), and even academic success (Denham & Brown, 2010; Izard et al., 2001) in TD children, and there is no reason to believe otherwise for children with DS. However, it remains unknown whether those with DS are able to appropriately apply their emotion recognition skills to social situations. It is a good possibility that they will need some training to effectively do so (e.g., in social referencing, Kasari, Freeman, Mundy, & Sigman, 1995; Knieps, Walden, & Baxter, 1994). Thus, it is important for professionals who implement such social skills programs to know the level of emotion knowledge their clients have achieved so they can individualize training programs at the appropriate level. A task such as the one used in this study could be a valuable assessment tool to do so within the DS population.

The EJT as a New Measure of Emotion Knowledge

The Emotion Judgment Test (EJT) was developed specifically for this dissertation because there was a need for a nonverbal task that could measure the ability to judge emotions from a variety of cues such as the social context. There was also a need for a task that used dynamic stimuli that could be engaging for participants with low MAs. The EJT seemed to successfully function as such a measure in both groups of participants. Impressively, every participant with DS and all but one TD child whose MA fell within the range for this study was able to successfully complete the EJT. Furthermore, performance in emotion recognition from this task correlated with MAs as expected in both the TD and DS participants. The EJT showed good internal consistency reliability in both groups, and its validity was supported by the correlation between the face only videos and face only photos from a well-established measure in the TD literature. Of course, this study still needs to be replicated with larger sample sizes over a variety of MAs. However, it is possible that the EJT could be a useful tool in measuring contextual emotion knowledge not only in children with DS but also in children with other developmental disabilities, language delays, or who speak English as a second language because the stimuli are language-free, instructions are minimal, and there is an option for a nonverbal (pointing) response mode. If the EJT is used in future studies, it should be expanded to include more trials per emotion and other emotions such as anger. However, one should be mindful of keeping the task as short in duration as possible when considering its use with young children or those with intellectual disabilities.

Limitations and Directions for Future Research

This study showed that children and adolescents with DS could perform as well as MA matched TD children on static photo and video emotion recognition using facial cues and the

social context. However, this finding should be replicated in other samples of children with DS. DS is such a heterogeneous disorder, and it is possible that this sample of individuals with DS was not truly representative of the larger population. To this end, sampling error may have affected the results of this study. However, a wide variety of children and adolescents with DS with a range of abilities were recruited, and out of those who participated, the only reason for exclusion from this study was MA outside of the 3 to 6 year range. There were no DS participants within the acceptable MA range who were tested and failed to complete the tasks. In fact, all who were included based on initial criteria were able to perform on the EJT; they successfully completed emotion identification in schematic faces, seemed to understand task instructions, and behaviorally cooperated throughout the task. Thus, this study did not simply include the "high-performing" participants with DS. For these reasons, it seems that there was no major sampling issue in this study, but this is still an important factor to consider in future studies.

The current sample consisted of a broad age range of participants with DS, adding to the heterogeneity of the DS group. A next step for researchers would be to begin tracking the development of emotion knowledge in younger children with DS to find out if the skill is delayed in developing and whether it continues to develop in older children and adolescents or if it plateaus at a certain point. It would also be prudent to include a comparison group of individuals with mixed etiology intellectual disability (ID) to find out how those with DS compare to others with ID. This would also determine whether the pattern of emotional development in DS is unique to DS or applicable to ID in a more general sense.

To more conclusively determine why the findings of this study differed from other studies examining emotion knowledge in DS, future studies should empirically test the idea that

higher-level vs. lower-level task demands may differentiate emotion performance between DS and TD participants matched on MA. For instance, studies could directly compare two emotion judgment tasks which differ only by one component at a time, such as visual vs. verbal narrative of the context, black-and-white vs. color photographs, or even computer-based vs. paper-based stimuli. These are just a few of the next steps to be taken to more fully understand task performance along with how emotions develop in children with DS. Aside from delineating the emotional and cognitive strengths and weaknesses in DS, the more we find out about this topic, the better able we will be to accurately target training programs to enhance social skill development in this population.

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APPENDICES

Appendix A

Pilot Phase

Purpose

The purpose of this phase was to pilot the Emotion Judgment Test (EJT), the video task that was created for the main study. The chief objective of the pilot phase was to find out if participants with characteristics similar to those that were proposed in the main study could understand the content of the videos and provide behaviorally meaningful responses.

Method

Participants

TD participants. Thirteen TD preschool-aged children participated in the initial phase of this study. However, 5 TD children did not meet the PPVT-4 mental age (MA) criterion from the main study. Some of these children had a MA that was too high. In light of the pilot phase's purpose, the EJT was administered to these participants anyway because these children were highly verbal and able to express their interpretations of the actions depicted by the context in the videos. Thus, the final sample constituted 10 TD children (CA range = 3.42 - 5.33 years, *M* = 4.44, *SD* = 0.66). This was a sufficient number to answer the questions of interest for the pilot phase, as both low and high ends of the PPVT-4 MA range were represented (MA range = 3.08 - 6.67 years, *M* = 5.02, *SD* = 1.34). However, it should be noted that children with MAs in the mid-range of the main study's sample were not represented. The PVPT-4 standard scores of the TD participants ranged from 85 - 121 (*M* = 105.8, *SD* = 11.95).

DS participants. Two children with DS also participated in the pilot phase. The CAs of the DS participants were 11.67 and 16.50 years, and the PPVT-4 MAs were 5.00 and 6.67 years, respectively. Thus, one of the participants had an MA that was too high for the main study. Once

again, the EJT was administered anyway to assess understanding of video content. Anecdotally, in terms of observable behavior, both participants seemed to be higher functioning than most participants with DS. They both were able to sit through more tasks than usual, and they also were able to follow more complex directions and provide more verbal responses than usual.

Measures

Peabody Picture Vocabulary Test, Fourth Edition (PPVT-4; Dunn & Dunn, 2007). This task was administered in the pilot phase because it is a criterion for participation in the main study, and it was necessary to find out the characteristics of the sample (i.e., MA) in the pilot phase to compare to those from the main study.

The PPVT-4 is a measure of receptive vocabulary. It consists of a series of illustrations arranged on a page. Each child was asked to point to the picture that best represents the word spoken by the examiner. Testing time averaged close to 20 minutes for each participant. Raw scores were calculated by subtracting the number of errors from the child's ceiling score. Standard scores, growth scores, and age equivalents were calculated by using the norms provided by the publisher. Higher scores indicate greater receptive vocabulary and higher MA. Internal consistency reliability for the PPVT-4 is reported to be .94, and reported test-retest reliability is .93. It is standardized for ages 2.5 years through 90 years and older.

Emotion Judgment Test (EJT). This was the task of interest in the pilot phase. It was designed specifically for the main study, although aspects of its design came from prior research. Administration of this task followed the procedure outlined in the main study. First, participants were asked to name and point to the schematic faces. Then, they were shown the three main video types: context only, face only, and context plus face, in counterbalanced order. Finally, they were shown the incongruent videos at the end of the task.

Additionally, after participants saw each video and made an emotion judgment, they were asked to describe what happened in the video. The video was replayed upon request, and the examiner recorded children's verbal responses. Although participants in the main study were not asked to report directly about the video vignette content, it was important to do so during the piloting phase to ensure that children were able to understand the sequence of actions in each video clip. Total testing time for this task averaged between 15 and 20 minutes.

Schematic faces. In the *generative* phase, schematic faces of three basic emotions (happiness, sadness, and fear) were placed in front of the participant in random order. The experimenter pointed to the faces one at a time and asked the participant "What is this face?" Then, to begin the *pointing* phase, the experimenter shuffled the faces and placed them in front of the participant in a different order. This time, the participant was asked to point to each emotion named by the experimenter. After the first attempt, the experimenter corrected the participant for any emotions he or she incorrectly identified, the faces were shuffled, and the participant was given another chance to point to each emotion named by the experimenter. The same procedure was repeated a third time. The repetitions allowed for a training phase in this task.

Although the *generative* score was useful in analyses of the main study, it was not used in the criterion score. In the criterion score, one point was awarded for accurate *pointing* to each emotion face, each of the three times. This yielded total raw scores out of nine (three possible points per emotion). A criterion of at least two out of three points per emotion was required for administration of the remainder of this task. This criterion was set because participants used the schematic faces to indicate their responses in the second portion of this task. Higher total scores indicate greater ability to match emotion labels with schematic faces.

Video stimulus. The second part of the EJT measured participants' ability to identify one of three basic emotions (happiness, sadness, or fear) from brief video clips depicting a child protagonist acting out a sequence of actions and/or making facial expressions. The video clips were between five and ten seconds each, depending on video content. See Table 2 in the main document for a list of each video's content. For all videos, there was no verbal language. Thus, participants were required to rely on visual processing to understand their content. There were three main types of videos that differed on what information was included within each clip: context only, face only, and context plus face.

In the context only condition, the protagonist portrayed a sequence of actions, and his facial expression was digitally masked. In the face only condition, the protagonist began with a neutral face and formed an emotion expression. In the context plus face condition, the protagonist portrayed a sequence of actions, and his face displayed an emotion expression in reaction to the event. Each video type contained six video clips expressing three basic emotions (happiness, sadness, and fear) two times each.

For context only and context plus face videos, vignettes consisted of situations that commonly evoke a particular emotion followed by either a masked expression (context only) or a viewable facial expression (context plus face). However, in the fourth video type, the incongruent videos, the social context was presented along with incongruent facial expressions. In other words, the protagonist portrayed a sequence of actions that commonly evokes one of three basic emotions, but his expression did not match the emotion depicted by the event. Each emotion was depicted twice in the context and twice in the expression, for a total of six videos of the incongruent type.

Video emotion recognition. For all video types, after viewing each clip, participants were asked first to tell the experimenter how the child felt. Then, the participants were asked to identify how the child felt by pointing to one of the schematic faces described earlier.

In the three main video types (context only, face only, and context plus face), one point was awarded for correctly labeling and one point for correctly identifying the depicted emotion, for a total of two possible points per video. Higher scores in the context only task indicate participants' ability to use context to identify emotions. Higher scores in the face only task reflect the ability to identify emotions expressed in dynamic faces. Higher scores in the context plus face task reflect participants' ability to judge emotions in a more realistic setting in which both the context and the facial expression are displayed.

The incongruent task yielded a valence score on a scale from -12 to +12. For each video, if participants responded based on *facial expression*, they were given one negative point (-1) for accurately naming and another negative point (-1) for accurately pointing to the *facial expression*. However, if participants responded based on *social context*, they were given one positive point (+1) for accurately naming and another positive point (+1) for accurately pointing to the emotion depicted by the *context* in each video. If participants responded incorrectly, they were given a zero for that item. This scoring system yields a total score ranging from -12 (always responded with facial expression) to +12 (always responded with context). The sole purpose of the valence score is to differentiate response types on a common scale; thus, the assignment of negative numbers to face responding and positive numbers to context responding was arbitrary. If participants did not consistently choose one strategy (face versus context), or if they did not respond with much accuracy, their scores were close to zero.

Results and Discussion

TD Participants

Behaviorally, the TD children were able to sit through the PPVT-4 and EJT in one session of approximately 30 minutes with minimal breaks. They seemed to enjoy watching the videos in the EJT, and they complied with the examiner's response requests after each video clip. As for their EJT scores, one child did not pass the schematic faces criterion; thus, his data were not included. The TD participants showed a range of scores on the EJT, from 61% - 100% accuracy across video types. The two youngest participants (also the two with the lowest MAs) scored the lowest on the EJT (61% and 67%), and scores reaching 100% were found in the older participants. Scores for all participants are provided in Table A1.

Table A1

Pilot Phase Proportion Scores for the EJT by Video Type

	Verbal MA	Context	Face	Both
TD Group				
Participant 1	3.08	0.33	0.67	1.00
Participant 2	3.17	0.33	0.83	0.67
Participant 3	5.00	0.67	1.00	0.83
Participant 4	5.17	1.00	1.00	1.00
Participant 5	5.50	0.83	1.00	1.00
Participant 6	5.67	0.67	1.00	0.83
Participant 7	5.83	1.00	1.00	1.00
Participant 8	5.92	0.50	1.00	1.00
Participant 9	6.25	1.00	1.00	1.00
Participant 10	6.42	0.83	0.67	1.00
Participant 11	6.67	0.83	1.00	1.00
DS Group				
Participant 1	5.00	0.67	1.00	0.83
Participant 2	6.67	0.83	1.00	1.00

Note: Participants in gray had PPVT MAs outside of the range for the current study.

Comparing video types, there was a range of scores. Overall, TD children scored highest on the context plus faces videos. This is not surprising, as the context plus face videos provide the richest cues and give the most amount of emotion information.

As for the content of the video vignettes, some children were verbally expressive and explained the vignettes with great detail, while others gave minimal responses. As a whole, children seemed to easily interpret the vignette content for each video with remarkable accuracy, with the exception of two vignettes. In one of them (*Sees a snake nearby in the grass*), a number of children reported that Charlie (the character in the video) was simply reaching for his toy airplane, which was sitting near the snake. In the other video (*While reading a book, a loud siren goes off*), most children simply reported that Charlie was reading. Some acknowledged the sound, but it was not very loud. Because of these findings, the two vignettes in question were revised and re-filmed to depict the vignettes more saliently. However, as a whole, they seemed to work quite well for the purposes of the main study.

DS Participants

The 2 participants with DS also performed well on the EJT. Both participants scored well above chance, and neither scored at 100% (see Table A1). They also were able to sit through the entire task with minimal breaks, seemed to enjoy watching the videos, and complied with the examiner's prompts for responses. However, as previously stated, these two DS participants may be exceptional in this regard.

Because both participants were verbally expressive with only minimal speech problems, they were asked to tell what happened in each video as well. Both participants did so quite accurately, although both also inferred some nonsensical information as well. For instance, after viewing Charlie crawling up the ladder into a dark space, one of them accurately reported "He is going up into that dark room. There must be something scary up there." She then continued, inferring that "maybe it's an alligator. There's an alligator in the attic!" Regardless, this participant was able to understand the actual sequence of actions in the videos.

Incongruent Videos

For the exploratory, incongruent set of videos, all children (TD and DS) leaned toward face responding. However, some scores fell close to zero while others were -12 (accurately responded according to face on every trial). Children also accurately reported the vignette content in these videos, and some TD children, without prompting, even strategized to make sense of the incongruent information. For instance, one child remarked "The doctor is giving him a shot, and he is happy. I don't know why! I cry when I get shots. Maybe he knows the shot will make him feel better." Another stated "He won a trophy [referring to the first place medal], but he's sad. He shouldn't be sad. He should be happy he won!" These strategies are commonly reported in the TD literature, although children often are prompted before providing this information. Although these interpretations move beyond the scope of the main study, it is interesting that the TD children reacted to these videos in similar ways to children in previous studies using incongruent face/context stimuli.

Conclusion

Both TD participants and those with DS were able to attend to the videos in the EJT, and they were also able to provide responses when prompted. The TD children showed an expected range of scores, with some of the youngest at chance and some of the oldest at 100%. All participants were able to follow the sequence of events in the contextual information of the videos. The two vignettes that produced some confusion in terms of content interpretation were re-filmed to depict the vignettes more saliently. As a whole, the EJT seemed to work as expected, and it was used in the main study.

Appendix B

Institutional Review Board

Approval

Office for Research

Institutional Review Board for the Protection of Human Subjects

THE UNIVERSITY OF ALABAMA RESEARCH

November 18, 2011

Marie Moore, M.A.
Department of Psychology
College of Arts and Sciences
Box 870348

Re: IRB Application # 10-001-R2: "Emotion Knowledge in Down Syndrome"

Dear Ms. Moore:

The University of Alabama Non-Medical IRB recently met to consider your renewal application. The IRB voted to approve your protocol for one year.

Your application will expire on 11/17/2012. You will receive a notice of the expiration date 90 days in advance. If your research will continue beyond this date, please complete the IRB Renewal Application. If you need to modify the study, please submit the Modification of an Approved Protocol form. **Changes in this study cannot be initiated without IRB approval, except when necessary to eliminate apparent immediate hazards to participants.** When the study closes, please complete the Request for Study Closure (Investigator) form.

Please use reproductions of the current IRB-stamped consent and assent forms.

Should you need to submit any further correspondence regarding this application, please include the above application number.

Good luck with your research.

Sincerely,

Stuart Usdan, Ph.D.
Chair, Non-Medical IRB
The University of Alabama

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