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Recognition, Expression, and Understanding Facial Expressions of Emotion in Adolescents with Nonverbal and General Learning Disabilities

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Abstract

Students with learning disabilities (LD) have been found to exhibit social difficulties compared to those without LD (Wong, 2004). Recognition, expression, and understanding of facial expressions of emotions have been shown to be important for social functioning (Custrini & Feldman, 1989; Philippot & Feldman, 1990). LD subtypes have been studied (Rourke, 1999) and children with nonverbal learning disabilities (NVLD) have been observed to be worse at recognizing facial expressions compared to children with verbal learning disabilities (VLD), no learning disability (NLD; Dimitrovsky, Spector, Levy-Shiff, & Vakil, 1998; Dimitrovsky, Spector, & Levy-Shiff, 2000), and those with psychiatric difficulties without LD controls (Petti, Voelker, Shore, & Hyman-Abello, 2003). However, little has been done in this area with *adolescents* with NVLD. Recognition, expression and understanding facial expressions of emotion, as well as general social functioning have yet to be studied simultaneously among adolescents with NVLD, NLD, and general learning disabilities (GLD). The purpose of this study was to examine abilities of adolescents with NVLD, GLD, and without LD to recognize, express, and understand facial expressions of emotion, in addition to their general social functioning.

Adolescents aged 12 to 15 were screened for LD and NLD using the Wechsler Intelligence Scale for Children – Third Edition (WISC-III; Weschler, 1991) and the Wide Range Achievement Test – Third Edition (WRAT3; Wilkinson, 1993) and subtyped into NVLD and GLD groups based on the WRAT3. The NVLD (n = 23), matched NLD (n = 23), and a comparable GLD (n = 23) group completed attention, mood, and neuropsychological measures. The

adolescent's ability to recognize (Pictures of Facial Affect; Ekman & Friesen, 1976), express, and understand facial expressions of emotion, and their general social functioning was assessed. Results indicated that the GLD group was significantly less accurate at recognizing and understanding facial expressions of emotion compared to the NVLD and NLD groups, who did not differ from each other. No differences emerged between the NVLD, NLD, and GLD groups on the expression or social functioning tasks. The neuropsychological measures did not account for a significant portion of the variance on the emotion tasks. Implications regarding severity of LD are discussed.

Résumé

Il a été démontré que les étudiants ayant des troubles d'apprentissage (TA) présentent des difficultés sociales comparativement à ceux qui n'ont pas de TA (Wong, 2004). Il a aussi été montré que la reconnaissance, l'expression et la compréhension des expressions faciales des émotions sont importantes pour le fonctionnement social (Custrini & Feldman, 1989; Monfries & Kafer, 1987; Philippot & Feldman, 1990). Le sous-types des TA ont été étudiés (Rourke, 1999) et il a été observé que les enfants avec des troubles d'apprentissage non-verbaux (TANV) sont moins bons dans la reconnaissance des expressions faciales des émotions comparativement à ceux qui ont des troubles d'apprentissages verbaux (TAV), ceux qui sont sans troubles d'apprentissage (STA; Dimitrovsky, Spector, Levy-Shiff, & Vakil, 1998; Dimitrovsky, Spector, & Levy-Shiff, 2000), ainsi que les personnes avec des difficultés psychiatriques non assortis avec ceux qui ont des troubles d'apprentissage (Petti, Voelker, Shore, & Hyman-Abello, 2003). Par contre, peu de recherche dans ce domaine a été faite avec les adolescents ayant des TANV. La reconnaissance, l'expression et la compréhension faciale des expressions faciale des émotions, tout comme le fonctionnement social général sont encore à étudier simultanément chez les adolescents ayant des TANV, des troubles d'apprentissage généraux (TAG), et ceux qui n'ont pas de troubles d'apprentissage. L'objectif de cette étude a été d'examiner les habilités des adolescents avec des TANV, TAG et ceux qui n'ont pas de troubles d'apprentissage de reconnaître, exprimer et comprendre les expressions faciales des émotions, en plus de leur fonctionnement social général.

En se basant sur les résultats obtenus dans le Wechsler Intelligence Scale for Children – troisième édition (WISC-III; Weschler, 1991) et le Wide Range Achievement Test – troisième édition (WRAT3; Wilkinson, 1993), des adolescents âgés de 12 à 15 ans ont été divisés en deux groupes : ceux qui ont des troubles d'apprentissage, et ceux qui n'en ont pas. Ensuite, les adolescents ont été séparés en sous-types (TANV et TAG) en se basant sur le WRAT3. Les participants avec des TANV (n = 23), le groupe STA assorti (n = 23) et un groupe comparable ayant des TAG (n = 23) ont complété des mesures neuropsychologiques, d'attention, et d'humeur. L'habilité des adolescents de reconnaître (Pictures of Facial Affect; Ekman & Friesen, 1976), exprimer et comprendre les expressions faciales des émotions, ainsi que leur fonctionnement social général ont été évalués. Les résultats indiquent que le groupe ayant des TAG a reconnu et compris les expressions faciales des émotions de façon significativement moins exacte que ceux qui ont des TANV et ceux qui n'ont pas de troubles d'apprentissage, qui n'ont pas différé entre eux. Aucune différence n'a émergé entre les groupes TANV, STA et TAG quant à l'expression ou tâches de fonctionnement social. Une portion significative de la variance reliée aux tâches émotionnelles n'a pas été expliquée par les mesures neuropsychologiques. Les implications concernant la gravité des troubles d'apprentissage sont examinées.

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Statement of Originality

Students with LD have been found to have lower peer status (Bruininks, 1978; Bryan, 1974, 1976; Scranton & Ryckman, 1979; Silver & Young, 1985; Siperstein et al., 1978; Wiener, 1987) and teachers tend to perceive these students as less socially competent and to have poorer peer relations than their NLD peers (Bender & Smith, 1990; Haager & Vaughn, 1995). One hypothesis that has been put forth by researchers to explain the low social status of these students is their difficulties in comprehending a variety of nonverbal cues. Although it has been well established that children and adolescents with LD are less accurate at recognizing different types of nonverbal cues (Axelord, 1982; Bryan, 1977; Jackson et al., 1987; Wiig & Harris, 1974), it is unclear as to whether their difficulties are a result of a specific nonverbal cue, namely facial expressions of emotion.

Despite the limited research within this area, a small number of studies have consistently shown that children and adolescents with LD are less accurate at recognizing facial expressions of emotion from still photographs compared to their NLD peers (Holder & Kirkpatrick, 1991; Most & Greenbank, 2000; Nabuzoka & Smith, 1995). Given the heterogeneity of the LD samples used in these studies, it is possible that the NVLD subtype was included as part of these LD populations. Consequently, it is unclear as to whether the difficulties found among the LD population in these studies are specific to certain LD subtypes that are expected to exhibit social difficulties, namely the NVLD subtype.

Taking into account the heterogeneous nature of the LD population when studying children and adolescents with LD, a few recent studies have directly

examined the ability of children with different LD subtypes to recognize facial expressions of emotions (Dimitrovsky et al., 1998; Dimitrovsky et al., 2000; Petti et al., 2003). In general, these studies have found children with NVLD to be less accurate at recognizing facial expressions of emotion compared to children with VLD and compared to children without LD (Dimitrovsky et al., 1998; Dimitrovsky et al., 2000; Petti et al., 2003). However, little has yet to be done in this area with adolescents with NVLD. In addition, no studies have directly examined the abilities to express or understand facial expressions of emotion among adolescents with NVLD. The ability to recognize, express, and understand facial expressions of emotions in a sample of adolescents with NVLD, as well as their social functioning as compared to adolescents with a general LD (GLD) and without LD has not been examined. Further, the degree to which neuropsychological measures may predict the adolescents' performance on these facial expressions of emotion tasks and social functioning has yet to be explored.

This study is of particular interest as it examines these emotion processing skills in the developmental period of adolescence. Perhaps the social-perceptual abilities of adolescents with NVLD are distinctly different. Nabuzoka and Smith (1995) hypothesized a 'social developmental lag' theory among LD populations, suggesting that children with LD develop more slowly than those without LD in this area. However, the poor performance experienced by children with LD in perceiving expressive cues as reported by Nabuzoka and Smith may have partly been due to the possible LD subtypes within their LD sample. The present study will be the first to examine the abilities of adolescents with NVLD, adolescents with a GLD and adolescents without LD to recognize, express, and understand

facial expressions of emotion, as well as their social functioning. In sum, the current study offers a unique addition to the field of LD by examining different abilities in facial expression of emotion processing (i.e., recognition, expression, and understanding) and social functioning in a sample of adolescents with NVLD, GLD, and without LD.

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Chapter I: Introduction

The importance of examining social functioning of students with learning disabilities (LD) has gained increasing recognition in the field (Bender, 2001; Tur-Kaspa, 2002; Wong, 2004; Wong & Donahue, 2002). Studies have consistently demonstrated that students with LD have lower peer status compared to their non-learning disabled (NLD) peers (Bruininks, 1978; Bryan, 1974, 1976; Scranton & Ryckman, 1979; Silver & Young, 1985; Siperstein, Bopp, & Bak, 1978; Wiener, 1987). In addition, teachers tend to perceive these students as less socially competent and to have poorer peer relations than NLD peers (Bender & Smith, 1990; Haager & Vaughn, 1995). Researchers seeking an explanation for the poor peer status of these students have investigated their social perceptions, their role/perspective taking, their social problem solving abilities, and their comprehension of nonverbal cues (Wong 2004; Wong & Donahue, 2002).

In general, children with LD have been found to be less accurate at interpreting social situations (Bruno, 1981; Pearl & Cosden, 1982), have been shown to do worse on measures of role/perspective taking (Bryan, 1991; Dickstein & Warren, 1980; Wong & Wong, 1980), and have been found to be less competent at social problem solving compared to their NLD peers (Carlson, 1987; Oliva & LaGreca, 1988). Studies examining these abilities in adolescents with LD have found similar results. Specifically, adolescents with LD have been found to be less accurate at interpreting social situations (Weiss, 1984) and to be less competent at social problem solving compared to their NLD peers (Hartas & Donahue, 1997; Silver & Young, 1985). In addition, children with LD have been shown to have more difficulty comprehending a variety of general nonverbal cues

(hand and arm gesture, posture, positions, movements of the body, legs, feet, and facial expressions) relative to their NLD peers (Bryan, 1977). Similar results have been found examining the comprehension of nonverbal cues in adolescents with LD (Axelord, 1982; Wiig & Harris, 1974). However, it is unclear as to whether their difficulties are a result of poor recognition, expression, or understanding of emotions for a specific nonverbal cue, such as facial expressions of emotion. For the purpose of the present study, recognition refers to the ability to recognize a facial expression of emotion from still photographs, drawings, or videotapes, whereas the ability to express facial expressions of emotion refers to one's ability to express an emotion on one's own face upon request. The ability to understand facial expressions of emotions refers to one's ability to choose among an array of still photographs a facial expression that would likely be expressed based on hearing a short story segment.

The ability to recognize, express, and understand facial expressions of emotion has been shown to be related to sociometric status, popularity, and general social competence among children and adolescents without LD (Boyatzis & Satyaprasad, 1994; Custrini & Feldman, 1989; Monfries & Kafer, 1987; Philippot & Feldman, 1990; Zuckerman & Przewuzman, 1979). However, few studies have directly examined these processes among LD populations. Despite the limited amount of research in this area, studies have consistently shown children and adolescents with LD to be less accurate overall at recognizing facial expressions of emotion from still photographs as compared to their NLD peers (Holder & Kirkpatrick, 1991; Most & Greenbank, 2000; Nabuzoka & Smith, 1995). However, due to the heterogeneity of the LD samples used in these studies,

it is unclear as to whether children and adolescents with LD in general experience such difficulties and how students with certain LD subtypes would perform on recognizing facial expressions of emotions. Although the ability to directly express or understand facial expressions of emotion has yet to be studied among adolescent LD populations, children and adolescents with other exceptionalities, such as those with attention deficit hyperactivity disorders (Singh, et al., 1998), emotional and behavioral disorders (Ellis, et al., 1997), as well as children with mental retardation (Mclpine, Singh, Kendall, & Ellis, 1992) have been shown to be less accurate on tasks that assess general understanding of facial expressions of emotion.

Realizing the problems inherent in using heterogeneous samples, investigators began to examine LD subtypes to acquire a more specific understanding of the academic, neuropsychological, social, and emotional functioning of these students (Ozols & Rourke, 1988, 1991; Rourke, 1999; Rourke & Finlayson, 1978; Rourke & Strang, 1978; Strang & Rourke, 1983; Shafir & Siegel, 1994; Siegel, & Linder, 1984; Siegel & Ryan, 1988, 1989). Specifically, the nonverbal learning disability (NVLD) subtype, which is hypothesized to be comprised of a distinct pattern of neuropsychological, academic, and social/emotional deficits has received significant attention (Rourke, 1999; Rourke, 1993; Rourke & Tsatsanis, 1996). These children and adolescents have been found to exhibit difficulties in visual-spatial-organizational skills, concept formation, tactile-perceptual skills, and nonverbal problem solving skills (Harnadek & Rourke, 1994; Rourke & Finlayson, 1978; Rourke & Strang, 1978; Strang & Rourke, 1983). They have been suggested to exhibit academic

difficulties within the area of mechanical arithmetic and mathematics, while demonstrating well-developed levels of word recognition and spelling (Rourke, 1993; Rourke & Tsatsanis, 1996). Their difficulties in reasoning, problem solving, hypothesis testing, and concept formation are postulated to lead to their difficulties to adapt to novel situations and poor social competence, which has been suggested to lead to withdrawal and social isolation among these children and adolescents (Rourke & Fuerst, 1996). In addition, their neuropsychological and social deficits may lead to difficulties in recognizing, expressing, and understanding facial expressions of emotion.

Recently, investigators studying almost exclusively children have found children with NVLD to be less accurate overall at recognizing facial expressions of emotions compared to children with verbal learning disabilities (VLD) and compared to children without LD (Dimitrovsky, Spector, Levy-Shiff, & Vakil, 1998; Dimitrovsky, Spector, & Levy-Shiff, 2000), as well as compared to children with psychiatric difficulties without LD controls (Petti, Voelker, Shore, & Hayman-Abello, 2003). However, little has been done in this area with adolescents with NVLD. In addition, the ability to express or understand facial expressions of emotion is yet to be studied in a sample of adolescents with different subtypes of LD. The importance of examining adolescents stems from the fact that perhaps during this developmental period the social-perceptual abilities of adolescents with NVLD have changed. Specifically, Nabuzoka and Smith (1995) found that as children with LD aged, their ability to perceive facial expressions improved. Nabuzoka and Smith hypothesized a 'social developmental lag' theory, such that perhaps children with LD develop more slowly than those

without LD in this area. The poor performance experienced by children with LD in perceiving expressive cues as reported by Nabuzoka and Smith may have partly been due to the possible LD subtypes which likely formed their LD sample. Subsequently, perhaps during the period of adolescence, those with NVLD eventually catch up to their NLD peers in their ability to perceive expressive cues. The focus of this study is to examine the abilities of adolescents with NVLD, general learning disabilities (GLD) and those without LD to recognize, express, and understand facial expressions of emotion. In addition, the social functioning of adolescents with NVLD, GLD, and without LD through a casual conversational interview was investigated. Further, exploratory research questions examining the degree to which performance on neuropsychological measures predicted the adolescent's ability to process facial expressions of emotion was assessed.

Examining these emotion processes (recognition, expression, understanding, and social functioning) among a sample of adolescents with NVLD, GLD, and without LD will contribute to the field of LD. Specifically, exploring the strengths and weaknesses of adolescents with different LD subtypes in this area of development may shed some light on their social-perceptual experiences within their environment.

Chapter II: Literature Review

Social Functioning in Students with Learning Disabilities

The generic term learning disabilities (LD) was first coined by Kirk (1962), when he described LD as process problems that affect the language and academic performance of people of all ages (Hammill, 1990). He attributed the cause to either cerebral dysfunction or emotional/behavioral disturbances. Although numerous definitions have emerged since the term was first put forth, the majority of them are in agreement regarding the notion that LD is a neurologically based cognitive disability, a dysfunction of thinking and reasoning (Hammill, 1990). As the disorder is postulated to be within the central nervous system, the disability itself is not visible.

Students with LD are primarily described as having a deficit in academic achievement (reading, and/or writing, and/or arithmetic) and/or language (listening and/or speaking) with average or above average intelligence (Bender, 2004; Fletcher, Morris, & Lyon, 2003; Learning Disabilities Association of Canada, 2002). However, they may also display significant difficulties in other nonacademic areas, such as memory, metacognition, cognition, motor and visual-motor skills, perceptual abilities, attention and hyperactivity, and social interactions (National Center for Learning Disabilities, 2003). Although students with LD may share similar characteristics, they will not have deficits in all of these areas. In addition, an area may be a particular strength for a student with an LD, which might exceed the abilities of his or her peers within that area (Bender, 2004). Thus, students with LD make up a heterogeneous population.

Research within the area of LD has placed much of its focus on the assessment and remediation of academic and processing deficits (Bender, 2001; Lerner, 2000). However, the importance of examining the social functioning of students with LD has gained increasing recognition in the field (Hutchinson, Freeman, & Berg, 2004; Wong & Donahue, 2002). Many studies have consistently demonstrated that students with LD have lower peer status as compared to their NLD peers (Bruininks, 1978; Bryan, 1974, 1976; Conderman, 1995; Scranton & Ryckman, 1979; Silver & Young, 1985; Siperstein, Bopp, & Bak, 1978; Wiener, 1987) and to be more rejected by their classmates (Stanovich, Jordan, & Perot, 1998; Stone & LaGreca, 1990; Wiener, Harris, & Shirer, 1990). Children and adolescents with LD have also been shown to have poorer social skills (Hutchinson et al., 2004; Kavale & Forness, 1996; Swanson & Malone, 1992) and lower quality of friendships (Wenz-Gross & Siperstein, 1997; Wiener & Schneider, 2002) as compared to those without LD. In addition, researchers have shown that in general teachers tend to perceive students with LD as less socially competent and to have poorer peer relations than NLD peers (Bender & Smith, 1990; Haager & Vaughn, 1995). Although it is well established that students with LD have poorer peer status than students without LD, the reason for this remains unclear. According to Wong (1996) researchers seeking an explanation for the poor peer status of students with LD have investigated the social aspects of these students from a variety of areas including: (a) social perception, (b) role/perspective-taking, (c) social-problem solving, and the (d) comprehension of nonverbal cues.

In the area of social perception, researchers have found that children with LD are less accurate at interpreting social situations. Bruno (1981) found boys with LD aged 9 to 16 years made more errors in their interpretations of pictorially presented social situations and in predicting the causality of the situations as compared to boys without LD. In another study, Pearl and Cosden (1982) using television clips observed more misinterpretations of the social interactions among children with LD as compared to their NLD peers. Weiss (1984) reported that boys with LD (both aggressive and non-aggressive) aged 11 to 15 years perceived videotaped social situations and verbal descriptions of children as more unfriendly than NLD peers.

In the area of role/perspective taking, researchers commonly investigate the abilities of individuals to put oneself in another person's position and to try to understand how they would be feeling if they were that person. In general, studies indicate that students with LD do worse on tasks of role/perspective taking than students without LD (Bryan, 1991). Dickstein and Warren (1980) observed that LD children scored significantly lower on cognitive, affective, and perceptual role-taking tasks compared to children without LD, with no improvement of the 10-year-olds over the 8-year-olds in the LD group. In another study Wong and Wong (1980) reported that girls with LD were worse at perspective taking when asked to repeat stories from the perspectives of two different characters based on previously heard story sequences compared to boys with LD and girls without LD.

In the area of social problem solving, students with LD have generally been found to be less competent as compared to their NLD peers. Carlson (1987)

found boys with LD to be worse in the quality and quantity of strategies chosen by chance in answering two of four open ended hypothetical peer conflict social situations as compared to their NLD peers. Similarly, Oliva and LaGreca (1988) reported that boys with LD had more difficulty in developing advanced goals in solving theoretical social situations. In another study, Toro, Weissberg, Guare, and Liebenstein (1990) found children with LD provided less alternative solutions as compared to their NLD peers when asked to invent as many different solutions as possible to four different age related social problem situations. Additionally, studies assessing the social problem-solving skills of children and adolescents with LD have found these students to display difficulties in giving different solutions to hypothetical social problems and finding a way to accomplish positive social behaviors (Schneider & Yoshida, 1988; Silver & Young, 1985). Following a group skills training program, Hazel, Schumaker, Sherman, and Sheldon (1982) found that adolescents with LD did not improve as much as adolescents without LD within a cognitive problem solving skill area, which required the generation and evaluation of alternative solutions. Similarly, Hartas and Donahue (1997) reported that adolescents with LD demonstrated limited competence in thinking of possible answers to interpersonal problem scenarios. Likewise, Tur-Kaspa and Bryan (1994) found that students with LD were worse than students without LD at generating their own solutions when solving social vignettes.

Finally, examining the comprehension of nonverbal cues refers to abilities in reading body language such as hand and arm gestures, posture, positions, movements of the body, legs, and feet, as well as facial expressions (Mehrabian,

1972). Many studies that have sought to study the comprehension of a variety of nonverbal cues in children and adolescents with LD have used a measure devised by Rosenthal, Hall, DiMateo, Rogers, and Archer (1979) called the Profile of Nonverbal Sensitivity (PONS). This standardized test consists of a black and white videotape lasting approximately 45-minutes, which contains 220 two second film clips of a young woman displaying numerous emotional responses. Three visual presentations (face, body, figure) and two auditory presentations (electronically filtered speech and scrambled speech) are presented. The visual and auditory presentations are shown alone as well as together. The task consists of listening to, or viewing, each clip and choosing among two responses the one that best describes the scenario.

Bryan (1977) using a shortened version of this test (40 scenarios) found children with LD to be less accurate in their overall comprehension of nonverbal cues than children without LD. However, Stone and La Greca (1984) provided a partial replication and extension of Bryan' (1977) study in addition to controlling for difficulties with attention. Using the shortened version (40-items) of the Profile for Nonverbal Sensitivity, these researchers tested the children individually and provided them with an incentive for maintaining their attention to the task. They found no differences between children with and without LD, suggesting that attention is an important factor in the comprehension of nonverbal cues. Two studies using the Profile of Nonverbal Sensitivity with adolescents reported that adolescents with LD were significantly worse at comprehending nonverbal cues than adolescents without LD (Axelord, 1982; Jackson, Enright, & Murdock, 1987). Wiig and Harris (1974) using videotaped clips of an adult

female displaying nonverbal cues through her face, head, shoulder, arms, and hands found adolescents with LD to be less accurate in their interpretations of the emotions being expressed compared to adolescents without LD.

Although children and adolescents with LD appear to have difficulties in comprehending nonverbal cues, it is unclear as to whether their difficulties are a result of a specific nonverbal cue (i.e. face, body, hands, head). Due to the heterogeneity of the LD samples used in these studies, it is difficult to determine whether these problems are specific to children and adolescents with an LD subtype expected to exhibit social difficulties, such as the NVLD subtype. Specifically, the social deficits that have been reported to occur among LD populations may partly be a function of the NVLD subtype within these samples. In addition, whether the social difficulties experienced by children and adolescents with LD are a result of recognition, expression, or understanding of the nonverbal cue, such as a facial expression is unclear. For the purpose of simplicity, throughout this literature review the term recognition also refers to decoding, discrimination, and identification, while the term expression refers to encoding, production, or making facial expressions of emotions.

Recognition, Expression, and Understanding Facial Expressions of Emotions in the General Population

The ability to recognize, express, and understand facial expressions of emotions has been shown to be important for the social functioning of children and adolescents (Boyatzis & Satyaprasad, 1994; Custrini & Feldman, 1989; Monfries & Kafer, 1987; Philippot & Feldman, 1990; Zuckerman & Przewuzman, 1979). Previous studies that have examined emotion processing using drawings,

and still photographs/slides of facial expressions have found the ability to recognize, express, and understand facial expressions to improve with age (Camras & Allison, 1985; Ekman & Oster, 1982; Field & Walden, 1982; Lewis, Sullivan & Vasen, 1987; Monfries & Kafer, 1987; Philippot & Feldman, 1990; Walden & Field, 1982; Zuckerman & Przewuzman, 1979). In terms of sex, some studies have reported differences in the recognition abilities of facial expressions among adults, with females having better performance than males (for review see Hall, 1978), as well as one study found girls to be more accurate at producing facial expressions as compared to boys among pre-school age children (Shortt, Bush, McCabe, & Gottman, 1994). However, many studies have found no significant sex difference in the ability to recognize, express, and understand facial expressions of emotions among children and adolescents (Boyatzis & Satyaprasad, 1994; Buck, 1975; Custrini & Feldman, 1989; Field & Walden, 1982; Kirouac & Dore, 1985; Phillipot & Feldman, 1990).

The processing of facial expressions of emotions has been found to be influenced by variables other than age and sex. Specifically, the ability to recognize facial expressions of emotions has been reported to be related to the socioeconomic level of children, such that children with lower socioeconomic levels scored lower on recognizing facial expressions (Izard, 1971). The ability to process facial expressions of emotions has also been suggested to be related to depressed mood. Specifically, individuals with depression were found to exhibit dampened facial expressions, which were suggested to be specific to positive expressions, as well as difficulties in emotion recognition and biases in emotion processing (Kring, 2001; Walker, 1981). In addition, children and adolescents

with LD were found to report higher levels of depressive symptoms and are at a greater risk for depression than those without LD (Bender, 1998; Heath, 1996; Heath & Wiener, 1996).

The processing of facial expressions of emotions has also been proposed to be influenced by attention. Children with attention deficit hyperactivity disorder were found to experience difficulty on a task that assessed their ability to understand facial expressions of emotions (Singh et al., 1998). In addition, when attention was controlled for in a task that assessed the comprehension of nonverbal cues, no differences were found among children with and without LD (Stone & LaGreca, 1984). Previous research in the field of LD has also generally found comorbidity of LD and ADHD among children and adolescents (Barkely, 1998; Biederman, Newcorn, & Sprich, 1991; Robins, 1992; Tarnowski & Nay, 1989).

The ability to process facial expressions of emotions has been suggested to be influenced by age, sex, socioeconomic level, depressed mood, and one's ability to maintain attention to the task. In addition, the occurrence of depressed mood and attention difficulties among populations with LD has been delineated. Consequently, in the current study these variables were assessed using various indices and were either controlled for in the methodology or used as covariates when necessary.

Recognition. Many studies examining the recognition of facial expressions of emotion have confirmed the existence of at least five universally recognized facial expressions among humans: happiness, anger, disgust, sadness, and combined fear/surprise (Fridlund, Ekman, & Oster, 1987; Izard, 1971). Although

other emotional categories of facial expressions, such as distress, interest, and shame have been suggested to exist universally across individuals (Ekman & Friesen, 1971; Izard, 1971), there is little research to support this claim.

Even if there is disagreement concerning the exact number and the nature of emotions that are universally recognized (Ekman, 1977; Izard, 1977), processing of facial expressions universally implies that the levels of recognition should be similar across cultures and between subgroups of a given culture. However, some studies have reported sex differences in the recognition abilities of facial expressions of emotion among adults, with female participants having better performances than males (for review see Hall, 1978). Others using still photographs have reported no significant sex difference and that sex differences accounted for a small portion of the variance (Carton, Kessler, & Pape, 1999; Ekman & Friesen, 1971; Hoffman, 1977; Kirouac & Dore, 1983, 1985). Although the adult literature on sex difference in recognition of emotions is inconsistent, studies using drawings, still photographs, and emotion-invoking social situations have consistently found no significant sex difference in the ability to recognize facial expressions of emotion among pre-school age children (Field & Walden, 1982; Shields, Dickstein, Seifer, Gusti, Magee, & Spritz, 2001), school-age children (Custrini & Feldman, 1989), and adolescents (Kirouac & Dore, 1985).

A difference between the accuracy levels for the different categories of emotions has been found using still photographs, drawings, and emotion-invoking scenarios. In general, happy expressions are recognized earliest and most easily, followed by sadness and disgust, and later anger, fear, and surprise (although not consistently in this order) in pre-school aged children (Field & Walden, 1982;

Walden & Field, 1982), school-age children (Custrini & Feldman, 1989) and adults (Kirouac & Dore, 1983, 1985). The recognition of facial expressions of emotion in studies using still photographs and drawings have also been found to improve with age (Camras & Allison, 1985; Ekman & Oster, 1982; Field & Walden, 1982; Monfries & Kafer, 1987; Shields et al, 2001; Walden & Field, 1982; Zabel, 1979), with the suggestion that these abilities stabilize at around 9 to 11 years of age (Fridlund et al., 1987; Odom & Lemond, 1972; Tremblay, Kirouac, & Dore, 1987).

Researchers have hypothesized a link between social functioning and the ability to recognize facial expressions of emotion in young and older children. Using still photographs, Edwards, Manstead, and MacDonald (1984) examined the relationship between the ability of children 8 to 11 years of age to recognize facial expressions of emotions and their sociometric status as measured by their level of friendliness with each classmate. Edwards et al. found children who were classified as high sociometric status were significantly more accurate at recognizing facial expressions of emotions relative to children who were rated as having low sociometric status. In addition, Monfries and Kafer (1987) reported that unpopular children (i.e., neglected and rejected) as measured by sociometric ratings were less accurate than controls at recognizing facial expressions of emotion from still slides. Similarly, Custrini and Feldman (1989) investigated the abilities of children 9 to 12 years of age with above or below average levels of social competence as measured by the Achenbach Child Behavior Checklist (Achenbach & Edelbrock, 1982) to recognize facial expressions of emotions as produced by undergraduate students who watched emotion invoking situations.

Custrini and Feldman found girls who scored higher on social competence to be more accurate at recognizing the facial expressions of emotion, whereas for boys the level of social competence had a minimal effect on their ability to recognize facial expressions of emotion. These studies suggest that the ability to recognize facial expressions of emotions may play an important role in the area social functioning.

Expression. A small number of studies have assessed sex differences in the ability to express facial expressions of emotion. Using direct measures of facial expression ability among pre-school age children, one study found girls to be more accurate at producing facial expressions (Shortt et al., 1994), while others found no significant sex difference (Buck, 1975; Field & Walden, 1982; Walden & Field, 1990). Similar to the ability to recognize facial expressions of emotion, the ability to express facial expressions has been found to improve with age (Lewis et al., 1987). In addition, studies have shown that pre-school age children and adults make less errors expressing happiness, followed by sadness, disgust, anger, fear, and surprise (although not always in this order) (Field, & Walden, 1982; Lewis et al., 1987) when directly asked to express these facial expressions. Using emotion-invoking scenarios, children have also been found to be more accurate at expressing happiness, followed by sadness, disgust, fear/surprise, and anger (Custrini & Feldman, 1989).

Researchers have also hypothesized a link between social functioning and the ability to express facial expressions of emotion. Using emotion-invoking scenarios, Custrini and Feldman (1989) observed that girls with higher social competence were more accurate at expressing facial expressions of emotions

based on judge's ratings compared to girls with low social competence, while the social competence of boys had little effect on their ability to express facial expressions of emotions. Boyatzis and Satyaprasad (1994) asked pre-school age children to express the facial expression that a character in a story would feel after hearing a vignette. They observed a positive correlation between the ability to express facial expressions of emotions and popularity based on teacher ratings. Likewise, using a similar expression task, Zuckerman and Przewuzman (1979) found that pre-school age children's adjustment to school, an indirect measure of social functioning was related to their capacity to express facial expressions of emotions. These studies suggest that general social functioning among children within the general population may be influenced by their abilities to express facial expressions of emotions.

Understanding. Researchers examining understanding of facial expressions of emotions have typically employed tasks that involve showing participants pictures of facial expressions accompanied by short verbal emotional situations which are read aloud. The participants are then asked to point to the facial expression that best depicts how the character in the story would look. In general, a few studies have shown understanding ability increases with age (Monfries & Kafer, 1987; Philippot & Feldman, 1990; Zuckerman & Przewuzman, 1979) with no sex difference (Boyatzis & Satyaprasad, 1994; Philippot & Feldman, 1990). Similar to recognition and expression, the facial expression of happiness was found to be the most easily understood among pre-school age children (Phillipot & Feldman, 1990).

Investigators have also suggested a connection between social functioning and the ability to understand facial expressions of emotion. Philippot and Feldman (1990) examined the relationship between social functioning, as measured by the Achenbach Child Behavior Checklist (Achenback & Edlebrock, 1982) and the ability of children 3 to 5 years of age to choose the most appropriate facial expression that the main character would depict in videotaped emotional situations. Philippot and Feldman found that children with higher social functioning chose the correct facial expression of emotion more often than children who were reported to exhibit lower social functioning. Similarly, Monfries and Kafer (1987) reported that unpopular children as measured by sociometric ratings were less accurate than controls at understanding facial expressions of emotions based on emotional situations depicted in large picture cards. Likewise, Boyatzis and Satyaprasad (1994) found a positive correlation between preschooler's ability to understand facial expressions of emotions based on still photographs accompanied by emotional situations and popularity as measured by teacher ratings. Further, in a study using a similar method to Boyatzis and Satyaprasad, Zuckerman and Przewuzman (1979) found pre-school age children's adjustment to school to be related to their capacity to understand facial expressions of emotions.

Recognition, Expression, and Understanding of Facial Expressions of Emotions in Populations with Learning Disabilities

The studies previously reviewed suggests an association between the ability to recognize, express, and understand facial expressions of emotion and social functioning among children and adolescents within the general population. In the area of LD, studies have consistently demonstrated students with LD to have lower peer status (Bruininks, 1978; Bryan, 1974, 1976; Conderman, 1995; Scranton & Ryckman, 1979; Silver & Young, 1985; Siperstein et al., 1978; Wiener, 1987), to exhibit poorer social skills (Hutchinson, et al., 2004; Kavale & Forness, 1996; Swanson & Malone, 1992) and to be perceived by their teachers as being less socially competent than NLD peers (Bender & Smith, 1990; Haager & Vaughn, 1995). To explain the lower social status of children and adolescents with LD researchers have hypothesized that their difficulties in recognizing a variety of nonverbal cues (i.e., face, body, hands, head) may play a role. Although it has been shown that children and adolescents with LD are less accurate at recognizing different types of nonverbal cues (Axelord, 1982; Bryan, 1977; Jackson et al., 1987; Wiig & Harris, 1974), few studies have directly examined whether these students have specific difficulties in recognizing facial expressions of emotion.

Despite the little research in this area, studies have found children and adolescents with LD to be less accurate at recognizing facial expressions of emotion as compared to their NLD peers (Holder & Kirkpatrick, 1991; Most & Greenbank, 2000; Nabuzoka & Smith, 1995). In general, authors of these studies

have reported happiness to be the facial expression of emotion that was most easily recognized among all groups (i.e., LD and NLD), with disgust and fear being the most difficult. However, the order of recognition accuracy and ease among the facial expressions of emotions of anger, surprise, and sadness was found to be less clear. The results of these studies are summarized in Table 1. Holder and Kirkpatrick (1991) investigated the accuracy and response time of younger children with (n = 24, M = 8.9 years) and without LD (n = 24, M = 9.2 years) and older children with (n = 24, M = 12.7 years) and without LD (n = 24, M = 12.6 years) in recognizing facial expressions of emotions. Younger and older children with LD were selected based on being formally identified by their school district, which was characterized by an average to above average range of intelligence, lower achievement than their age and ability level, and a discrepancy between their achievement and intellectual ability. The recognition task involved a version of the Pictures of Facial Affect (Ekman & Friesen, 1976), which contains 35mm black and white still slides of adult males and females making the facial expressions of the emotions of happiness, anger, sadness, surprise, fear, and disgust. The participants were asked to recognize the emotion by providing a verbal label.

Table 1

Summary of Findings of Recognition of Facial Expressions of Emotions among Populations with Learning Disabilities

Study	Method	Results
1. Holder & Kirkpatrick (1991)	Younger children with (M = 8.9) and without LD (M = 9.2), older children with (M = 12.7) and without LD (M = 12.6). Accuracy of recognition and response time using Pictures of Facial Affect.	Groups were more accurate at recognizing happiness, then anger, surprise, sadness, fear, and disgust. Children with LD were less accurate at recognition than those without LD, with no age or gender effects. Children with LD were less accurate at recognizing only surprise and disgust than those without LD. Groups needed less time to recognize happiness, then anger, surprise, disgust, sadness, and fear. Younger children, specifically those with LD needed the most time to respond to fear, anger, and disgust. Young males, specifically those with LD needed more time to respond to happiness than any other group.
2. Nabuzoka & Smith (1995)	Younger (M = 6.7 years), Middle (M = 9.2 years) and Older (M = 11.1 years) children with and without LD (M = 9.4 years) shown 10 photographs on a card and asked to point to the one that	Children with LD were less accurate at recognition than those without LD at all three age levels. There was a developmental progression among children with LD with the older group scoring highest in recognition, followed by the middle and then the youngest group. Significant differences in recognition were only found between the younger and older children with LD. Groups were most accurate at recognizing happiness and self-satisfied with bored and neutral being the most difficult to recognize. Older children with LD were more accurate than younger children and children without LD were more

	depicts the emotion stated by the examiner. A one-year follow-up study was conducted using the same measures.	accurate than those with LD at recognizing disgusted, puzzled, angry, frightened, surprised, and self-satisfied. More girls correctly identified disgusted than boys. Children with LD were significantly less accurate at recognition than those without LD one year later. Older children were more accurate than the middle group at recognition, with no significant differences between the younger and middle groups or between the younger and older groups. In general, facial expressions were more accurately recognized at one-year follow-up.
3. Most & Greenbank (2000)	Adolescents (M = 14.2 years) with LD and adolescents (M = 13.8 years) without LD Identification of Emotions Test Hebrew adaptation of the Student and Teacher Social Skills Rating Scale	Adolescents with LD were less accurate at recognition compared to adolescents without LD. No significant differences emerged between adolescents with and without LD on self-ratings on any of the social skills categories Teachers rated the adolescents with LD as being lower on every measure of social skill and behavior than those without LD.

Note. LD = Learning disability.

The authors found the LD group in general to be less accurate overall in their ability to recognize facial expressions of emotions and no significant age or sex effects were observed. In terms of the order of recognition for the specific facial expressions of emotions, all groups were more skilled in recognizing happiness, followed by anger, surprise, and sadness, and least proficient in recognizing fear and disgust. As for the specific emotions, children with LD were found to be less accurate at recognizing the facial expressions of surprise and disgust compared to children without LD.

In terms of response time, all groups required less time to recognize the facial expression of happiness, followed by anger, surprise, disgust, sadness, and fear. As for the specific facial expressions of emotions by the age groups, younger children with LD required more time to respond to fear and anger than any other group. Older boys with LD required the least amount of time to respond to fear than any other group, while older children without LD required the least amount of time to respond to anger. Younger children with LD required the most time to respond to disgust, while older children with LD required the least amount of time. Girls with LD required the most time to respond to sadness, while older females with LD required the least amount of time, and were more accurate at recognizing this emotion. In addition, older boys with LD required less time to respond to sadness than younger boys with LD; however, they were less accurate.

Although many results emerge from this study, the most straightforward and pertinent finding is that younger and older children with LD were less accurate overall at recognizing facial expressions of emotions relative to those without LD. Although the largest difference in performance between these two

groups occurred for the later-developing emotions of surprise and disgust, Holder and Kirkpatrick (1991) contend that this may be a function of problems in deciphering subtle, or complex facial expressions, or simply a lag in the normal development of facial expression recognition. In addition, Holder and Kirkpatrick suggest that the lack of finding a significant difference between younger and older children in their ability to recognize facial expressions of emotions might be a result of their narrow age span. Holder and Kirkpatrick contend that perhaps if older participants had been used in the older age group, that the recognition accuracy would have improved with age. Finally, Holder and Kirkpatrick imply the possible existence of particular subgroups with difficulties. Specifically, young girls with LD as they generally required more time to respond, with lower accuracy at recognizing the facial expressions. Adolescent males with LD was suggested to be another subgroup as they required little time to respond, but were also fairly inaccurate at recognizing the facial expressions.

In a developmental study, Nabuzoka and Smith (1995) examined the ability of children with LD at three age levels, younger ($M = 6.7$, $n = 21$), middle ($M = 9.2$, $n = 19$) and older ($M = 11.1$, $n = 34$) and children without LD ($M = 9.4$ years, $n = 19$) to recognize facial expressions of emotions. Overall, the children with LD had an average IQ of 85 and academic achievement of 1 to 3 years below age level in reading and/or writing and/or math. The children were shown a card with ten photographs (9 were of a female adult, 1 was of a male adult) and were asked to point to the photograph that depicted the emotion stated by the examiner.

In general, Nabuzoka and Smith (1995) found children with LD at the three age levels to be less accurate at recognizing facial expressions of emotions

than children without LD. An age progression was observed for the facial expressions of disgust, anger, puzzled, frightened, surprised, and self-satisfied, such that older children with LD were more accurate than younger children with LD. The age progression was not observed for the middle age group of children with LD except for the facial expressions of fear, happiness, surprise, and self-satisfaction. Happiness and self-satisfied were the most accurately recognized among all groups, while bored and neutral were the most difficult to recognize. In terms of sex, a significant difference was found only for disgust, with girls correctly recognizing this facial expression more often than boys. As for the specific facial expressions of disgust, puzzled, angry, frightened, surprise, and self-satisfied, older children with LD were more accurate than younger children with LD, while children without LD were more accurate at recognizing these facial expressions than children with LD.

Approximately half of the sample was followed-up one-year later and reassessed on their ability to recognize facial expressions of emotion using the same procedure as that for the initial data collection. One-year later, children with LD from all three age levels were again significantly less accurate at recognizing facial expressions of emotion compared to children without LD. Among the children with LD, the oldest age group was significantly more accurate at recognizing facial expressions of emotion than the middle age group; however, there were no significant differences between the younger and middle age groups or between the younger and older age groups on recognizing facial expressions of emotion. Nabuzoka and Smith (1995) also observed a significant effect of time, such that facial expressions were correctly recognized more often at one-year

follow up among all the groups as compared to the initial study. However, for children with LD, the difference in performance between the first study and one-year follow-up approached significance, with better performance at follow-up. No time effects were observed for children without LD, or for any of the groups of children with LD when considered separately.

The study by Nabuzoka and Smith (1995) demonstrates that the accuracy of recognizing facial expressions of emotions among children with LD increases with age relative to their NLD peers. Nabuzoka and Smith propose that recognition abilities may be developmental in nature, consequently the improvement with age. Children with LD were less accurate at recognizing facial expressions of emotions than their age-matched controls and older children with LD were more accurate as compared to younger children with LD. Based on these findings, the authors hypothesize "a social developmental lag theory" such that children with LD lag behind their NLD peers on these skills. No significant differences between the younger and middle age groups of children with LD nor between the middle and older age groups of children with LD were found, which is suggested by Nabuzoka and Smith to reflect the narrow age range of the groups. Although children with LD performed at lower levels than those without LD, due to the heterogeneity of the LD sample it is difficult to conclude whether these results are in part a consequence of the LD sample containing children with NVLD subtypes.

Most and Greenbank (2000) examined the abilities of adolescents with (n = 30, M = 14.2) and without LD (n = 30, M = 13.8) to recognize facial expressions and tone of voice of emotions through visual, auditory, and combined

visual-auditory presentations, as well as their social skills. For the purpose of this review, solely the results that pertain to the visual presentation will be discussed. Although test scores were not provided, the adolescents with LD were all eighth grade students in special education classes and were assessed by the school's psycho-educational team as demonstrating learning difficulties, namely, not functioning as expected based on their age in certain academic areas (e.g., reading, written expression, mathematics), and having an average IQ or better. The students without LD were selected from an eighth grade regular classroom and were matched to the LD group on age, gender, and socioeconomic status. Participants were administered the Identification of Emotions Test (Most, Weisel, & Zaychik, 1993) in groups of five to eight, which consists of six presentations of six emotions (anger, disgust, surprise, sadness, fear, and happiness) in a random order through the three modalities (visual, auditory, and combined visual-auditory). In the visual presentation, the participants watched a video recording of an actor displaying the facial expressions of the six emotions one at a time without sound. A Hebrew adaptation (Margalit, Ankonina, & Al-Yagon, 1991) of the Student and Teacher Social Skills Rating Scale (Gresham & Elliott, 1987, 1990) was used to assess student and teacher perceptions of the student's social skills.

Most and Greenbank (2000) found the adolescents with LD to be less accurate overall at recognizing the facial expressions of emotion as compared to adolescents without LD. In terms of social skills, no significant differences emerged between adolescents with and without LD on their self-ratings on any of the social skills categories (e.g., cooperation, self-control, empathy, and

assertion). However, the teachers rated the adolescents with LD as being lower on every measure of social skill (e.g., assertion, cooperation, and self-control) and behavior (e.g., introversion and extroversion) as compared to the adolescents without LD.

As the relationship between the adolescents' ability to recognize facial expressions of emotion and their social skills was not examined, it is difficult to draw conclusions regarding the connection between poor social skills based on teacher ratings and inaccurate recognition of facial expressions of emotion for this population. Most and Greenbank (2000) found adolescents with LD to be less accurate at recognizing facial expressions of emotion. The fact that difficulties with attention were not controlled might have influenced these results. Additionally, due to the heterogeneity of the LD sample, it is unclear as to whether adolescents with LD experienced these difficulties because perhaps the sample in part included adolescents with NVLD subtypes.

The ability to recognize facial expressions of emotions has also been investigated among children, adolescents, and adults with other exceptionalities (Walker, McGuire, & Bettes, 1984; Zabel, 1979). Zabel (1979) examined the abilities of children from special elementary (M = 8.68 years), regular elementary (M = 9.19 years), and adolescents from special junior high (M = 14. 23 years) and regular junior high (M = 13.55 years) to recognize facial expressions of emotions. The students from the special schools were considered to have emotional and behavioral problems too severe to be accommodated by regular schools. A set of 42 photographs from Ekman and Friesen's Pictures of Facial Affect (1976) with six different facial expressions of emotions (happy, sad, surprise, fear, anger, and

disgust) in addition to six neutral faces were presented six times. The participants were asked to examine each photograph and state the emotion that was being expressed.

Zabel (1979) found the students with special needs to be less accurate overall at recognizing facial expressions of emotion. The overall percent of correct responses for the groups were as follows: special elementary (59.31%), special junior high (66.11%), regular elementary (71.36%), regular junior high (76.7%), all regular students (73.7%), and all special students (62.7%). The regular junior high students were more accurate than the regular elementary students for every facial expression except anger and fear, while the special junior high students were more accurate than the special elementary group for every facial expression except sadness and anger. In terms of specific emotions, students with special needs were significantly less accurate at recognizing sadness, fear and disgust compared to students without special needs. A significant effect of age level (i.e., elementary/junior) was observed for overall recognition accuracy, however, in terms of the individual facial expressions of emotion, only surprise was found to be significant. This study supports the notion that recognition ability improves with age, as the junior high students were better at recognizing facial expressions of emotions than the elementary students. Although it is not mentioned in the study, in conjunction with their emotional and behavioral difficulties, these students may have had an LD. Consequently, having an LD may have contributed to their poor ability to recognize facial expressions of emotions.

In a study investigating recognition abilities among adults with exceptionalities, Walker et al. (1984) found adults with schizophrenia and

affective disorders to be less accurate at recognizing facial expressions of emotions from still photographs than normal controls. The results obtained by Walker et al. (1984) and Zabel (1979) generally suggest that children, adolescents, and adults with different exceptionalities are less accurate at recognizing facial expressions of emotions from still photographs as compared to normal controls.

The ability to directly express or understand facial expressions of emotions in children and adolescents with LD has yet to be examined. However, the ability to understand facial expressions of emotions has been studied among children and adolescents with emotional and behavioral disorders (Ellis et al., 1997) attention deficit hyperactivity disorder (Singh et al., 1998), as well as among children and adults with intellectual disabilities (McAlpine, Singh, Kendall, & Ellis, 1992). Although all three studies used four sets of six still photographs depicting facial expressions of the six basic emotions (happy, sad, angry, fear, surprise, disgust), two sentence stories were also used to describe an event that was said to have produced one of the six emotions. In all three studies, while looking at one set of the six photographs at the same time, the participants were read a story and asked to point to the facial expression that looked like the emotion the person in the story would be displaying. As these tasks involve social situations that are attached to facial expressions, they require a level of understanding from the participants and will not be considered strict recognition tasks. The latter task solely asks the participant to name or chose from a multiple choice answer sheet the facial expression of emotion that is being depicted in a still photograph. Thus, for the purpose of this literature review, these studies have

been considered to employ understanding tasks as opposed to direct recognition of facial expressions of emotions from still photographs. The results of the three studies are summarized in Table 2.

In the first study, Ellis et al. (1997) found a high degree of overall accuracy on understanding for all emotions (91%) among children and adolescents with emotional and behavioral disorders. The accuracy levels in understanding facial expressions of emotions in decreasing order were happiness (99%), sadness (96%), disgust (95%), anger (91%), surprise (84%), and fear (83%), similar to studies using this task with other special populations (McAlpine et al., 1992; Singh et al., 1998). The most common confusion in understanding occurred among the emotions of fear and surprise. Although no significant effect of sex for the total score or for any of the six individual emotion scores was found, age was consistently related to understanding accuracy, such that a significant relationship with the total score and each of the individual emotions was observed.

In the second study, Singh et al. (1998) found the mean correct response level for their understanding task across the six facial expressions of emotion for children and adolescents with attention deficit hyperactivity disorder to be 74%. In terms of individual emotions, the correct responses in descending order were happiness (93.5%), sadness (86.0%), disgust (76.0%), surprise (65.5%), anger (64.5%), and fear (61.0%), which is similar to other studies using this task with participants with exceptionalities (Ellis et al., 1997; McAlpine et al., 1992). In addition, the most common error was confusing fear and surprise, which has previously been demonstrated using the same task (Ellis et al., 1997).

Table 2

Summary of Percentage of Correct Responses to Each Facial Expression of Emotion in an Understanding Task Among Participants with Exceptionalities

Study	Sample	Happiness	Sadness	Disgust	Anger	Surprise	Fear	Total	Confusion Errors
1. Ellis et al. (1997)	Children and adolescents (*M*= 12.6 years; range = 7 to 16 years) with E/BD.	99%	96%	95%	91%	84%	83%	91%	Surprise for Fear (15%) Fear for Surprise (12%) Disgust for Anger (6%) Anger for Disgust (3%)
2. Singh et al. (1998)	Children and adolescents (*M*= 8.6 years; range = 5 to 13 years) with ADHD	94%	86%	76%	65%	66%	61%	74%	Fear for Surprise (26%) Surprise for Fear (23%) Anger for Disgust (22%) Disgust for Anger (10%)
3. McAlpine et al. (1992)	Children and adults with MR and C matched on mental age.	MR 80% C 100%	MR 50% C 88%	MR 48% C 78%	MR 46% C 85%	MR 38% C 71%	MR 42% C 63%	MR 51% C 81%	MR 1. Happiness for Surprise C 1. Surprise and Fear

Note. E/BD = Emotional and behavioral disorder; ADHD = Attention deficit hyperactivity disorder; MR = Mental retardation; C = Control participants.

In the third study, McAlpine et al. (1992) found children and adults with mild and moderate intellectual disabilities to be less accurate on the understanding task for all emotions compared to non-handicapped controls matched on mental age (based on their level of intellectual ability). In terms of the individual emotions, the correct responses for individuals with intellectual disabilities in descending order were happiness (80%), sadness (50%), disgust (48%), anger (46%), fear (42%), and surprise (38%). The matched controls made correct responses which were similar to the intellectual disabled groups in terms of order of accuracy, with happiness (100%), sadness (88%), anger (85%), disgust (78%), surprise (71%), and fear (63%). As a group children and adults with intellectual disabilities had an overall accuracy level on the understanding task employed in this study of 51%.

In general these studies suggest that as with recognition, happiness appears to be the facial expression of emotion that is most accurately and easily understood, with fear being the more difficult to understand among exceptional populations. As for the facial expressions of sadness, disgust, anger, and surprise, the order of the accuracy of understanding among these emotions, that is the specific emotion hierarchy, is less clear. These studies also suggest that children, adolescents, and adults with other exceptionalities are less accurate at understanding facial expressions of emotions as compared to normal controls.

Taken together, the studies reviewed thus have generally found children and adolescents with LD to be less accurate than children and adolescents without LD at recognizing facial expressions of emotions from still photographs and video recordings (Holder & Kirkpatrick, 1991; Most & Greenbank, 2000; Nabuzoka &

Smith, 1995). However, due to the heterogeneity the LD samples used in these studies, it is difficult to conclude whether these deficits are due to a specific LD subtype, namely the NVLD subtype, which may have been included within the LD samples in these studies. Although the ability to directly express or understand facial expressions of emotions has yet to be studied among LD populations, children and adolescents with other exceptionalities have been shown to be less accurate on tasks that assess the understanding of facial expressions of emotions (Ellis et al., 1997; McAlpine et al., 1992; Singh et al., 1998).

Recognition, Expression, and Understanding of Facial Expressions of Emotion in Populations with Learning Disability Subtypes

Learning disability subtypes. More than thirty years ago Johnson and Myklebust (1967) hypothesized the possibility of a distinction between different subtypes of LD, suggesting the existence of a NVLD subtype. Previous studies examining the academic deficits and social difficulties among children and adolescents with LD have generally used research designs comparing undifferentiated groups of children and adolescents (for reviews see Bender & Wall, 1994; Little, 1993). However, researchers have classified children, adolescents, and adults with LD subtypes based on academic deficits in reading and arithmetic (Shafir & Siegel, 1994; Siegel & Linder, 1984; Siegel & Ryan, 1988, 1989). In general, Siegel has classified three LD subtypes, the reading-disabled (RD), the arithmetic disabled (AD), and the combined reading and arithmetic disabled (RAD).

In general, children with AD and RD have more difficulty with short-term memory and working memory as compared to their normally achieving peers, but

as they age their performance on such tasks appears to improve (Siegel & Linder, 1984). However, these deficits have been shown to be task specific, such that children with RD had memory deficits for verbal material, whereas children with RAD had difficulty for both verbal and visual information as compared to NLD students (Fletcher, 1985; Siegel & Ryan, 1989). However, only the AD group performed poorly on nonverbal visual working memory tasks as compared to children without LD (Fletcher, 1985; Siegel & Ryan, 1989). This finding is supported by a more recent study where children classified as having a NVLD, which is often used interchangeably with AD, exhibited more difficulties on tasks that involved visual-spatial working memory and visual imagery relative to children without LD (Cornoldi Rigoni, Tressoldi, & Vio, 1999).

Shafir and Siegel (1994) examined the performance of a combined adolescent and adult sample with these same LD subtypes (i.e., AD, RD, RAD) on various cognitive and achievement measures. In general, both the RD and RAD groups exhibited significant weaknesses in phonological processing, spelling, vocabulary, and short-term memory as compared to NLD control, while the AD group's performance on word reading and vocabulary were within normal limits. In addition, the AD and RAD groups demonstrated more difficulties on visual-spatial tasks relative to the RD and NLD groups. Based on these findings there appears to be significant differences between the RD, AD, and RAD groups in terms of their difficulties with specific cognitive processes and academic tasks.

Rourke and his associates have also strongly suggested that children and adolescents with LD constitute a heterogeneous population with differing academic and cognitive abilities and that subtypes can be reliably identified

(Rourke & Finlayson, 1978; Rourke & Strang, 1978; Strang & Rourke, 1983). In their early studies, these researchers examined whether children who exhibited specific patterns on the Wide Range Achievement Test (WRAT; Jastak & Wilkinson, 1984) also demonstrated specific patterns of neuropsychological assets and deficits. Based on their findings, Rourke and his associates identified three groups of children with distinct neuropsychological and academic profiles, namely, children with verbal learning disabilities (VLD), nonverbal learning disabilities (NVLD), and combined verbal and nonverbal learning disabled (BVNLD). For the purpose of this literature review, these three terms will be used throughout when describing the findings reported by Rourke and his associates.

Rourke and Finlayson (1978) examined the performance of children with LD between the ages of 9 and 14 years of age on reading, spelling, and arithmetic on the WRAT. Specifically, children later classified as BVNLD were consistently weak in reading, spelling, and arithmetic, similar to Siegel's RAD. Children later classified as VLD had higher arithmetic performance than in reading and spelling, similar to Siegel's RD. Children later classified as NVLD exhibited higher performance on word reading and spelling and significantly poor performance in arithmetic, similar to Siegel's AD. In addition, children later classified as VLD and NVLD demonstrated better performance on arithmetic as compared to those classified as BVNLD. Based on the three groups' performance on 16 neuropsychological and cognitive measures, Rourke and Finlayson (1978) reported that children later classified as BVNLD and VLD exhibited significantly better performance than children later classified as NVLD on tasks that measured visual-spatial and visual-perceptual abilities. Additionally, children later classified

as NVLD performed at significantly higher levels than children later classified as BVNLD and VLD on tasks that measured verbal and auditory-perceptual abilities. Further, children later classified as BVNLD and the majority later classified as VLD were found to have lower Verbal IQs relative to Performance IQs, whereas all children later classified as NVLD were found to have higher Verbal IQs than Performance IQs (Rourke & Finlayson, 1978).

Rourke and Finlayson (1978) imply that children later classified as VLD might be expected to exhibit arithmetic difficulties because of poor verbal abilities, whereas children later classified as NVLD may experience these difficulties because of poor visual-spatial abilities. The different types of arithmetic errors made by these two groups of LD subtypes would suggest this distinction (Strang & Rourke, 1985). Specifically, children later classified as NVLD made errors in spatial organization such as misaligning numbers, in visual details such as misreading the mathematical signs, as well as procedural errors such as missing or adding steps when solving a mechanical arithmetic problem. In addition, these children tended to have difficulties in shifting psychological sets, that is when two or more numerical operations of one kind (e.g., addition) occur after another kind (e.g., subtraction) when answering mechanical arithmetic questions (Strang & Rourke, 1985).

In a further investigation, Strang and Rourke (1983) studied nonverbal problem solving and concept formation abilities as measured by the Halstead Category Test (Reitan & Davidson, 1974) of only children who were later classified as VLD and NVLD. The authors observed that children with NVLD made significantly more total errors on this test relative to children with VLD. In

addition, children with NVLD performed approximately one standard deviation below age level, whereas children with VLD performed within the normal range. Looking at the different subtests, Strang and Rourke (1983) found that children with VLD demonstrated higher performance on subtests that involved complex visual-spatial analysis and incidental memory for previously correct solutions.

In general the major findings from these three studies suggest that children with NVLD exhibit deficits within visual-perceptual-organizational, psychomotor, tactile-perceptual, and conceptual areas. In addition, based on the analysis of math errors, Strang and Rourke (1985) suggest that the arithmetic difficulties seen in children with NVLD encompass a wider variety and a greater number of errors than those with VLD who tend to experience difficulties in reading and insufficient knowledge with arithmetic. Specifically, Rourke (1989, 1993) details the errors made by children with NVLD as those that involve spatial organization, visual detail, procedural errors, failure to shift psychological set, graphomotor skills, memory problems, and judgment and reasoning. These arithmetic difficulties have been suggested to reflect the poor visual-spatial-organizational abilities, limited concept-formation, poor psychomotor skills and hypothesis testing often experienced by children with NVLD (Rourke, 1993). In addition, the poor verbal and auditory-perceptual skills exhibited by children with VLD and the poor visual-spatial skills found among children with NVLD has been demonstrated in younger children between the ages of 7 and 8 years using similar cognitive and neuropsychological measures (Ozols & Rourke, 1988, 1991).

Taken together, children classified as having a NVLD, have been postulated to exhibit deficits in visual-spatial-organizational, psychomotor,

concept formation, tactile and visual memory, tactile-perceptual skills, and nonverbal problem-solving skills (Rourke & Finlayson, 1978; Rourke & Strang, 1978; Strang & Rourke, 1983). These children have been hypothesized to display assets in psycholinguistic skills such as auditory and verbal attention, auditory perception, auditory and verbal memory, verbal classification, and rote verbal learning. These children and adolescents have also been proposed to exhibit academic difficulties within the area of mechanical arithmetic and mathematics, while demonstrating well-developed levels of word recognition and spelling. Socially, these children and adolescents have been hypothesized to demonstrate difficulties in social competence, problems adapting to novel situations, and poor emotional stability (Rourke, 1993; Rourke & Tsatsanis, 1996).

In an attempt to determine the most salient dimensions of the NVLD syndrome, that is the relative discriminative validity of their neuropsychological assets and deficits, Harnadek and Rourke (1994) used discriminant function analysis on 15 neuropsychological variables. Deficits in visual-perceptual-organizational psychomotor coordination and tactile-perceptual skills accurately discriminated the NVLD group from the VLD and the NLD control. These neuropsychological measures appear to be assessing the assets and deficits among children with NVLD, as these dimensions are consistent with the primary neuropsychological deficits as outlined in the NVLD model (Rourke, 1987, 1989, 1995). The neuropsychological measures employed by Harnadek and Rourke (1994) will be administered in the current study to all the adolescents to explore the degree to which their performance on such measures may predict their ability

to recognize, express, and understand facial expressions of emotions, as well as their social functioning.

In general, studies (Fisher & DeLuca, 1997; Fisher, DeLuca, & Rourke 1997; Rourke & Tsatsanis, 1996) suggest that the hypothesized neuropsychological deficits as outlined in the NVLD model (Rourke, 1982, 1989, 1995; Rourke & Tsatsanis, 1996) and the methodological criteria employed by Harnadek and Rourke (1994) have been reliably employed to study the neuropsychological processing assets and deficits among LD subtypes. In addition, the poor problem solving abilities and concept formation of children and adolescents with this subtype has been suggested to lead to the socioemotional and adaptive deficits in handling novel situations, unpredictability, ambiguity, and social competence (Fisher et al., 1997; Harnadek & Rourke, 1994; Rourke, 1989, 1993, 1995; Tsatsanis & Rourke, 1996).

Although the elucidation of the academic, cognitive, and neuropsychological patterns of children and adolescents with NVLD have been widely investigated (for reviews see Rourke, 1993; Rourke & Fuerst, 1996; Rourke & Tsatsanis, 1996), the psychosocial functioning of these children is also important. Previous researchers have hypothesized that the four categories of neuropsychological assets and deficits are related to the academic, psychosocial, and adaptive dimensions, possibly being dependent variables of the NVLD subtype (Rourke, 1993; Rourke & Fuerst, 1996; Tsatsanis & Rourke, 1996). There is also a suggestion that the pattern of neuropsychological assets and deficits seen among children and adults with this subtype leads to an increased risk of socio-

emotional difficulties (Porter & Rourke, 1985; Rourke, Young, Strang, & Russell, 1986).

Specifically, children and adolescents with NVLD have been shown to be at risk for internalized forms of personality disturbance, such as depression, and suicide (Rourke, Young, & Leenaars, 1989). Casey, Rourke & Picard (1991) demonstrated that while both children and adolescents with NVLD displayed significant internalizing forms of emotional disturbance as measured by the Personality Inventory for Children, adolescents exhibited even greater difficulties, particularly on the depression and social skills scales. In a similar vein, Gross-Tsur, Shalev, Manor, and Amir (1995) reported that children who displayed the clinical spectrum of NVLD exhibited social isolation, withdrawal, and difficulties with attention. During their psychological evaluation, Gross et al. found these children to exhibit poor comprehension of social rules, to display few facial and body gestures during speech, flat speech prosody, and problems maintaining eye contact.

As previously stated, the social and emotional difficulties often exhibited by individuals with NVLD are proposed to arise from the relationship between their neuropsychological assets and deficits (Rourke, 1993; Rourke & Fuerst, 1996; Rourke & Tsatsanis, 1996). Specifically, difficulties in reasoning, problem solving, hypothesis testing, and concept formation are postulated to lead to difficulties to adapt to novel situations and poor social competence, which has been suggested to lead to withdrawal and social isolation among children and adolescents with NVLD (Rourke & Fuerst, 1996). In addition, the interaction between the neuropsychological and social deficits often experienced by children

and adolescents with NVLD have also been postulated to lead to difficulties in recognizing nonverbal cues (Rourke, 1999).

Neuropsychological correlates of emotion processing among LD subtypes.

Children and adolescents classified as having a NVLD have previously been suggested to exhibit deficits in visual-spatial-organizational processing, concept formation, visual memory, and nonverbal problem solving skills (Rourke & Finlayson, 1978; Rourke & Strang, 1978; Strang & Rourke, 1983). More recently, this population of children and adolescents has been hypothesized to display a specific pattern of neuropsychological assets and deficits, which have been postulated to account for their academic and psychosocial difficulties (Harnadek & Rourke, 1994; Rourke, 1989, 1993; Rourke & Tsatsanis, 1996). Specifically, visual and tactile perception difficulties, poor visual and tactile attention, difficulties with visual and tactile memory, as well as deficits in concept formation and problem solving are among some of the neuropsychological deficits thought to be exhibited by children and adolescents with NVLD. Their limited ability to cope adaptively with novel material and their constrained exploratory behavior has also been viewed to be among the neuropsychological deficits displayed by these children and adolescents. However, children and adolescents with NVLD have been found to display good auditory memory and auditory attention, as well as strong skills in phonology.

In order to better classify the neuropsychological variables involved in the identification of children with NVLD, Harnadek and Rourke (1994) using discriminant function analysis reported that deficits in visual-perceptual-organizational processing and tactile perceptual skills accurately discriminated the

NVLD group from the VLD and NLD controls. Specifically, Harnadek and Rourke (1994) reported that the Trail Making Test (Reitan & Davidson, 1974) and the Target Test (Reitan, 1966), which combined is referred to as the Visual-Perceptual-Organization measure, correlated 0.60 with the function that accounted for 69% of the total variance in the discrimination of the NVLD and VLD groups. In addition, these authors also found the Grooved Pegboard Test (Klove, 1963) and the Speech Sounds Perception Test (Halstead, 1947; Reitan & Davidson, 1974) to correlate 0.47 and 0.44 with the function that accounted for 69% and 31% of the total variance respectively in the discrimination of the NVLD and VLD groups. These four neuropsychological measures, namely: The Trail Making Test, The Target Test, The Grooved Pegboard Test, and The Speech Sounds Perception Test have been suggested to be a current valid and reliable way of being able to discriminate children with NVLD from those with VLD and NLD controls (Harnadek & Rourke, 1994).

One explanation that has been put forth to support such a battery of neuropsychological measures in the discrimination of children with NVLD is that the neuropsychological constructs being measured by such assessments correspond to the neuropsychological assets and deficits seen among children with NVLD. Specifically, The Trail Making Test has been suggested to measure the neuropsychological abilities of visual perception, visual scanning, visual attention, and visual-spatial sequencing (Mitrushina, Boone, & D'Elia, 1999). The Target test has been found to be a measure of visual-spatial memory and visual-organizational abilities (Reitan, 1966). The Grooved Pegboard Test has been shown to measure visual-spatial-motor coordination and visual perceptual skills

(Lezak, 1995; Mitrushina et al., 1999). The Speech Sounds Perception Test has been found to measure immediate auditory memory, auditory attention, phoneme discrimination, and good reading and spelling abilities (Mitrushina et al., 1999).

The neuropsychological assets and deficits hypothesized to lead to the academic assets and deficits seen among children and adolescents with NVLD may also underlie their social and emotional difficulties. One important aspect in social interactions is the recognition and understanding of subtle cues, which is intrinsic to nonverbal communication. The ability to recognize facial expressions of emotions, which children with NVLD were found to be less accurate than children with VLD and NLD controls, but similar to those with combined verbal and nonverbal LD (Dimitrovsky, et al., 1998; Dimitrovsky, et al., 2000; Petti et al., 2003) is a critical aspect of nonverbal communication during social interactions. The poor ability of children with NVLD to process facial expressions of emotions may play a significant role in the social and emotional difficulties experienced by these children and adolescents.

One hypothesis that has been put forth to explain the difficulties encountered by children with NVLD in being able to accurately recognize various nonverbal cues, such as facial expressions of emotions is their neuropsychological deficits in visual-perceptual-organizational skills (Rourke, 1993, 1999). Although the pattern of neuropsychological assets and deficits exhibited by children and adolescents with NVLD has been widely illustrated (for reviews see Rourke, 1993; Rourke & Fuerst, 1996; Rourke & Tsatsanis, 1996), the relationship between central processing assets and deficits among children with NVLD and their poor ability in recognizing facial expressions has been seldom examined

(Williams, 1996). In his doctoral dissertation, Williams (1996) investigated the relationship between measures of neuropsychological functioning and social perception among children in grades four and five with NVLD. Specifically, he examined the relationship between two measures of visual-perceptual abilities (The Judgment of Line Orientation Test and The Spatial Relations Test) and the ability to recognize facial expressions of emotions (Ekman & Friesen's Pictures of Facial Affect, 1976).

Williams (1996) reported that none of the visual-perceptual measures were found to predict facial expression recognition among children with NVLD. However, Williams also failed to find a significant difference between children with NVLD and children with VLD on any of the visual-perceptual measures. In addition, children with NVLD were found to be less accurate than children with VLD on only a task of facial expression recognition that involved matching an expression to a target facial expression. One possible explanation for the result that the visual-perceptual measures did not predict facial expression recognition is the type of measures that were used. As no difference was found between children with NVLD and those with VLD on any of the visual-perceptual measures, perhaps the type of visual-perceptual measures used might not have tapped into the deficits often experienced by children with NVLD and consequently would not predict facial expression recognition among children with NVLD. However, the neuropsychological measures outlined by Harnadek and Rourke (1994) have been found to accurately discriminate children with NVLD from those whose LD lies mainly in the language area and to likely be measuring the constructs that correspond to the neuropsychological assets and deficits of these children. As

such, there may be a relationship between the neuropsychological measures used to discriminate the NVLD group from those whose LD lies mainly in the language area and the differential abilities of these two groups to process facial expressions of emotions.

Specifically, performance on the Trail Making Test, The Target Test, and the Grooved Pegboard Test may predict adolescents' ability to recognize, express and understand facial expressions of emotions, as well as their social functioning. Thus, as these processes have remained unexplored among adolescents with NVLD, the possibility exists that the neuropsychological constructs being assessed by these measures may also underlie the ability of adolescents to process facial expressions of emotions.

Studies on recognition, expression, and understanding of facial expressions of emotions in populations with learning disability subtypes.

In general, studies that have directly examined the abilities of children and adolescents with LD to recognize facial expressions of emotion have not focused on defining subtypes which may be at particular risk for such difficulties (Holder & Kirkpatrick, 1991; Most & Greenback, 2000; Nabuzoka & Smith, 1995). Although there is little research directly examining the ability to recognize facial expressions of emotion among members of the NVLD subtype, three recent studies have investigated these skills almost exclusively in children, with one that used a wider age range (Dimitrovsky et al., 1998; Dimitrovsky et al., 2000; Petti et al., 2003). See Table 3 for summary of findings.

Table 3

Summary of Results for Recognition of Facial Expressions of Emotions Among Learning Disability Subtypes

Study	Method	Results
1. Dimitrovsky, Spector, Levy-Shiff, & Vakil (1998)	Children with NVLD, VLD, and BVNLD, as well as children without LD (ages 9 to 10 and 11 to 12). Pictures of Facial Affect	Children without LD and with VLD were more accurate at recognizing facial expressions than those with NVLD and BVNLD. Happiness was the easiest to recognize, then anger, surprise, sadness, fear, and disgust. Significant differences in recognition were found between happiness and anger, anger and both fear and disgust, and sadness and disgust. Children without LD gave more correct responses than the BVNLD and VLD group on all emotions except happiness and disgust, and more correct responses than the NVLD group on all emotions except happiness and sadness. Children without LD did better than the VLD group at recognizing the facial expression of surprise and the VLD group did better than the NVLD group at recognizing the facial expression of only disgust.

2. Dimitrovsky, Spector, & Levy-Shiff (2000)	Children with NVLD, VLD, and BVNLD (*M* = 10.6), and without LD (*M* = 10.8) Pictures of Facial Affect: easy level of emotion recognition (happiness, anger, and surprise). Difficult level of emotion recognition (sadness, fear, and disgust).	Children with and without LD were more accurate at recognizing facial expressions of emotions classified as easy. Children with and without LD favored females for only facial expressions of emotion classified as difficult. Children without LD and those with VLD were more accurate overall at recognizing facial expressions of emotion than the NVLD and the BVNLD, and children without LD were more accurate than the VLD group.
3. Petti, Voelker, Shore, & Hyman-Abello, 2003	Children with NVLD, VLD, and psychiatric NLD controls (*M* = 12.3) Diagnostic Analysis of Nonverbal Accuracy: Facial expressions subtest, 48 slides of adult faces of four different expressions Personality Inventory for Children – Revised (PIC-R)	Children without LD and those with VLD were more accurate at recognizing facial expressions of emotions than children with NVLD. No overall differences emerged between the groups on the PIC-R as rated by their parents.

Note. LD = Learning disabilities; NVLD = Nonverbal learning disabilities; VLD = Verbal learning disabilities; BVNLD = Combined verbal and nonverbal learning disabilities.

Dimitrovsky et al. (1998) compared the abilities of children with NVLD (n = 23), VLD (n =19), and BVNLD (n = 25) to children without LD (n = 48) in grades 3 through 6 to recognize facial expressions of emotion. The children were classified as LD by the school district psychological services based on testing on the Hebrew version of the Wechsler Intelligence Scale for Children-Revised (Wechsler, 1976), the Bender-Gestalt Test (Koppitz, 1975), Figure Drawings (Koppitz, 1968), and achievement tests, with the achievement test scores being at least two years below grade level. The LD sample was further subtyped based on their standard scores on the Rey Auditory Verbal Learning Test (Rey, 1964) and the Benton Visual Retention Test (Benton, 1974). Children with scores below 0 on the Rey Auditory Verbal Learning Test and above 0 on the Benton Visual Retention Test were classified as having a VLD. Children with standard scores above 0 on the Auditory Verbal Learning Test and below 0 on the Benton Visual Retention test were classified as having a NVLD. Children with standard scores below 0 on both measures were classified as having BVNLD. The NLD group was chosen from regular education classes among the three grades and had standard scores above 0 on both the Auditory Verbal Learning Test and the Benton Visual Retention Test. The children's ability to recognize facial expressions of emotion was individually assessed by Ekman and Friesen's (1976) Pictures of Facial Affect. This measure consists of 110 35-mm black and white slides of men and women displaying the facial expressions of happiness, sadness, anger, surprise, fear, and disgust, in addition to a set of neutral faces. In this study, a subset of 48 slides was used, four male and four female faces for each of the six

emotions. The participants were asked to state the emotion that was being expressed by each facial expression and their answers were recorded verbatim.

Dimitrovsky et al. (1998) found that overall the NLD and the VLD groups were significantly more accurate at recognizing facial expressions of emotion as compared to the NVLD and BVNLD groups and no difference emerged between the NVLD and BVNLD groups. In addition, the NLD group was significantly more accurate at recognizing facial expressions relative to the VLD group. In terms of specific emotions, the NLD group produced significantly more accurate responses on all facial expressions of emotion than the NVLD group with the exception of happiness and sadness, and significantly more accurate responses on all facial expressions of emotions than the BVNLD group except for happiness and disgust. The VLD group was significantly better than the NVLD group at recognizing the facial expression of disgust, while the NLD group gave more correct responses that the VLD group solely for surprise. Most children, regardless of group were more accurate at recognizing the facial expression of happiness, followed by anger, surprise, sadness, fear, and disgust. In addition, the only significant age difference was in favor of the older group displaying better recognition of the facial expressions of fear and disgust. In summary, children with NVLD were found to be less accurate overall than children with VLD and children without LD at recognizing facial expressions of emotion; however, these differences also appear to be a function of the facial expression that they are being asked to recognize.

Dimitrovsky et al. (2000) attempted to further investigate the differential recognition accuracy among different facial expressions of emotions and the sex

of the person displaying the facial expression among children with specific LD subtypes. The six studied emotions were divided into two levels of difficulty based on the recognition criteria as put forth by Ekman and Friesen (1976). The easy level included happiness, anger, and surprise, which were facial expressions of emotions that have been found to be correctly recognized at least 70% of the time in previous studies with children with LD (Dimitrovsky et al., 1998; Holder & Kirkpatrick, 1991). The more difficult level consisted of sadness, fear, and disgust, which were correctly recognized 60% of the time or less.

Children in grades 3 to 6 were selected from both LD and regular education classes. The children were classified as LD based on a diagnosis by the school district psychological services using scores on the Wechsler Intelligence Scale for Children- Revised (Wechsler, 1976), the Bender-Gestalt Test (Koppitz, 1975), a Figure Drawing Test (Koppitz, 1968), as well as achievement test scores that were two or more years below grade level. The LD (n = 76) group was further subtyped into those with NVLD (n = 23), VLD (n = 19), and BVNLD (n = 25). The LD sample was subtyped based on their standard scores on the Auditory Verbal Learning Test and the Benton Visual Retention Test as outlined in a previous study (Dimitrovsky et al., 1998). The NLD group (n = 48) were selected from general education classes and had a standard score above 0 on both the Auditory Verbal Learning Test and the Benton Visual Retention Test as shown in a previous study (Dimitrovsky et al., 1998). All participants were administered Ekman and Friesen's (1976) Pictures of Facial Affect as described in a previous study (Dimistrovsky et al., 1998). The number of correctly recognized male and female facial expressions for each of the six emotions, for each level of difficulty,

as well as the total that were correctly recognized were calculated for each participant.

Dimitrovsky et al. (2000) found that overall children were more accurate at recognizing female facial expressions of emotion, as well as those that were classified as easy (happiness, anger, surprise) regardless of group placement or sex of the child. A significant interaction emerged in the accuracy of recognition between the male and female faces in favor of the female facial expressions for only the emotions that were classified as difficult (sadness, fear, disgust) for all groups. Consistent with a previous study (Dimitrovsky et al., 1998), the NLD and VLD groups were more accurate at recognizing facial expressions of emotions than the NVLD and BVNLD groups. In addition, the NLD group was more accurate than the VLD group, which is concordant with a previous finding (Dimitrovsky et al., 1998).

In a more recent study, Petti et al. (2003) compared the social perception and social adjustment abilities of children (M = 12.4 years) with NVLD (n = 11), VLD (n = 11) and children with psychiatric difficulties without LD controls (n = 11). Children were classified into their respective groups based on the scores on the WISC-III and WRAT-R and a discrepancy between these measures. Specifically, children classified as NVLD had Verbal IQ at least 12 points higher than Performance IQ and arithmetic scores on the WRAT-R at least one standard deviation less than their Verbal IQ. Children classified as VLD had a Performance IQ at least 12 points higher than Verbal IQ and their WRAT Reading or Spelling scores were at least one standard deviation less than their Performance IQ. Children with psychiatric difficulties without LD controls had a

Verbal/Performance IQ discrepancy of less than 10 points and their WRAT-R Reading, Spelling, and Arithmetic scores were all above the 16th percentile.

Participants were administered the four receptive subtests of the revised Diagnostic Analysis of Nonverbal Accuracy (DANVA-2; Baum & Nowicki, 1998; Nowicki & Carton, 1993; Nowicki & Duke, 1994).This task contains four subtests, Postures, Gestures, Facial Expressions and Paralanguage. The Postures subtest consisted of 12 slides with an adult female portraying happy, sad, angry, and fearful emotions using only postures. The Gestures subtest consisted of 12 slides of models portraying the four emotions using gestures only. The Facial Expressions subtest consisted of 48 slides of faces, with half of the expressions posed by adult models and half by child models, with male and female models equally represented (four targeted emotions were happy, sad, angry, and fearful). The Paralanguage subtest consisted of 24 auditory recordings of an adult (or 16 recordings of a child) saying the same using vocal modulation to reflect one of the four targeted emotions. The social functioning of these children was also assessed using The Personality Inventory for Children – Revised (PIC-R; Lachar, 1982).

For the purpose of this literature review, only the results on the Facial Expressions subtest of the DANVA and the PIC-R will be discussed. In general, similar to previous findings (Dimitrovsky et al., 1998; Dimitrovsky et al., 2000) the authors reported that children with NVLD were significantly less accurate at recognizing adult facial expressions of emotions as compared to children with VLD or children with psychiatric difficulties without LD controls, who did not differ from each other. In terms of the individual emotions, no specific accuracy levels were provided and issues related to the possible severity of the NVLD or

VLD groups were not discussed. In addition, no overall significant difference was observed among the groups on the PIC-R as rated by their parents.

In summary, although there is evidence to suggest that children with NVLD have difficulty recognizing facial expressions of emotion (Dimitrovsky et al., 1998; Dimitrovsky et al., 2000; Petti et al., 2003), little has been done in this area with adolescents with NVLD. In addition, no studies have directly examined the abilities to recognize, express, or understand facial expressions of emotions simultaneously in a sample of adolescents with NVLD, general LD and without LD.

Problem Statement

Students with LD have been found to have lower peer status (Bruininks, 1978; Bryan, 1974, 1976; Scranton & Ryckman, 1979; Silver & Young, 1985; Siperstein et al., 1978; Wiener, 1987) and teachers tend to perceive these students as less socially competent and to have poorer peer relations than their NLD peers (Bender & Smith, 1990; Haager & Vaughn, 1995). One hypothesis that has been put forth by researchers to explain the low social status of these students is their difficulties in comprehending a variety of nonverbal cues. Although it has been well established that children and adolescents with LD are less accurate at recognizing different types of nonverbal cues (Axelord, 1982; Bryan, 1977; Jackson et al., 1987; Wiig & Harris, 1974), it is unclear as to whether their difficulties are a result of a specific nonverbal cue, namely facial expressions of emotion. In addition, whether their difficulties are a result of their poor ability to recognize, express, or understand the facial expression of emotion is yet to be studied simultaneously in an adolescent LD sample.

Despite the limited research within this area, a small number of studies have consistently shown that children and adolescents with LD are less accurate at recognizing facial expressions of emotion from still photographs compared to their NLD peers (Holder & Kirkpatrick, 1991; Most & Greenbank, 2000; Nabuzoka & Smith, 1995). Given the heterogeneity of the LD samples used in these studies, it is possible that the NVLD subtype was included as part of these LD populations. Consequently, it is unclear as to whether the difficulties found among the LD population in these studies are specific to certain LD subtypes that are expected to exhibit social difficulties, namely the NVLD subtype. Although the ability to directly express or understand facial expressions of emotion has yet to be studied among adolescent LD populations, children and adolescents with other exceptionalities have been shown to be less accurate on tasks that assess the understanding of facial expressions (Ellis et al., 1997; McAlpine et al., 1992; Singh et al., 1998).

Taking into account the heterogeneous nature of the LD population when studying children and adolescents with LD, a few recent studies have directly examined the ability of children with different LD subtypes to recognize facial expressions of emotions (Dimitrovsky et al., 1998; Dimitrovsky et al., 2000; Petti et al., 2003). In general, these studies have found children with NVLD to be less accurate at recognizing facial expressions of emotion compared to children with VLD and compared to children without LD (Dimitrovsky et al., 1998; Dimitrovsky et al., 2000; Petti et al., 2003). However, little has been done in this area with adolescents with NVLD. In addition, no studies have directly examined the abilities to express or understand facial expressions of emotion among

adolescents with NVLD. The ability to recognize, express, and understand facial expressions of emotions in a sample of adolescents with NVLD, as well as their social functioning as compared to adolescents with a general LD (GLD) and without LD has not been examined. Further, the degree to which neuropsychological measures may predict the adolescents' performance on these facial expressions of emotion tasks and social functioning has yet to be explored.

Previous studies have documented difficulties in facial expression recognition mainly among children with NVLD as compared to those with VLD and without LD (Dimitrovsky et al., 1998; Dimitrovsky et al., 2000; Petti et al., 2003), however, it is unclear as to whether these difficulties are specific to the NVLD subtype or occur solely when compared to the VLD subtype and NLD controls. In addition, comparing the strengths and weaknesses of the NVLD subtype to a more generalized LD on these emotion processing tasks has remained unexplored. This may raise important issues regarding the possible role of severity among LD populations and how it may be related to abilities in recognizing, expressing and understanding facial expressions of emotion, as well as social functioning. This study is also of interest as it examines these emotion processing skills in the developmental period of adolescence. Perhaps the social-perceptual abilities of *adolescents* with NVLD are distinctly different. Nabuzoka and Smith (1995) hypothesized a 'social developmental lag' theory among LD populations, suggesting that children with LD develop more slowly than those without LD in this area. However, the poor performance experienced by children with LD in perceiving expressive cues as reported by Nabuzoka and Smith may have partly been due to the possible LD subtypes within their LD sample.

Subsequently, during the period of adolescence it is possible that those with NVLD eventually catch up to their NLD peers in their ability to perceive expressive cues.

In summary, the present study offers a unique contribution to the field of LD being the first to examine the abilities of adolescents with NVLD, adolescents with a GLD and adolescents without LD to recognize, express, and understand facial expressions of emotion, as well as their social functioning.

Research Questions and Hypotheses

As stated above, the primary objective of the thesis is to explore recognition, expression, and understanding of facial expressions of emotions among adolescents with NVLD, GLD, and without LD. Below the specific associated research questions and hypotheses are listed. The key primary, or unique and original research questions and hypotheses are bolded, whereas the secondary, or replications or validation research questions and hypotheses are in regular font. In addition, consistent with the literature review, the research questions and hypotheses pertaining to the larger field of LD are presented first and the research questions and hypotheses specific to the subtypes of LD (i.e., NVLD, GLD) are outlined second.

Confirmation of Groups

1. It is expected that adolescents with NVLD will be worse on the Trail Making Test Part B, The Target Test, and the Grooved Pegboard Test, which generally measure visual-spatial/motor abilities compared to adolescents with a general LD (GLD) and without LD

2. It is predicted that adolescents with GLD will be worse on the Speech Sounds Perception Test, intended to measure phonetic discrimination abilities compared to adolescents with NVLD and without LD.

Recognition of Facial Expressions

1. Based on previous literature in the area of facial expression recognition (Curstrini & Feldman, 1989; Dimitrovsky et al., 1998; Holder & Kirkpatrick, 1991; Kirouac & Dore, 1983, 1985), it is predicted that the adolescents will be more accurate at recognizing the facial expression of happiness than any of the other emotions.

2. Based on the work of Holder and Kirkpatrick (1991), Most and Greenbank (2000), and Nabuzoka and Smith (1995), it is predicted that adolescents with LD will be less accurate overall than adolescents without LD at recognizing facial expressions of emotion.

3. As with previous studies that reported children with NVLD to be less accurate overall at recognizing facial expressions of emotion as compared to those without LD (Dimitrovsky et al., 1998; Dimitrovksy et al., 2000; Petti et al., 2003), it is predicted that adolescents with NVLD will be less accurate overall at recognizing facial expressions of emotions than adolescents without LD and those with GLD, with the latter two groups being similar in their ability to recognize facial expressions of emotion.

4. Based on previous findings (Dimitrovsky, et al., 1998; Dimitrovksy et al., 2000), it is predicted that adolescents with NVLD will be less accurate at recognizing the more difficult facial expressions of emotion (i.e., anger, fear, surprise, disgust) than adolescents without LD and with GLD, whereas no

differences will emerge among the groups in the recognition of easier emotions (i.e., happiness, sadness). The GLD group will be similar to the NLD group in their ability to recognize the individual emotions.

Expression of Facial Expressions of Emotion

1. Based on previous literature in the area of expressing facial expressions of emotion (Field & Walden, 1982; Lewis et al., 1987), it is predicted that the adolescents will be more accurate at expressing the facial expression of happiness than any of the other emotions.

2. It is hypothesized that adolescents with LD will be worse overall at expressing facial expressions of emotion and will receive lower mean certainty scores based on judge's ratings than adolescents without LD.

3. It is predicted that adolescents with NVLD will be worse overall at expressing facial expressions of emotion, will receive lower mean certainty and controversial scores based on judge's ratings as compared to adolescents with GLD without LD, with the latter two groups performing similarly.

4. It is proposed that adolescents with NVLD will be worse at expressing the more difficult facial expressions of emotion (i.e., anger, fear, surprise, disgust) than adolescents without LD and with GLD, whereas no differences will emerge among the groups in their ability to express the easier emotions (i.e., happiness, sadness). The GLD group will be similar to the NLD group in their ability to express all of the facial expressions of emotion.

Understanding Facial Expressions of Emotion

1. As with previous studies (Ellis et al., 1997; Singh et al., 1998), it is hypothesized that adolescents will be more accurate at understanding the facial expression of happiness than any of the other emotions.

2. It is predicted that adolescents with LD will be less accurate overall than adolescents without LD at understanding facial expressions of emotion.

3. It is hypothesized that adolescents with NVLD will be less accurate overall at understanding facial expressions of emotions than adolescents without LD and those with GLD, with the latter two groups being similar in their ability to understand facial expressions of emotion.

4. It is proposed that adolescents with NVLD will be less accurate at understanding the more difficult facial expressions of emotion (i.e., anger, fear, surprise, disgust) than adolescents without LD and with GLD, whereas no differences will emerge among the groups in understanding the easier emotions (i.e., happiness, sadness). The GLD group will be similar to the NLD group in their ability to understand the individual emotions.

Social Functioning

1. Based on previous findings directly examining social functioning in a sample of children with LD (Bryan, Sherman, & Fisher, 1980), it is predicted that adolescents with LD will display worse overall social skills and perform significantly worse on the other individual scales (i.e., Clarity, Fluency, Appropriate Affect, Flat Affect, Gaze, Engagement, Meshing, Strangeness, Pleasantness of Conversation, Asks Questions, Social Anxiety) on the social role-play rating scale compared to adolescents without LD.

2. As with a study conducted by Gross-Tsur et al. (1995) on the social functioning of children with NVLD, it is hypothesized that adolescents with NVLD will display worse overall social skills and perform significantly worse on the other individual scales (i.e., Clarity, Fluency, Appropriate Affect, Flat Affect, Gaze, Engagement, Meshing, Strangeness, Pleasantness of Conversation, Asks Questions, Social Anxiety) on the social role-play rating scale compared to adolescents without LD and with GLD, with the latter two groups being similar in their social skills.

Exploratory Research Questions: Neuropsychological Measures and Recognition, Expression, and Understanding Facial Expressions of Emotion, as well as Social Functioning

1. Whether the adolescents' scores on the visual-spatial/motor tasks, namely the Trail Making Test Part B, the Target Test, and the Grooved Pegboard Test predicts their performance on the recognition, expression and understanding task, as well as on social functioning will be explored.

2. Whether the adolescents' scores on the Speech Sounds Perception Test predicts their performance on the recognition, expression and understanding task, as well as on social functioning will be explored.

Chapter III: Method

Participants

The final sample of participants consisted of 69 adolescents (39 boys, 30 girls) ranging between 12.0 and 15.9 years (M =170.3 months, SD = 12.3 months) from eight schools in the Greater Montreal area and five schools in the Cornwall/South Glengarry region in Ontario. In total, 1,723 consents forms were distributed in the 13 schools and 308 forms were returned (Return Rate = 17.9%), with 261 parents giving permission to take part in the Screening phase of the project. Of the 261 adolescents who obtained consent, 184 took part in the Screening Phase of the project and of those adolescents, 105 took part in the Full Phase of the project (see Appendixes A and B for parental and student screening and full phase consent forms). Fifty-seven participants were excluded from the final sample as they either did not meet the IQ criteria (IQ Estimate >=85) and/or did meet the academic achievement criteria of one of the three groups (see Table 5).

The final sample of 69 participants consisted of 23 adolescents with nonverbal learning disabilities (NVLD) (13 boys, 10 girls), 23 matched adolescents without learning disabilities (NLD) (13 boys, 10 girls), and a comparable group of 23 adolescents with general learning disabilities (GLD) (13 boys, 10 girls). The adolescents from the NVLD group were matched to the adolescents from the NLD group on gender, age within 10 months, and IQ within 6 points based on the short form of the Wechsler Intelligence Scale for Children (WISC-III; Wechsler, 1991). A less stringent criterion was used to create a

comparable GLD group whereby the group was matched to the NVLD and NLD groups on sex, age within 18 months, and IQ within 20 points. This was done because of the difficulty in obtaining a three way match between the NVLD, GLD, and NLD groups. See Table 4 for the breakdown of age and sex by group.

Table 4

Breakdown of Participants, Sex and Age for Groups with and without Learning Disabilities

Group	Participants *(n)*		Age (months)	
	Males	Females	*M*	*SD*
NLD	13	10	170	12.6
NVLD	13	10	172	12.8
GLD	13	10	169	11.9
Total	39	30	170	12.3

Note. NLD = No learning disability; NVLD = Nonverbal learning disability; GLD = General learning disability.

The sample was comprised predominately of Caucasian adolescents (85.5%) with a small proportion of African Canadians (8.7%), East Indian (2.9%) and other (2.9%). The primary language spoken in the home by most of the adolescents was English (78.3%), with some of the adolescents' primary language being a mixture of English and French (11.6%), and a small proportion being French (1.4%) or another language (2.9%). However, all of the adolescents were schooled in English.

The adolescents' Father's and Mother's occupations were provided in order to obtain a general sense of the socioeconomic status (SES) of the sample. The Father's and Mother's occupations were classified separately based on the National Occupation Classification System (Human Resources Development Government of Canada, 2001) and a general average yearly income of each occupation by Father and Mother was obtained from the Statistics Canada Census (Statistics Canada Census, 2001). The average yearly income of the household was then calculated by combining the Father's and Mother's average yearly income, which served as the general proxy indicator of SES. The average combined yearly income for the groups were NVLD (M = $52, 997, SD = 25, 621) GLD (M = $63, 304, SD = 23, 946) and NLD (M = $61, 836, SD = $17, 949).

The SES of the sample was also categorized into Quintiles (Statistics Canada, 2000) such that the majority of the sample (37.7%) fell into the 3rd highest Quintile ($50, 100-$70, 500), with some of the sample (27.5%) falling into the 2nd highest Quintile ($70, 510-$99, 000), and small amounts of the sample falling into the second lowest (17.4%), lowest (14.5%), and highest (2.9%) Quintiles, ($32, 110-$50, 600), ($0-$32, 100), and ($99, 100 or above) respectively. Using independent samples t tests, the LD and NLD groups were compared a priori on their level of SES. No significant results were observed between the adolescents without LD (M = $61,836, SD = $17,949) and with LD (M = $58,151, SD = $25,021) on their level of SES, $t(67) = 0.63$, *ns*. Additionally, a one-way Analysis of Variance (ANOVA) was conducted a priori to compare the NVLD, GLD, and NLD groups on SES. Again, results did not reveal any

significant differences between adolescents with NVLD (M = $52,997, SD = $25,621), GLD (M = $63,305, SD = $23,846) or without LD (M = $61,836, SD = $17,949) on their level of SES, $F(2, 66) = 1.39$, *ns*.

In terms of school location, the sample was comprised of students from schools within the greater Montreal area and the Cornwall/South Glengarry regions in Ontario, with approximately half of the sample being from the greater Montreal area (59.4%) and the remaining proportion from the Cornwall/South Glengarry region (40.6%). Separate independent *t* tests were conducted on the variables of IQ, and the Reading, Spelling, and Arithmetic academic achievement standard scores between the adolescents from the different regions to test whether differences emerged as a function of location. No significant differences were observed among the adolescents from the two regions on the measures of IQ, $t(67) = 0.23$, $p = 0.82$, Reading, $t(67) = 1.40$, $p = 0.17$, Spelling, $t(67) = 0.20$, $p = 0.84$, or Arithmetic, $t(67) = 0.30$, $p = 0.76$. Subsequently, for the remaining analyses, scores from the adolescents within the 2 regions were collapsed to form the 3 groups within the study.

Classification of adolescents with learning disabilities. Adolescents were classified as exhibiting an LD based on their IQ estimate scores on the WISC-III short form (Wechsler, 1991) and their academic achievement scores based on the Wide Range Achievement Test – Third Edition (WRAT3; Wilkinson, 1993). Specifically, adolescents were classified as having an LD if they obtained: (a) a Full Scale IQ Estimate score of 85 or above on the WISC-III and (b) a Standard Score of 80 or below (i.e., at least one standard deviation below the mean) on at least one area of academic achievement (i.e., Reading, Spelling, and/or

Arithmetic) on the WRAT3. Adolescents who obtained a Full Scale IQ Estimate on the WISC-III of 85 or above and a Standard Score above 85 in all three areas of academic achievement (i.e., Reading, Spelling, and Arithmetic) were classified as NLD.

The criteria used to classify the adolescents into LD and NLD groups generally reflect LD researchers' and practitioners' thinking within the field (Fletcher, Morris, & Lyon, 2003, Learning Disabilities Association of Canada, 2002). There is general agreement within the field that students with LD are a heterogeneous group with average to above average intelligence with significant difficulties in processing within one or more areas of academic achievement (i.e., reading, mathematics, writing/spelling) (Bender, 2004; Fletcher, Morris, & Lyon, 2003; Learning Disabilities Association of Canada, 2002; National Center for Learning Disabilities, 2003). However, the types of processing deficits included within the definition of a LD may differ depending on the country and/or province as well as the theoretical perspective of the LD association being used (Bender, 2001). In addition, given the assumption that students with LD are not performing as well as they should be academically there has been much debate within the field in regards to the validity of using discrepancy criteria to identify these students (Bender, 2001; Lerner, 2000).

Discrepancy criteria are used to indicate a significant difference between intelligence as measured by a standardized IQ assessment and achievement in one or more academic areas. There are generally two ways for calculating discrepancy: intra-individual and ability-achievement discrepancies. Intra-individual discrepancy refers to significant differences between verbal and

nonverbal abilities on intelligence tests. Although this type of discrepancy was commonly used in the past as an indicator of a LD, given the problems associated with its assumptions it is no longer regarded as meaningful to the definition of a LD (Bender, 2001). The ability-achievement discrepancy refers to a significant deficit in an area of academic achievement compared to potential (Bender, 2001; Lerner, 2000). Specifically, the achievement test score is subtracted from the intelligence test score and if the discrepancy is significant enough (i.e., generally greater than 15 standard score points), this may be evidence for a LD. However, researchers within the field have questioned the validity of using the ability-achievement discrepancy to identify students with LD given the variation of discrepancy formulas between different countries, states, and provinces, as well as the notion that some aspects of intelligence tests likely measure the abilities in an area where a student with an LD may be experiencing difficulties, thus lessening their IQ score (Lerner, 2000; Swanson, 1993). Subsequently, the use of a discrepancy between IQ and achievement scores was not used within the present study as this method has not been deemed meaningful by researchers within the field of LD (Bender, 2004; National Center for Learning Disabilities, 2003). Rather, in the present study a student was defined as having a LD if they had average to above average intelligence with a processing deficit in one or more areas of academic achievement, without necessarily demonstrating a significant difference between their ability (i.e., intelligence) and achievement (i.e., academic) performance. For example in the current study a student classified as having a LD could have a standard score of 90 on the Short Form of the WISC-III

with a standard score of 80 on the Reading subtest on the WRAT-3, which does not indicate a significant ability-achievement difference.

Classification of adolescents into learning disability subtypes. Following the classification of adolescents into LD and NLD groups, the adolescents with LD were further classified into those with NVLD and those with GLD based on their performance on the WRAT3. Researchers within the field of LD have classified children and adolescents with NVLD using various types of standardized and non-standardized measures of academic and central processing. However, within the literature there is consistent agreement that children and adolescents with NVLD exhibit difficulties in the area of arithmetic, with the essence of NVLD being a clear difficulty in the academic area of arithmetic compared to that of reading, which is critical to the definition of NVLD (Rourke, 1999; Shafir & Siegel, 1994; Siegel & Heaven, 1986). Subsequently, in the current study, adolescents were classified as exhibiting a NVLD by meeting the following criteria: (a) a Standard Score of 80 or below on the Arithmetic subtest, with a Standard Score above 85 on the Reading subtest (b) at least a 15 point difference between the Standard Score on the Arithmetic subtest and on the Reading subtest (i.e., Standard Score on the Arithmetic subtest is at least 15 points below Standard Score on the Reading subtest).

Although it could be argued that the NVLD group in the present study is generally an arithmetic disability group, the distinction between students with NVLD and arithmetic disabilities within the field of LD appears to be somewhat unclear. Specifically, studies using the semantic distinction of labeling their participants as either exhibiting a NVLD or an arithmetic disability have

demonstrated that both groups tend to experience difficulties within the area of arithmetic and visual-spatial-organizational skills with strengths in reading and verbal abilities (Shafir & Siegel, 1994; Siegel & Ryan, 1989; Rourke, 1989,1993). However, for the purpose of the present study, students were classified as having a NVLD given the significant difference between their reading and arithmetic performance, as well as a deficit within the arithmetic area of academic achievement. In addition, the use of the various visual-spatial and phonetic types of neuropsychological measures to further validate the NVLD group gives credence to the appropriateness of the classification of these students.

Adolescents who did not meet the specific criteria of NVLD, but met the LD criteria were classified as GLD. Specifically, adolescents were classified as exhibiting a GLD if they had a Standard Score of 80 or below in at least one area of academic achievement (i.e., Reading, Spelling, and/or Arithmetic). The GLD group is notably different from the NVLD group as the majority of the adolescents with GLD experienced difficulties in the areas of Reading and/or Spelling. Additionally, given the nature of the criteria used to classify both the NVLD and GLD groups, adolescents within the NVLD group experienced a relative weakness in the area of Arithmetic as compared to that of Reading (i.e., Standard Score on the Arithmetic subtest is at least 15 points below Standard Score on the Reading subtest). This relative weakness in the area of Arithmetic as compared to that of Reading was not exhibited by the adolescents with a GLD, consequently forming discrete groups of adolescents with NVLD and GLD. See Table 5 for a summary of the criteria used for the classification of participants

into the following groups: NVLD, GLD, and NLD. Also see Table 6 regarding IQ group scores and academic achievement area breakdowns.

Table 5

Summary of Criteria for the Classification of Adolescents into those with Nonverbal Learning Disabilities, General Learning Disabilities and without Learning Disabilities

Group	Group Criteria
NVLD	(A) Standard Score of 85 or above on the WISC-III. (B) Standard Score of 80 or below on the Arithmetic subtest and a Standard Score above 85 on the Reading subtest on the WRAT3. (C) Standard Score on the Arithmetic subtest at least 15 points below the Reading subtest on the WRAT3.
GLD	(A) Standard Score of 85 or above on the WISC-III. (B) Standard Score of 80 or below on at least one area of academic achievement (Reading, Spelling, and/or Arithmetic) on the WRAT3.
NLD	(A) Standard Score of 85 or above on the WISC-III. (B) Standard Score above 85 on all three areas of academic achievement (Reading, Spelling, and Arithmetic) on the WRAT3.

Note. NVLD = Nonverbal learning disabilities; GLD = General learning disabilities; NLD = No learning disability; WISC-III = Wechsler Intelligence Scale for Children - Third Edition; WRAT3 = Wide Range Achievement Test - Third Edition.

Table 6

Mean and Standard Deviation IQ and Achievement Standard Scores for Groups with and without Learning Disabilities

	WISC-III		WRAT3 Reading		WRAT3 Spelling		WRAT3 Arithmetic	
Group	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
NLD	96.3	7.0	100.0	10.2	101.3	9.1	95.5	6.5
NVLD	93.5	6.9	98.2	6.7	88.1	11.6	73.4	6.2
GLD	94.9	9.5	78.8	11.0	77.6	9.6	83.1	12.4
Total	94.9	7.9	92.4	13.4	89.0	14.0	84.0	12.6

Note. WISC-III = Wechsler Intelligence Scale for Children Third Edition Short Form (Block Design and Vocabulary Subtests); WRAT3 = Wide Range Achievement Test - Third Edition; NLD = No learning disability; NVLD = Nonverbal learning disability; GLD= General learning disability.

Measures

Measures consisted of a short form IQ and academic achievement assessment, a depression and attention inventory and neuropsychological inventories. Emotion processing tasks, specifically a recognition, expression and understanding tasks, as well as a social functioning measure were also administered.

Measures of IQ and Academic Achievement

The Wechsler Intelligence Scale for Children – Third Edition (WISC-III, Wechsler, 1991). The WISC-III is an individually administered test of intelligence for children and adolescents from 6-16 years old ($M = 100$, $SD = 15$). In this

study, the short form version of the WISC-III which consists of the Vocabulary and Block Design subtests were administered to obtain a Full Scale IQ Estimate. This particular short form combination was chosen as it has good reliability (0.91) and validity (0.86) with the Full Scale IQ and is considered a good measure of general intelligence (Sattler, 1992). In the Vocabulary subtest, participants were asked to tell and explain the meaning of words. In the Block Design subtest, participants were asked to copy a design using a selected number of blocks. The short form version of the WISC-III took approximately 10-15 minutes to administer and the Full Scale IQ Estimate Standard Score was calculated for each participant.

Wide Range Achievement Test – Third Edition (WRAT3, Wilkinson, 1993). The WRAT3 is an individually administered test of academic achievement ($M = 100$, $SD = 15$), which measures the basic skills of Reading, Spelling, and Arithmetic among individuals from age 5 through 74. Two forms (Blue and Tan) are available and contain the three subtests of Reading, Spelling, and Arithmetic. In the Reading subtest, participants were asked to recognize and read words out of context, which increased in their level of difficulty. In the Spelling subtest, participants were asked to spell words after hearing them aloud and in a sentence. In the Arithmetic subtest, participants were asked to perform written computations in the areas of addition, subtraction, multiplication, division, and fractions in a specified period of time.

The WRAT3 has been found to demonstrate good internal consistency with coefficient alphas ranging from 0.85 to 0.95 over the nine WRAT3 tests (i.e., the individual and combined subtests for each form). Alternate form correlations

are also found to be reliable, with the Reading subtest correlations ranging from 0.87 to 0.99, the Spelling subtest correlations ranging from 0.86 to 0.99, and the Arithmetic subtest correlations ranging from 0.82 to 0.99. The test-retest reliability over a four week period was also good, with corrected stability coefficients ranging from 0.91 to 0.98. This measure has been found to demonstrate strong content validity, with an item separation of 1.00 for each of the tests. There is a positive correlation between the scores on each test with age. In addition, moderate to high positive correlations has been found among the various skills measured by this test as well as with the WISC-III subtest scale score and indices. This measure of academic achievement has also been found to be moderately correlated to other standardized tests of achievement such as: the California Tests of Basic Skills-Fourth Edition, the California Achievement Test-Form E, and the Stanford Achievement Test. In addition, discriminant analysis revealed that the WRAT3 was able to discriminate among children with and without learning disabilities (Wilkinson, 1993). The WRAT3 took approximately 20-30 minutes to administer and Standard Scores based on age norms for each of the individual subtests was calculated for each participant.

Measures of Attention and Depressive Symptomatology

Conners-Wells' Adolescent Self-Report Scale: Short Form (CAAS: S, Conners, 2000). The CASS: S is an individually administered 27-item self-report inventory designed to assess the presence and severity of Attention Deficit Hyperactivity Disorder (ADHD) symptoms in adolescents aged 12 to 17-years-old. In this study, it was used as a measure of self-reported symptoms of

Inattention and ADHD. The short self-report, which is approximately 30% of the length of the long self-report, contains the following four subscales: (a) Conduct Problems (6 items), (b) Cognitive Problems/Inattention (6 items), (c) Hyperactive-Impulsive (6 items), and (d) ADHD Index (12 items). Items are scored on a 0 to 3 scale point scale (0= Not True At All, 1=Just A Little True, 2=Pretty Much True, 3= Very Much True). Separate profiles are available for males and females. Raw scores are converted to T-scores, with higher T-scores indicating more clinically significant problems on each individual subscale. The internal reliability coefficients for the four subscales range from 0.753 to 0.849 and factorial analysis indicates that this measure indeed assesses three problem areas: Conduct Problems with Cognitive Problems/Inattention (0.43), Conduct Problems with Hyperactivity (0.42), and Cognitive Problems/Inattention with Hyperactivity (0.56). This measure took approximately 10-15 minutes to complete. As the ability to sustain attention has been shown to be related to how one processes facial expressions of emotions (Singh et al., 1998; Stone & LaGreca, 1984), for the purpose of this study any differences which emerged between the groups (i.e., LD or NLD or NVLD, GLD, NLD) on any of the CASS: S subscales were used as covariates in subsequent analyses.

Reynolds Adolescent Depression Scale (RADS; Reynolds, 1986, 1987). The RADS is an individually administered 30-item self-report questionnaire designed to assess the presence and severity of depressive symptoms in adolescents from 12 to 18 years of age. In this study, it was used as a measure of self-reported symptoms of depression. The 30-items of the RADS were selected

to reflect symptoms of depression as delineated by the Diagnostic and Statistical Manual for Mental Disorders, Third Edition (DSM-III; American Psychiatric Association, 1980), the Research Diagnostic Criteria (RDC; Spitzer, Endicott, & Robins, 1978), and the Hamilton Depression Rating Scale (Hamilton, 1960, 1967). Although the RADS was written when the DSM-III was in effect, there have been few changes in the symptoms and criteria for depressive disorders between DSM-III, DSM-IIIR (American Psychiatric Association, 1987) and DSM-IV (American Psychiatric Association, 1994; Reynolds, 1995). The adolescent was asked to respond to questions on a four-point Likert rating scale ranging from 1 (*almost never)* to 4 (*most of the time)* to describe how they felt. Twenty-three items were scored 1 = almost never, 2 = hardly ever, 3 = sometimes, 4 = most of the time, while 7 items were scored in reverse. The items were then summed to give the total RADS raw score, which can range from 30 to 120, with higher scores indicating more reported depressive symptoms.

The psychometric properties of the RADS have been widely investigated in both clinical and non-clinical adolescent samples (Davis, 1990; Reynolds, 1987; Reynolds & Mazza, 1998). In general, the RADS has been shown to have high internal consistency, with Cronbach's coefficient alpha ranging from 0.90 to 0.96, with high item-total scale correlations supporting homogeneity. The RADS has also been shown to have strong test-retest reliabilities with correlations ranging from 0.80 (6 weeks) to 0.79 (three months) to 0.63 (1 year) (Reynolds, 1987). The criterion-related validity between the RADS and the Hamilton Depression Rating Scale clinical interview has also been established, with a correlation between the RADS and the Hamilton of 0.83 (Reynolds, 1987). The

RADS has also been shown to have moderate to high convergent construct validity with other self-report and clinical rating scales of depression such as the Beck Depression Inventory (BDI; Beck, Ward, Mendelson, Mock, & Erbaugh, 1961); the Beck Depression Inventory-II (BDI-II; Beck, Steer, & Brown, 1996; Krefetz, Steer, Nazli, & Beck, 2002); Center for Epidemiological Studies-Depression Scale (CES-D; Radloff, 1977); The Self-Rating Depression Scale (Zung, 1965); and the Children's Depression Inventory (CDI; Kovacs, 1979) with coefficients ranging from 0.68 to 0.76 (Reynolds, 1987).

This measure of depressive symptoms has also been found to correlate with constructs related to depression such as: self-esteem (-0.67 to –0.75), anxiety (0.73 to 0.80), loneliness (0.64 and 0.67), and suicide ideation (0.59 to 0.61) (Reynolds, 1987). Additionally, the RADS has also been demonstrated to be a valid and reliable assessment of depressive symptoms in young adolescents ranging from 11 to 15 years of age (Reynolds & Mazza, 1998). This measure was individually administered and took approximately 5-10 minutes to complete. As one's mood has been shown to be related to how one processes facial expressions of emotions (Kring, 2001), for the purpose of this study any differences which emerged between the groups (i.e., LD or NLD or NVLD, GLD, NLD) on the RADS raw scores were used as covariates in subsequent analyses.

Neuropsychological Measures

All the adolescents (those with NVLD, GLD, and NLD controls) were administered four neuropsychological measures to assess the degree to which their performance on these measures predicted their ability on the emotion tasks, namely recognition, expression, understanding and social functioning. In addition,

these measures were also used to confirm the appropriateness of the LD subtype groupings.

The selection of the four measures was based on a study by Harnadek and Rourke (1994) who examined the relative discriminant validity of 15 neuropsychological measures in order to determine which measures were most effective in categorizing participants as NVLD from those whose LD lies more in the language area. Based on their findings, they concluded that the Trail Making Test (Reitan & Davidson, 1974) and the Target Test (Reitan, 1966) combined correlated 0.60 with the function that accounted for 69% of the total variance in the discrimination of the NVLD from those whose LD lies more within the language area. They referred to these two tests as the Visual-Perceptual Organization measure. In addition, they also found the Grooved Pegboard Test (Klove, 1963) to correlate 0.47 with the function that accounted for 69% of the total variance in the discrimination of the NVLD from those whose LD lies more in the language area. The authors also reported that the Speech Sounds Perception Test (Halstead, 1947; Reitan & Davidson, 1974), a test of language function, to correlate 0.44 with the function that accounted for 31% of the total variance in the discrimination of those whose LD lies more in the language area from the NVLD group.

The authors concluded that these four neuropsychological measures (Trail Making Test, Target Test, Grooved Pegboard Test, and Speech Sounds Perception Test) are able to discriminate children and adolescents with NVLD from those whose LD lies more in the language area. In addition, such assessments have been shown to measure the neuropsychological constructs that correspond with the

neuropsychological assets and deficits of these children and adolescents (Harnadek & Rourke, 1994).

Trail Making Test Part B (Mitrushina, Boone, & D'Elia, 1999; Reitan & Davidson, 1974; Spreen & Strauss, 1998). The Trail Making Test Part B has been found to measure attention, integration of numbers and letters, visual scanning, speed of eye-hand coordination (psychomotor), information processing, and executive functioning (Mitrushina et al., 1999). The Trail Making Test Part B was originally part of the Army Individual Test Battery (1944) and was added to the Halstead-Reitan Neuropsychological Test Battery (Reitan & Davidson, 1974). This test has been demonstrated to have good reliability and construct validity for rapid visual search and visual-spatial sequencing (desRosiers & Kavanagh, 1987; Ehrenstein, Heister, & Cohen, 1982) and not to correlate with verbal tests (Ehrenstein et al., 1982).

There are two forms to this test: The Adult version and the Children's version. In the Adult version, this measure consists of an 8 x 11 inch page with 25 circles spread out over the page consisting of numbers 1 through 13 and letters A through L. In the Children's version, this measure consists of an 8 X 11 inch page with 15 circles spread out over the page consisting of numbers 1 through 8 and letters A through G. The Children's version was used in this study. The participant was asked to draw lines linking the numbers and letters in order, such that he/she alternated between numbers and letters (e.g., 1-A-2-B). Prior to the administration, participants were asked to state the alphabet and the numbers, to ensure that not knowing the alphabet did not confound their ability on this task. Specific administration procedures are provided in Reitan's (1979) Manual for

Administration of Neuropsychological Test Batteries for Adults and Children. One score was obtained, which was the total time in seconds to complete the task, with higher scores indicating worse performance. In the Reitan (1979) administration format, errors are not scored; however, as outlined in the Reitan (1979) administration Manual, the participant was told when he/she made a mistake and instructed to correct it, which likely slowed down his/her performance time. The participant was presented with a short sample item set prior to the administration of the task. The time required to complete this measure was approximately 5-10 minutes.

The Target Test (Reitan, 1966; Reitan & Wolfson, 1990, 1994). The Target Test is a measure of visual-spatial memory and is also part of the Reitan-Indiana Neuropsychological Test Battery (Reitan & Davidson, 1974; Reitan & Wolfson, 1985; Reynolds & Fletcher-Janzen, 1997). This test was developed to measure the ability to integrate, specifically to receive and produce visual-spatial relationships, as well as short-term visual memory as a delayed response is required (Reitan & Wolfson, 1990, 1994).

The Target Test consists of an 18 x 18 inch stimulus figure board containing nine large black dots arranged in the form of a square. Using a pointer, the researcher tapped out a design on the figure board for each item on this task. The participant was required to watch the researcher and following a three-second delay was asked to reproduce the same visually presented figure pattern on his/her answer sheet. The participant's answer sheet consisted of 20 items, which were all the same smaller versions of the stimulus figure board (i.e., nine black dots arranged in the form of a square). The test proceeded through the 20 items, which

increased in their level of difficulty. The participant's score is the total number of items correctly reproduced, with higher scores indicating better performance.

The Grooved Pegboard Test (GPT, Klove, 1963; Mitrushina et al., 1999). The GPT is part of two neuropsychological test batteries; The Wisconsin Neuropsychological Test Battery (Harley, Leuthold, Matthews, & Berg, 1980) and the Lafayette Clinic Repeatable Neuropsychological Test Battery. The GPT has been shown to measure psychomotor speed, fine motor control, and rapid visual-motor coordination (Lezak, 1995; Mitrushina, 1999). The reliability of the GPT has been shown to range between 0.69 and 0.76 for the dominant hand and 0.68 to 0.78 for the non-dominant hand over a 6-month period (Ruff & Parker, 1993).

The GPT consists of a small metal board containing a 5 x 5 inch matrix of slotted holes angled in different directions. Each peg has a ridge along one side requiring it to be rotated into position for correct insertion into the hole. The task was to insert the 25 metal pegs with ridges along the sides one at a time into each hole in sequence. The participants were required to put the pegs into the holes as quickly as possible, first with the dominant hand and then with the non-dominant hand without skipping any holes. Scores represent time in seconds to complete the matrix with each hand, with higher scores reflecting a lower level of performance, as well as the number of pegs dropped (i.e., errors) per trial. The time required to complete this task was approximately 5-10 minutes.

The Speech Sounds Perception Test (SSPT; Halstead, 1947; Mitrushina, et al., 1999; Reitan & Davidson, 1974; Reitan & Wolfson, 1993; Russell, Neuringer, & Goldstein, 1970). The SSPT is one of the tests in the original Halstead-Reitan

Neuropsychological Test Battery (Halstead, 1947; Reitan & Davidson, 1974) and subsequently employed in the expansion of the Halstead Battery (Reitan & Wolfson, 1993; Reynolds & Flecther-Janzen, 1997). The SSPT necessitates sustained attention, immediate auditory memory, and phoneme discrimination, but also good reading and spelling abilities. The split-half reliability of the SSPT has been reported to be between 0.74 and 0.87 in patient samples (Bornstein, 1982). Specific scoring and administration procedures are provided in Reitan's (1979) Manual for Administration of Neuropsychological Test Batteries for Adults and Children. Research suggests that a shortened version of the SSPT (30 items versus 60 items) may yield the same information in roughly half the administration time (Ryan, Larsen, & Prifitera, 1982); however, for the purpose of this study, the SSPT long version (i.e., 60 items) was used.

The participants were played an audiotape of 60 spoken single-syllable "nonsense" words divided into six series of ten items, which all contained the long "e" vowel sound. They were given a score sheet with four multiple-choice options for each of the 60 words which differed in their beginning and/or ending consonants sounds. Participants were asked to underline the choice which matched the word heard on the audiotape. Participants' scores represent both the total number of correct items and wrong items (i.e., errors) out of sixty. The time to complete this measure was approximately 15 minutes.

Facial Expressions of Emotion Measures

Recognition measure: Pictures of Facial Affect (PFA, Ekman & Friesen, 1976). The PFA was used in this study to assess the adolescent's ability to recognize facial expressions of emotions. The PFA contains 110 35mm black and

white slides of adult men and women expressing the facial expressions of happiness, sadness, anger, fear, surprise, and disgust in addition to a set of neutral faces. Ekman and Friesen (1976) report inter-judge agreement to range from 70%-100% for the emotions expressed on these photographs. In addition, race and culture of participants has generally not been found to play a significant role in the recognition of facial expressions of emotions (Boucher, 1979; Ekman, 1973; Izard, 1971). Previous research with children with LD has used a subset of 36 slides (no neutral faces; Holder & Kirkpatrick, 1991) as well as a larger subset of 48 slides (four male and four female faces for each of the six emotions; Dimitrovsky et al., 1998; Dimitrovsky et al., 2000). In addition, previous studies have used the PFA and found reliable results with both adults and children with intellectual disabilities (McAlpine et al., 1991), with children and adolescents with emotional and behavioral disorders (Ellis et al., 1997), children and adolescents with ADHD (Singh et al., 1998), and children and adolescents with Asperger Syndrome (Grossman, Klin, Carter, & Volkmar, 2000).

In this study, the subset of 48 slides (four male and four female faces for each of the six emotions, no neutral faces) was used. The individual emotion choices (i.e., happy, sad, anger, fear, surprise, and disgust) were placed on a sheet next to the participant and the choices were read aloud in order to not confound the results with low reading ability. For each picture of the individual facial expressions which appeared on the computer screen, the participant was asked to choose from among the six represented choices on the sheet in front of him/her, which face he/she thought was being expressed. The participant's choice was circled on his/her answer sheet and scores represent the total number of correctly

recognized facial expressions, with higher scores indicating better performance. The total time to complete this task was approximately 20-30 minutes.

Expression Measure. To assess the adolescent's ability to display facial expressions of emotion, he/she was asked to make the six different facial expressions of emotions (happiness, fear, anger, surprise, sadness, and disgust) four times and to maintain each one for a period of six seconds in front of a video camera while being recorded. The video camera was paused while the participant was told which expression to express and then recorded again prior to the participant resuming the facial expression for each emotion which he/she was asked to make. After the participant completed the task, he/she was asked whether he/she felt it is good or bad to show his/her emotions. This question was asked to take into consideration the notion that some adolescents may feel as though it is negative to display facial expressions of emotions.

Five adult judges, who were all undergraduate students in Psychology and blind to the study, the hypotheses and to the group placement of the participants, were used to code the data. The judges were first asked to individually study the facial expressions of emotions and their corresponding appropriate verbal labels from Ekman and Friesen's (1976) PFA. They were then trained to sample videotapes of adolescents who were not directly used in the study expressing facial expressions of emotions. Following this, the judges individually viewed the participant's facial expressions of emotions and were asked to provide the verbal label of the emotion (i.e., happy, sad, anger, fear, surprise, disgust) for each of the individual faces expressed by each participant. In addition, the judges were asked to assign a certainty rating for each expression made, specifically of how certain

they were of their judgment of the participants' expressions. Certainty was rated on a Likert-type scale (1 = not sure at all, 2 = just a little, 3 = moderately sure, 4 = pretty sure, 5 = certain).

The judges were trained on sample videotapes of adolescents making facial expressions which were not directly used in the study. Once satisfactory reliability was achieved (i.e., Kappa >= 0.70), the facial expressions of the participants in the study were rated. Kappas were calculated individually for the three groups of participants (i.e., NLD, NVLD, and GLD). The Kappa ratings between randomized pairs among the five raters on 43.4% of the NLD group ranged from 0.34 to 0.90 with a mean of 0.70, on 43.4% of the NVLD group ranged from 0.30 to 0.95 with a mean of 0.70, and on 43.4% of the GLD sample ranged from 0.44 to 0.85 with a mean of 0.65. The mean Kappa ratings were also calculated for the individual emotions for 43.4% of each of the three groups (see Table 7).

Table 7

Mean Kappa Ratings for the Individual Emotions for Groups with and without Learning Disabilities

Group	Happy	Sad	Anger	Fear	Surprise	Disgust
NLD	0.87	0.81	0.82	0.49	0.46	0.57
NVLD	0.83	0.75	0.71	0.53	0.46	0.63
GLD	0.77	0.61	0.48	0.38	0.42	0.46

Note. NLD = No learning disability; NVLD = Nonverbal learning disability; GLD= General learning disability.

The participant's ability to express emotions was scored as the total number of correct facial expressions made as categorized by the judges. The number of correct expressions for each of the six emotions and the entire 24-item set was calculated for each participant. The total time to complete this task was approximately 15-20 minutes. Previous research has shown this task to be effective in studying the ability of children and adults to display facial expressions of emotions (Borod & Koff, 1991; Browne, 1994; Field & Walden, 1982; Flack & Cavallano, 1997; Lewis et al., 1987; Shortt et al., 1994; Walden & Field, 1990).

Social Functioning Measure. To assess the adolescent's social functioning, a 3-minute videotape of the participant's interaction with the researcher was used. Following the facial expression task, a short casual conversation between the researcher and participant took place. Specifically, the participant was asked general questions about the latest movie that he/she saw.

Each participant was asked the following questions in the same order:

(a) "What was the name of the most recent movie that you saw?"

(b) "Did you like the movie?"

(c) "Why or why not?"

(d) "Could you tell me a little bit about the movie, that is what was it about"?

(e) "What was your favorite part of the movie"?

(f) "Why was this you're favorite part?"

(g) "Would you recommend this movie to a friend? Or any particular age group?"

The entire conversation was videotaped and viewed by five undergraduate students in Psychology (same students who viewed and coded the expression task), who were blind to the study, the hypotheses and to the group placement of the participants.

The social skills of the participants were assessed by an adapted version of the Conversation Probe Role-Play Test, which has been used in previous research with individuals with Schizophrenia (Ihnen, Penn, Corrigan, & Martin, 1998; Mueser et al., 1996; Penn, Mueser, Spaulding, Hope, & Reid, 1995). The Role-Play Rating Sheet assesses social functioning within the following individual subscales: Overall Social Skills, Clarity, Fluency, Appropriate Affect, Flat Affect, Gaze, Engagement, Meshing, Strangeness, Pleasantness of Conversation, Asks Questions, Social Anxiety. Performance on the individual subscales is rated on a 9-point Likert-scale ranging from 1 (extremely poor) to 9 (extremely good).

The judges were trained on sample videotapes of adolescents taking part in the casual conversational interactions which were not directly used in the study. Once satisfactory reliability was achieved (i.e., Intra-class Correlation >= 0.70), the casual conversational interactions of the participants in the study were rated. Intra-class Correlation ratings between randomized pairs among the five raters were calculated individually for the three groups (i.e., NLD, NVLD, and GLD). The Intra-class Correlations (ICCs) between the randomized pairs among the five raters on 43.4% of the NLD group ranged from 0.96-0.99 with a mean of 0.98, on 43.4% of the NVLD group ranged from 0.97 to 0.99 with a mean of 0.98, and on 43.4% of the GLD group ranged from 0.97-0.99 with a mean of 0.99. The participant's score on the Overall Social Skills item scale as well as his/her scores on each of the individual item scales represents his/her social functioning during a casual interaction interview with the researcher, with higher scores indicating a better display of general social functioning. The total time to complete this task was approximately five minutes.

Understanding Measure. To assess the adolescent's understanding of facial expressions of emotions he/she was asked to complete a short 2-sentence story task, which was accompanied by a visual component (see Appendix C for verbal and visual stories of the understanding task). Specifically, the researcher read a short 2-sentence story aloud while the participant followed along and simultaneously looked at a drawn picture directly below the verbal content that matched the story. After hearing the story and seeing the picture of the story simultaneously, the participant was asked to point to the likely facial expression of emotion from an array of six slides from Ekman and Friesen's Pictures of

Facial Affect (one for each of the six emotions) that would best illustrate the facial expression of emotion that the main character would be displaying based on the story. For example, for the facial expression of sadness, one of the stories was "If your best friend moved away to another country and you would not see him/her for a long time". The understanding task is distinctly different from both the recognition and expression measures as it specifically includes contextual cues through the use of a short story and accompanying picture depicting a situation. A basic understanding of facial expressions of emotions is likely necessary to identify facial expressions in the recognition task or to produce a facial expression. However, the understanding task is unlike the recognition and expressions measures as it requires a higher level of deduction or inference based on the context. This is important within the present study as perhaps adolescents with different LD subtypes may be able to recognize a facial expression in isolation, but have more difficulty understanding facial expressions of emotions within a specified context.

The participants' response was recorded by the researcher on a multiple choice answer sheet. The participants' score represents the total number of correctly matched facial expressions, with higher performance indicating a better understanding of facial expressions. The total time to complete this task was approximately 15-20 minutes. The verbal stories of this measure were adapted from Ellis et al (1997), McApline et al (1992), Singh et al (1998), and Stewart & Singh (1995) such that the same content and topic from the stories used in these studies were employed in the present study; however, the stories were adapted to

fit the developmental level of the participants (see Appendix C for verbal and visual stories of the understanding task).

Procedure

After having obtained the official school board and principal approval from the schools, letters of explanation and consent forms were distributed to students in grades7 through 9. Following parental consent for the screening phase and subsequently the screening for LD, all the participants who were asked to continue into the full phase of the study were administered the RADS, the CASS: S as well as all of the neuropsychological and emotion measures (see Figure 1 for data collection flow chart).

ADMINISTRATIVE CONSENT
PARENTAL CONSENT

↓

SCREENING FOR LD and NON-LD

Session 1: WISC-III (short form) & WRAT3
(30-45 minutes per participant/counterbalanced order)

↓

CLASSIFICATION OF NLD GROUP AND LD SUBTYPES BASED ON WISC-III and WRAT3 (see Table 5)

↓

NLD NVLD GLD

↓

Session 2: RADS and CASS: S (10-20 minutes per participant/counterbalanced order)

↓

ADMINISTRATION OF NEUROPSYCHOLOGICAL MEASURES: CORRELATES OF EMOTION PROCESSING AMONG ALL ADOLESCENTS

Session 1: Trail Making Test (Part B) & Target Test
(20 minutes per participant/counterbalanced order)
Session 2: Grooved Pegboard Test & Speech Sounds Perception
(25 minutes per participant/counterbalanced order)

↓

ADMINISTRATION OF EMOTION TASKS TO ALL ADOLESCENTS

Session 1: Recognition Task = Pictures of Facial Affect (30 minutes per participant)
Session 2: Expression Task = Production of four facial expressions for each of the six emotions (videotaped; 20 minutes per participant)
Social Functioning = 3-minute videotape of adolescent social interaction with researcher.
Session 3: Understanding Task = Choosing among an array of 6 slides the emotion that would be displayed by the main character in 12 different stories (20 minutes per participant).

Total Time for entire study: Approximately 3.0 hours/participant

Figure 1. Data Collection Flow Chart.

LD = Learning disability; NLD = No learning disability; GLD = General learning disability; NVLD = Nonverbal learning disability; WISC-III = Wechsler Intelligence Scale for Children - Third Edition; WRAT3 = Wide Range Achievement Test – Third Edition.

Screening for LD. Data collection began with the participants being individually administered the WISC-III short form and WRAT3 in a counterbalanced order within the session in a quiet well lit room. Based on the participant's WISC-III and WRAT3 Standard Scores he/she was classified as being either NLD or LD (see Table 5 for a summary of the criteria used for the classification of participants into those with NLD or LD). Following the classification of participants into LD/NLD groups, the Conners-Wells' Adolescent Self-Report Scale: Short Version and the Reynolds Adolescent Depression Scale were also individually administered in a counterbalanced order within the session to all adolescents who were asked to continue in the study. These measures were administered over two sessions, with one session that took approximately 30-45 minutes and the other session which took 10-20 minutes.

Classification of LD subtypes. Participants who were classified as having a LD were further subtyped into two groups; those with NVLD and those with GLD based on their Standard Scores on the WRAT3 achievement areas (see Table 5 for a summary of the criteria used for the classification of participants into those with NVLD or GLD).

Neuropsychological correlates of emotion processing. Following the classification of adolescents into distinct NVLD, GLD, NLD, they were individually administered in a quiet well-lit room the four neuropsychological measures (Trail Making Test Part B, Target Test, Grooved Pegboard Test, and Speech Sounds Perception Test). These measures were administered in a counterbalanced order within each session over two sessions of approximately 30 minutes each.

Recognition of facial expressions of emotion. The participants were tested on the Pictures of Facial Affect for approximately 30 minutes in a quiet well-lit room. The PFA testing task was prefaced by a practice task in recognizing facial expressions. Six slides from the PFA that were not included in the testing session (one for each emotion) were used for practice. During the practice task, correct responses were confirmed and given for incorrect answers. Once it was clear that the participant understood the task, the 48 slides (four male and four female slides for each of the six emotions) of the testing subset were individually presented in random order on a computer screen, and each slide was exposed for 10 seconds or until the participant provided a response. Following the exposure of each slide, the participant was asked to choose among the six possible emotion responses (which were read aloud as well as seen by the participant on a sheet next to them) the facial expression of emotion he/she thought was being expressed.

Expression of facial expressions of emotion. Each participant was individually seen in a quiet well lit room where he/she was seated approximately 3 feet in front of a video camera. The researcher explained to the participant that she was going to film him/her making individual facial expressions of emotion. Instructions to the participants at the beginning of the session were as follows: "I am going to videotape you making different kinds of faces. I want you to make your face look like you really have a certain kind of feeling inside and hold your expression for approximately six seconds. I will tell you what kind of face to make and will then ask you to look directly at the camera, make the face, and hold it for six seconds OK? I will pause the camera in between the faces in order to let you know which face I would like you to make and then I will continue to record

when I ask you to make the face. I am going to ask some people to recognize what faces you made". Following this explanation, the participants were provided with the opportunity to practice making facial expressions of emotions that were not directly asked in the testing session (e.g., making a silly face, making a confused face) to ensure that the participant understood the task. This task took approximately 20 minutes to complete.

Social functioning. Following the facial expression task, a casual 3-minute conversational interview was conducted with each participant, which was videotaped. The participant was asked a set of questions about the latest movie that he/she saw. Undergraduate students in Psychology, who were blind to all aspects of the study viewed and rated the interaction using the Role-Play Rating Scale (Please see measures section for further detail on this task).

Understanding facial expressions of emotions. Each adolescent was individually seen in a quiet well-lit room and the task was prefaced by a brief discussion about emotions. A three-ring binder was placed in front of the participant, which contained a verbal and pictorial representation of a story on the left side and the six slides of facial expressions (one depicting each emotion) on the right side. For each story, the six individual pictures of the facial expressions (one for each emotion) were randomly assigned in terms of placement on the sheet; however, each participant viewed a fixed presentation. The participant was asked to follow along as the story was read aloud, while looking at a visual drawing that matched the story. The participant was asked to choose among the six slides of facial expressions of emotions the likely resultant facial expression of the main character in the story. After hearing and seeing the story, the participant

was asked to point to the slide that would best describe the emotion that would be illustrated by the main character in the story. The researcher recorded each of the participants' responses. In total, each adolescent was shown 12 verbal/visual stories and their corresponding facial expressions of emotions (i.e., happiness, sadness, anger, fear, surprise, and disgust), with half of them being male pictures and half being female pictures (see Appendix C for verbal and visual stories of the understanding task).

Chapter IV: Results

Based on previous literature suggesting that the process of recognizing and expressing facial expressions of emotions may be affected by mood and attention (please see Method Section pp. 91 and 93) differences between the NLD and LD subtypes on these variables were assessed to determine their possible use as covariates. In addition, although two of the groups (i.e., NLD and NVLD) were matched on gender, age within 10 months, and IQ within 6 points, the GLD groups was comparable to the NLD and NVLD groups on these indices. Specifically, the GLD group was matched to the NLD and NVLD groups on gender, however, was comparable to the NLD and NVLD groups on the other two indices (i.e., similarly within the same IQ and age range). Given that the same stringent criteria could not be applied to obtain a three-way match, the use of paired t-tests or repeated measures analyses were not conducted as such analyses were not deemed appropriate. Such analyses within the current study may have been necessary had the exact same criteria on the indices of gender, age and IQ been used to match the NVLD, GLD, and NLD groups, which was not the case. Subsequently, the data analysis section is divided into two parts: (a) preliminary exploratory analyses pertaining to variables (i.e., Depression and Attention) to determine their possible importance as covariates, as well as examining the variable of sex (male/female) on the emotion processing tasks and (b) the results pertaining to the hypotheses posed.

Preliminary Analyses

Depression. To determine whether the adolescents with and without LD differed on their level of reported depressive symptoms, an independent samples *t* test was conducted with group (NLD/LD) serving as the independent variable and raw scores on the RADS serving as the dependent variable. Levene's Test for Homogeneity of Variance revealed a significant effect, $F = 4.15$, $p = 0.045$ and subsequently, equal variances were not assumed. Results revealed a significant effect for group, $t(58.4) = 2.60$, $p = 0.01$, effect size estimated using Cohen's $d = 0.76$ (medium effect) with adolescents with LD reporting significantly more depressive symptoms ($M = 59.33$, $SD = 13.79$) than those without LD ($M = 51.78$, $SD = 9.92$).

To determine whether adolescents with NVLD, GLD, and NLD differed on the level of reported depressive symptoms, a one-way ANOVA was conducted, with group (NVLD/GLD/NLD) serving as the independent variable and raw scores on the RADS serving as the dependent variable. Levene's Test of Homogeneity of Variances was not significant, $F(2, 66) = 2.16$, *ns.* No significant results were observed, $F(2, 66) = 2.74$, *ns*, between the adolescents with NVLD ($M = 58.74$, $SD = 13.31$), GLD ($M = 59.91$, $SD = 14.53$) or NLD ($M = 51.78$, $SD = 9.92$) on their levels of reported depressive symptoms, with the effect size estimated using the partial eta as being $\eta p^2 = .077$ (medium effect). The effect size was estimated using the partial eta, which according to Stevens (1996) is an appropriate effect size measure for F tests.

However, in light of the large standard deviation of the GLD group, a follow-up independent samples *t* test was conducted on the RADS between the

GLD and NLD groups. Levene's Test for homogeneity of Variance was not significant. A significant difference between the GLD and NLD groups was found, $t(44) = 2.22, p = 0.03$, effect size estimated using Cohen's $d = 0.82$ (large effect) with the GLD group reporting higher levels of depressive symptoms. Additionally, a follow-up independent samples t test was conducted on the RADS between the NVLD and NLD groups given the large standard deviation of the NVLD group. Levene's Test for homogeneity of Variance was not significant. A significant difference between the NVLD and NLD groups was found, $t(44) = 2.01, p = 0.05$, effect size estimated using Cohen's $d = 0.70$ (medium effect) with the NVLD group reporting higher levels of depressive symptoms.

Attention. To determine whether the adolescents with and without LD differed on any of the subscales of the CASS: S, a one-way MANOVA was conducted, with group (NLD/LD) serving as the independent variable and the individual subscales of the CASS: S serving as the dependent variables. Consistent with Stevens (1996), both multivariate and univariate results were examined even in the absence of a multivariate effect given the exploratory nature of the study. No significant multivariate results were revealed, Wilks' Lambda, $\Lambda = 0.92$, ${}_{multi}F(4, 64) = 1.38$, *ns,* with the effect size estimated using the partial eta being $\eta p^2 = .079$ (medium effect size). However, univariate F tests revealed a significant result on the Cognitive Problems/Inattention subscale, $F(1, 67) = 4.85$, $p = 0.03$, with the effect size estimated using the partial eta being $\eta p^2 = .067$ (medium effect size). Specifically, the LD group ($M = 57.30$, $SD = 9.40$) reported significantly more problems on the Cognitive Problems/Inattention subscale than the NLD group ($M = 52.39$, $SD = 7.20$).

In order to assess whether the adolescents with NVLD, GLD, and NLD differed on any of the subscales of the CASS: S, a one-way MANOVA was conducted, with group (NVLD/GLD/NLD) serving as the independent variable and the individual subscales of the CASS: S serving as the dependent variables. No significant multivariate results were revealed, Wilks' Lambda, $\Lambda = 0.81$ $_{multi}F(8, 126) = 1.78$, *ns,* with the effect size estimated using the partial eta being $\eta p^2 = .101$ (large effect size). However, univariate F tests revealed significant results on the Cognitive Problems/Inattention subscale, $F(2, 66) = 5.04$, $p = 0.007$ and on the ADHD Index $F(2, 66) = 3.23$, $p = 0.046$, with the effect sizes estimated using the partial eta being $\eta p^2 = .141$ (large effect size) and $\eta p^2 = .089$ (large effect size) respectively. Tukey HSD post-hoc tests revealed adolescents with GLD reporting more problems on the Cognitive Problems/Inattention subscale) $M = 60.26$, $SD = 8.85$ compared to the NVLD (M =54.35, $SD = 9.17$) and NLD ($M = 52.39$, $SD = 7.20$) groups, who did not significantly differ from each other.

Sex. In order to assess whether males and females differed in their overall accuracy in recognizing facial expressions of emotions, an independent samples *t* test was conducted with sex (male/female) serving as the independent variable and the mean total recognition score serving as the dependent variable. Levene's Test of Homogeneity of Variance was not significant and no significant difference was observed between males ($M = 36.77$, $SD = 4.33$) and females ($M = 38.70$, $SD = 3.79$) in their ability to recognize facial expressions of emotions, $t(67) = 1.94$, *ns.*

In order to assess whether males and females differed in their overall accuracy in expressing facial expressions of emotions, an independent samples *t* test was conducted with sex (male/female) serving as the independent variable and the mean total expression score serving as the dependent variable. Levene's Test of Homogeneity of Variance was not significant and no significant difference was observed between males ($M = 18.92$, $SD = 3.83$) and females ($M = 18.43$, $SD = 3.46$) in their ability to correctly express facial expressions of emotions, $t(67) = 0.55$, *ns*.

To determine whether males and females differed in their overall accuracy at understanding facial expressions of emotions, an independent samples *t* test was conducted with sex (male/female) serving as the independent variable and the mean total understanding score serving as the dependent variable. Levene's Test of Homogeneity of Variance was not significant and results revealed a significant effect for sex, $t(67) = 2.74$, $p = 0.008$, such that females ($M = 10.10$, $SD = 1.42$) were more accurate at understanding facial expressions of emotions than males ($M = 9.13$, $SD = 1.49$).

To assess whether males and females differed on their overall social skills or on any of the individual subscales of the social-role play rating scale, a one-way Multivariate Analysis of Variance (MANOVA) was conducted with sex (male/female) serving as the independent variable and the mean scores of the individual scales of the role-play rating sheet serving as the dependent variables. No significant multivariate difference was found between males and females on the overall social skills scale or on any of the individual scales of the rating system, Wilks' Lambda, $\Lambda = 0.88$, ${}_{multi}F(12, 56) = 0.65$, *ns*. Looking at the

univariate results, no significant differences were observed between males and females on any of the individual scales.

Based on the above results, the measures of depression and attention where differences among the LD/NLD or NVLD/GLD/NLD groups were found were used as covariates on subsequent analyses assessing group differences (i.e., NLD/LD or NVLD/GLD/NLD) on all of the emotion variables (i.e., recognition, expression, understanding of facial expressions, as well as social functioning). Although a significant sex difference was found on understanding facial expressions of emotions, this variable will not be used as a covariate as the groups were matched on sex.

Results Pertaining to the Specific Hypotheses

Confirmation of groups. In order to determine whether adolescents with NVLD performed worse on the Trail Making Test Part B, the Target Test, and the Grooved Pegboard Test compared to adolescents with GLD and without LD and whether adolescents with GLD performed worse on the Speech Sounds Perception Test compared to adolescents with NVLD and without LD, a one-way MANOVA was conducted with group (NVLD/GLD/NLD) serving as the independent variable and neuropsychological measures (i.e., Trail Making Test Part B, Target Test, Grooved Pegboard Test Dominant and Non-dominant Hands, and the Speech Sounds Perception Test) serving as the dependent variables. Results revealed a significant overall multivariate effect for group (NVLD/GLD/NLD), Wilks' Lambda, $\Lambda = 0.68$, $_{multi}F(12, 122) = 2.18$, $p = 0.02$, with the effect size estimated using the partial eta being $\eta p^2 = .176$ (large effect). Univariate F tests revealed a significant effect of group (NVLD/GLD/NLD) on

the Trail Making Test Part B, $F(2, 66) = 3.49, p = 0.04$ and on the Speech Sounds Perception Test, $F(2, 66) = 6.79, p = 0.002$ with the effect sizes estimated using the partial eta being $\eta p^2 = .096$ (large effect size) and $\eta p^2 = .171$ (large effect size) respectively. No other significant univariate group differences were found on the other measures. Following Tukey HSD post-hoc multiple comparisons it was observed that the NVLD group ($M = 37.78$, $SD = 14.14$) performed significantly worse as measured by a slower completion time on the Trail Making Test Part B compared to the NLD group ($M = 29.20$, $SD = 8.35$), (Mean Difference between NVLD and NLD = 8.48, $p = 0.04$). No significant differences emerged between the NVLD and GLD groups nor between the GLD and NLD groups, who performed similarly on this task (see Figure 2). The opposite pattern emerged for the Speech Sounds Perception Test. Specifically, Tukey HSD post-hoc multiple comparisons revealed that the GLD group ($M = 8.04$, $SD = 4.37$) made significantly more errors on this task than the NLD group ($M = 4.35$, $SD = 2.33$), (Mean Difference between GLD and NLD = 3.70, $p = 0.001$), while no significant differences emerged between the GLD and NVLD groups nor between the NVLD and NLD groups on this task (see Figure 3).

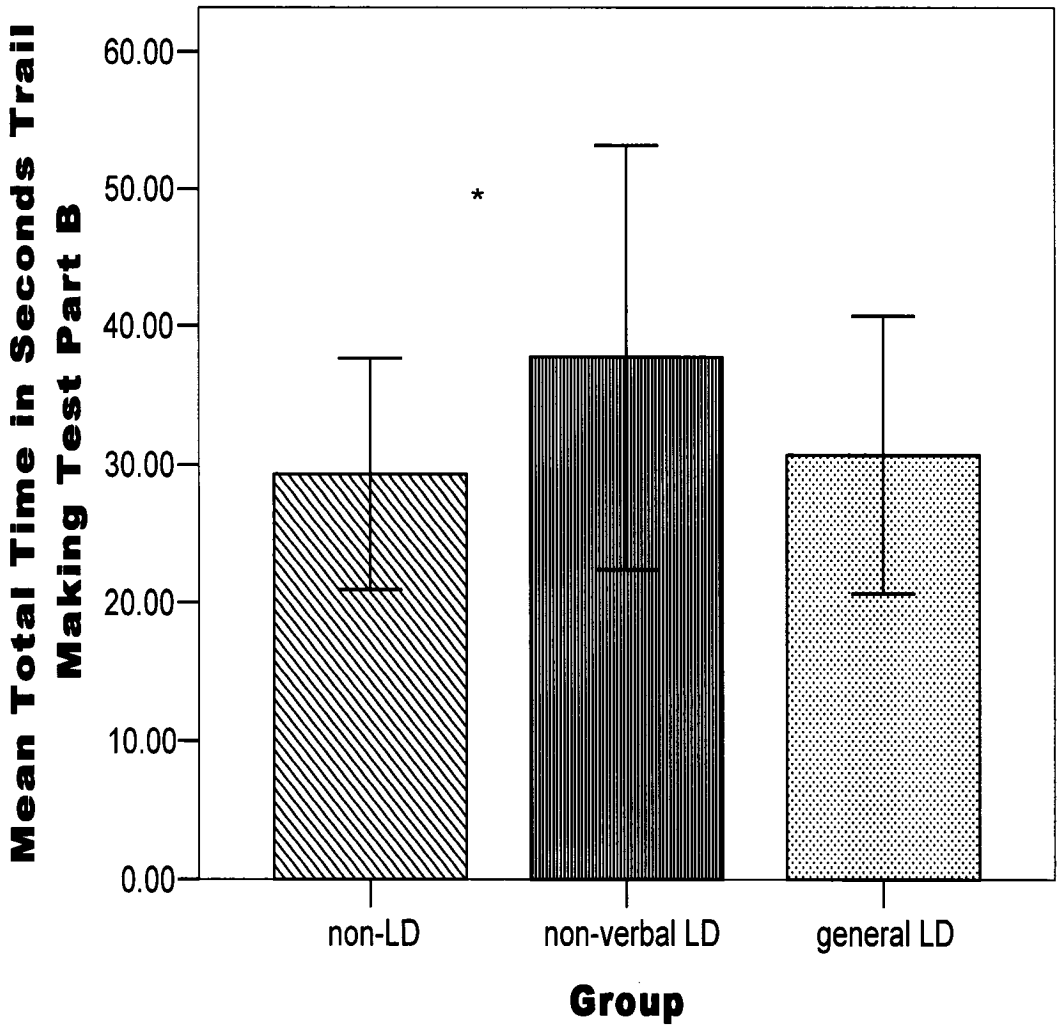

Figure 2. Significant NVLD/NLD group effect for Trail Making Test Part B total time in seconds. Vertical lines (i.e., error bars) depict standard deviations.

*$p < 0.05$ for total completion time in seconds on Trail Making Test Part B between NVLD and NLD groups.

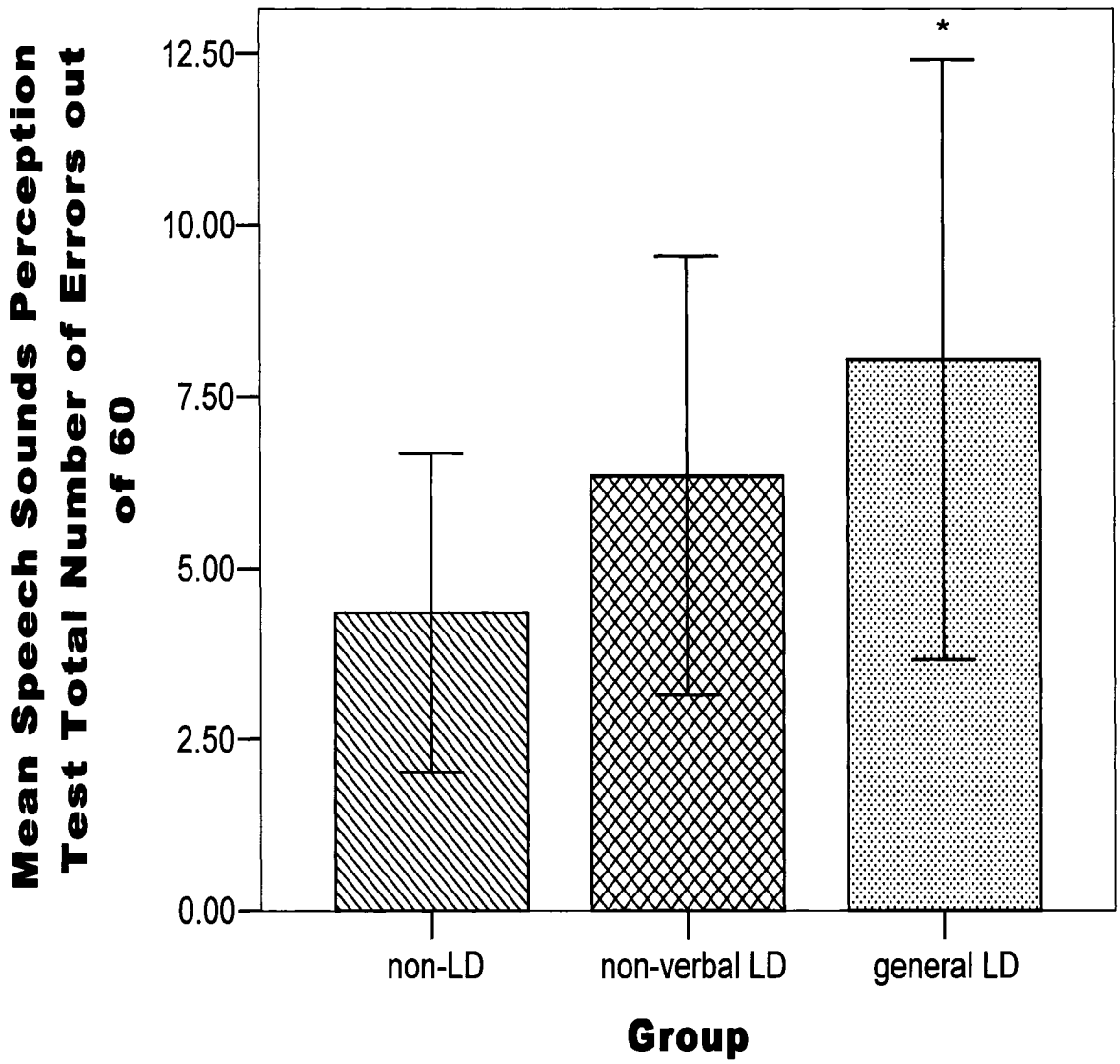

Figure 3. Significant GLD/NLD group effect for Speech Sounds Perception Test total number of errors. Vertical lines (i.e., error bars) depict standard deviations. *$p < 0.05$ for total number of errors on Speech Sounds Perception Test between GLD and NLD groups.

Recognition of Facial Expressions of Emotion

Recognition of facial expressions among sample. In order to assess whether the adolescents were more accurate at recognizing the facial expression of happiness compared to any of the other emotions, a repeated measures MANOVA was conducted with the within subjects factor emotion being repeated. Results revealed a significant overall multivariate effect for Emotion, Wilks' Lambda, $\Lambda = 0.13$, ${}_{multi}F(5, 64) = 84.97$, $p < 0.001$. Parameter t tests estimates revealed a significant difference for happiness $t(68) = 321.7$, $p < 0.05$; sadness $t(68) = 58.6$, $p < 0.05$; anger $t(68) = 43.7$, $p < 0.05$; fear $t(68) = 17.1$, $p < 0.05$; surprise $t(68) = 49.1$, $p < 0.05$; and disgust $t(68) = 49.1$, $p < 0.05$. Least significant difference pairwise comparisons with Bonferroni Correction with probability set at 0.016 revealed that the facial expression of happiness was significantly more accurately recognized than any of the other emotions. Additionally, there was a significant difference between every emotion of facial expressions in terms of accuracy of recognition with the exception of the facial expressions of sad and surprise, where no differences emerged. Please refer to Table 8 for descriptive statistics of facial expression recognition for the individual emotions.

Table 8

Descriptive Statistics for Recognition of Facial Expressions of Individual Emotions

Emotion	HA	SA	AN	FE	SU	DI
HA	-----	6.72/7.96**	6.16/7.96**	4.45/7.96**	6.84/7.96**	5.51/7.96**
SA	7.96/6.72**	-----	6.16/6.72*	4.45/6.72**	6.84/6.72	5.51/6.72**
AN	7.96/6.16**	6.72/6.16*	-----	4.45/6.16**	6.84/6.16*	5.51/6.16**
FE	7.96/4.45**	6.72/4.45**	6.16/4.45**	-----	6.84/4.45**	5.51/4.45**
SU	7.96/6.84**	6.72/6.84	6.16/6.84*	4.45/6.84**	-----	5.51/6.84**
DI	7.96/5.51**	6.72/5.51**	6.16/5.51*	4.45/5.51**	6.84/5.51**	------

Note. Cells are equal to the mean recognition score (out of 8) of the emotion on the horizontal over the mean recognition score of the emotion on the vertical, horizontal entry/vertical entry. HA = Happy; SA = Sad; AN = Anger; FE = Fear; SU = Surprise; DI = Disgust.

*p < 0.05 for mean differences score, **p <0.001 for mean difference score.

Recognition of facial expressions among LD and NLD groups. To determine whether adolescents with LD as a group were less accurate overall at recognizing facial expressions of emotion than adolescents without LD, a one-way Analysis of Covariance (ANCOVA) was conducted with group (LD/NLD) serving as the independent variable, the mean total recognition scores serving as the dependent variable, and the RADS raw scores and CASS: S Cognitive

Problems/Inattention subscale scores serving as covariates. No significant difference was found on the Levene's test of the Homogeneity of Variances. A significant group (LD/NLD) effect was found $F(1, 65) = 5.57, p = 0.02$, with adolescents with LD ($M = 36.78$, $SD = 4.38$) being less accurate overall at recognizing facial expressions of emotions than adolescents without LD ($M = 39.26$, $SD = 3.28$), with the effect size estimated using the partial eta being $\eta p^2 = 0.079$ (medium effect), (see Figure 4). The RADS and CASS: S Cognitive Problems/Inattention covariates were also significant $F(1, 65) = 4.52, p = 0.04$ and $F(1, 65) = 5.03, p = 0.03$ respectively.

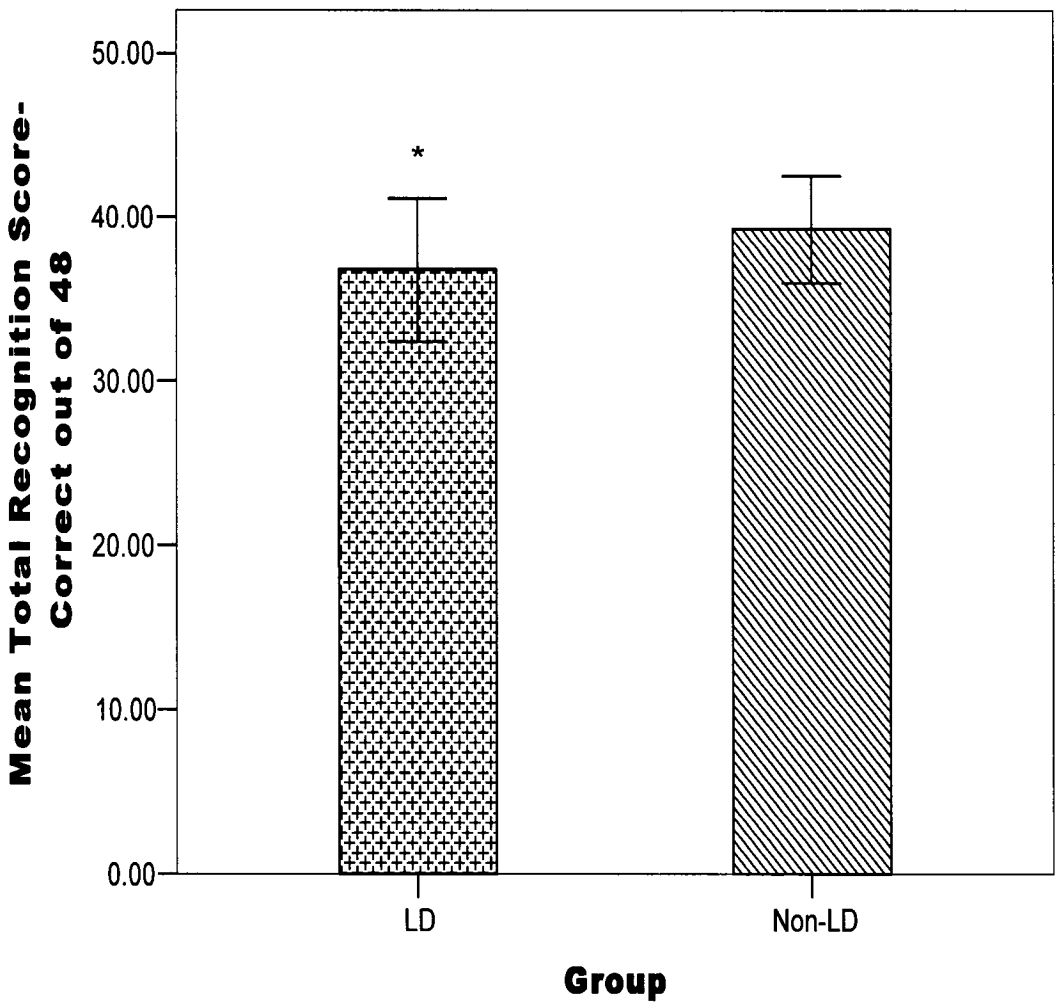

Figure 4. Significant LD/NLD group effect for recognition of facial expressions total correct score. Vertical lines (i.e., error bars) depict standard deviations. *$p < 0.05$ difference between LD and NLD groups.

Recognition of facial expressions among NVLD, GLD and NLD groups. In order to assess whether adolescents with NVLD as a group were less accurate overall at recognizing facial expressions of emotion than adolescents with GLD and without LD, a one-way ANCOVA was conducted. LD category

(NVLD/GLD/NLD) served as the independent variable, the mean total recognition scores served as the dependent variable, and scores on the CASS: S Cognitive Problems/Inattention and ADHD subscales served as covariates. Levene's Test for Homogeneity of Variances did not reveal any significant differences. A significant effect of group (NVLD/GLD/NLD) was uncovered $F(2, 64) = 8.26, p = 0.001$, with the effect size estimated using the partial eta being $\eta p^2 = 0.205$ (large effect). The CASS: S Cognitive Problems/Inattention and ADHD subscale covariates were not significant, $F(1, 64) = .110, p = 0.74$ and $F(1, 64) = 0.001, p = 0.98$ respectively. Least significant difference pairwise comparisons with Bonferroni Correction with probability set at 0.016 revealed the GLD ($M = 34.70$, $SD = 3.76$) to be significantly less accurate overall at recognizing facial expressions of emotions than adolescents with NVLD ($M = 38.87$, $SD = 3.99$) and without LD ($M = 39.26$, $SD = 3.26$), (Mean Difference between GLD and NLD = 4.32, $p = 0.001$; Mean Difference between GLD and NVLD = 4.00, $p = 0.001$). No significant difference was found between adolescents with NVLD and without LD in their abilities to recognize facial expressions of emotion (see Figure 5).

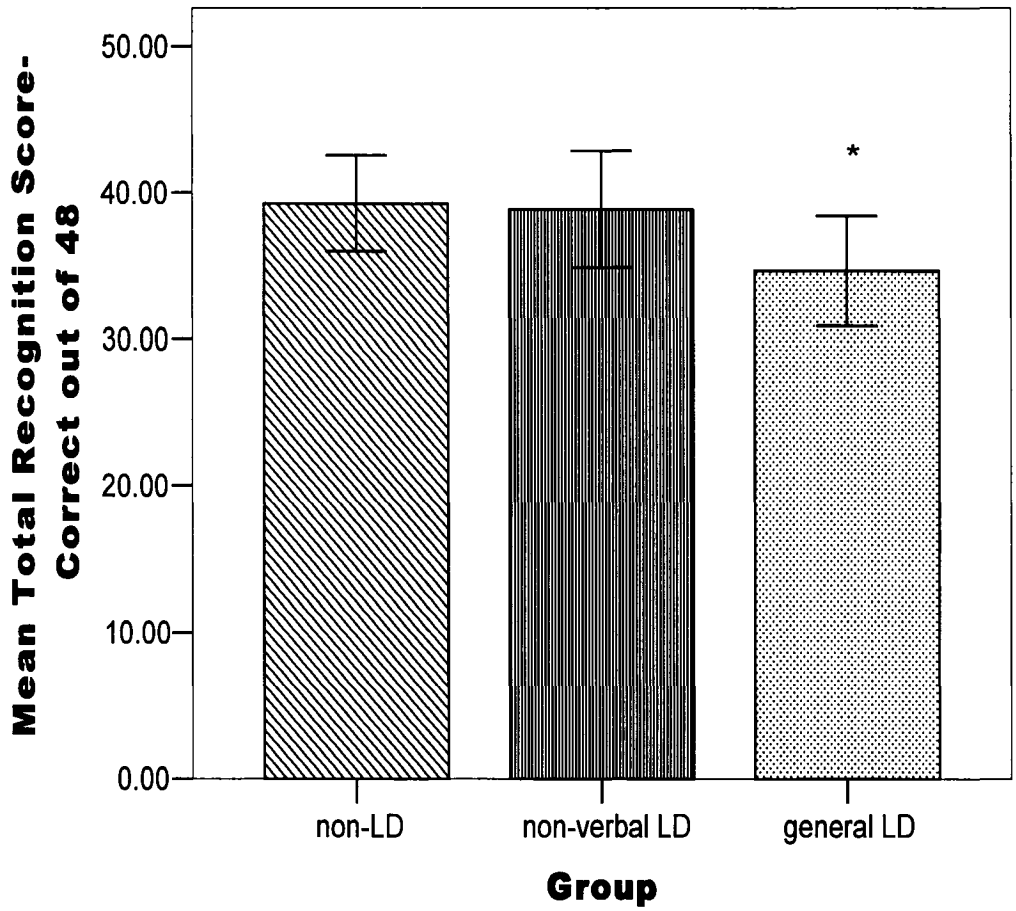

Figure 5. Significant GLD group effect for recognition of facial expressions total correct score. Vertical lines (i.e., error bars) depict standard deviations.

*$p < 0.05$, the GLD group is significantly different from the NVLD and NLD groups.

Recognition of facial expressions among NVLD, GLD, and NLD groups by emotions. To assess whether differences emerged among the groups (NVLD/GLD/NLD) on the individual emotions, a one-way MANCOVA with repeated measures was conducted. Group (NVLD/GLD/NLD) served as the independent variable and the individual emotions (i.e., happy, sad, anger, fear, surprise, disgust) served as the within subjects multiple variates and CASS: S Cognitive Problems/Inattention and ADHD subscales served as the covariates. Results revealed a significant overall multivariate effect of emotion, Wilks' Lambda, $\Lambda = 0.83$, $_{multi}F(5, 60) = 2.55$, $p = 0.04$ and a significant effect of group (NVLD/GLD/NLD), $F(2, 64) = 8.04$, $p = 0.001$, with the effect size estimated using the partial eta being $\eta p^2 = 0.175$ (large effect) and 0.201 (large effect) respectively. No significant emotion by group interaction was uncovered. The CASS: S Cognitive Problems/Inattention and ADHD subscale covariates were not significant, $F(1, 64) = .171$, $p = 0.68$ and $F(1, 64) = 0.006$, $p = 0.937$ respectively. Parameter t test estimates revealed a significant effect of group (NVLD/GLD/NLD) on the facial expression of fear between the GLD and NLD groups, $t(66) = 3.08$, $p = 0.003$ and between the GLD and NVLD groups, $t(66) = 2.97$, $p = 0.004$. In addition, there was also a significant difference between the GLD and NVLD groups on disgust, $t(66) = 2.28$, $p = 0.03$. Specifically, the GLD group ($M = 3.09$, $SD = 2.11$) was significantly worse at recognizing the facial expressions of fear compared to the NVLD ($M = 5.04$, $SD = 2.06$) and NLD ($M = 5.22$, $SD = 1.73$) groups; and GLD was poorer on disgust ($M = 4.70$, $SD = 1.69$)

compared to the NVLD group ($M = 5.96$, $SD = 1.55$). No other significant group differences were found on the other facial expressions.

Expression of Facial Expressions

Expression of facial expressions among sample. To assess whether the adolescents were more accurate at expressing the facial expression of happiness compared to any of the other emotions, a MANOVA repeated measures with the within subjects factor emotion being repeated was conducted. Results revealed a significant overall multivariate effect for Emotion, Wilks' Lambda, $\Lambda = 0.41$, ${}_{multi}F(5, 64) = 18.74$, $p < 0.001$. Parameter t test estimates revealed significant effects for the individual emotions: happiness $t(68) = 51.6$, $p < 0.05$; sadness $t(68) = 33.9$, $p < 0.05$; anger $t(68) = 25.1$, $p < 0.05$; fear $t(68) = 18.1$, $p < 0.05$; surprise $t(68) = 18.6$, $p < 0.05$; and disgust $t(68) = 21.2$, $p < 0.05$. Least significant difference pairwise comparisons with Bonferroni Correction with probability set at 0.016 revealed the facial expression of happiness was significantly more accurately expressed than any of the other emotions. Additionally, there was a significant difference between every emotion of facial expressions in terms of accuracy of expression with the exception of the facial expressions of sad and disgust, anger and disgust, and fear and surprise where no differences emerged. Please refer to Table 9 for descriptive statistics of accuracy of expression of the facial expressions for the individual emotions.

Table 9

Descriptive Statistics for Expression of Facial Expressions of Individual Emotions

Emotion	HA	SA	AN	FE	SU	DI
HA	-----	3.48/3.75*	3.25/3.75**	2.52/3.75**	2.65/3.75**	3.09/3.75**
SA	3.75/3.48*	-----	3.25/3.48	2.52/3.48**	2.65/3.48**	3.09/3.48
AN	3.75/3.25**	3.48/3.25	-----	2.52/3.25**	2.65/3.25*	3.09/3.25
FE	3.75/2.52**	3.48/2.52**	3.25/2.52**	-----	2.65/2.52	3.09/2.52*
SU	3.75/2.65**	3.48/2.65**	3.25/2.65*	2.52/2.65	------	3.09/2.65*
DI	3.75/3.09**	3.48/3.09	3.25/3.09	2.52/3.09*	2.65/3.09*	------

Note. Cells are equal to the mean expression score (out of 4) of the emotion on the horizontal over the mean expression score of the emotion on the vertical, horizontal entry/vertical entry. HA = Happy; SA = Sad; AN = Anger; FE = Fear; SU = Surprise; DI = Disgust.

*$p < 0.05$ for mean differences score, **$p < 0.001$ for mean difference score.

Expression of facial expressions among LD and NLD groups. To determine whether adolescents with LD as a group were less accurate overall at expressing facial expressions of emotion than adolescents without LD, a one-way ANCOVA was conducted with group (LD/NLD) serving as the independent variable, the mean total expression scores serving as the dependent variable, and the RADS raw scores and CASS: S Cognitive Problems/Inattention subscale scores serving as covariates. Contrary to what was predicted, no significant difference was found between LD ($M = 18.37$, $SD = 3.59$) and NLD ($M = 19.39$,

SD = 3.79) groups in the ability to express facial expressions of emotions, $F(1, 65) = 0.50$, *ns*, with effect size estimated by partial eta $\eta p^2 = .008$ (small effect). In addition, the RADS and Cognitive Problems/Inattention subscale scores were not significant, $F(1, 65) = 0.002$, *ns* and $F(1, 65) = 1.53$, *ns*, respectively.

To assess whether adolescents with LD as a group received lower certainty ratings (i.e., as defined by how certain the judges were of their judgement of the participants' facial expressions) in their ability to express facial expressions compared to adolescents without LD, a one-way ANCOVA was conducted. The group (LD/NLD) served as the independent variable, the mean certainty ratings served as the dependent variable, and the RADS raw scores and CASS: S Cognitive Problems/Inattention subscale scores served as covariates. Contrary to what was predicted, no significant difference was found between the LD (M = 3.22, SD = 0.55) and NLD (M = 3.38, SD = 0.45) groups on the mean certainty ratings as given by the judges when rating the abilities of adolescents with and without LD to express facial expressions of emotions, $F(1, 65) = 0.50$, *ns,* with effect size estimated by partial eta $\eta p^2 = .008$ (small effect). The RADS covariate was significant and $F(1, 65) = 4.14$, $p = 0.046$; however, the Cognitive Problems/Inattention subscale scores covariate was not significant, $F(1, 65) = 0.205$, *ns*.

Expression of facial expressions among NVLD, GLD and NLD groups. To assess whether adolescents with NVLD as a group were less accurate overall at expressing facial expressions of emotion than adolescents without LD and with GLD, a one-way ANCOVA was conducted. The LD category (NVLD/GLD/NLD) served as the independent variable, the mean total expression

scores served as the dependent variable, and scores on the CASS: S Cognitive Problems/Inattention and ADHD subscales served as covariates. No significant effect for group was uncovered, $F(2, 64) = 0.73$, *ns,* thus not lending support to the hypothesis that the NVLD group would be worse at expressing facial expressions than the GLD and NLD groups, with effect size estimated by partial eta $\eta p^2 = .022$ (small effect). The covariates Cognitive Problems/Inattention and ADHD subscales were also not significant, $F(1, 64) = 2.08$, *ns* and $F(1, 64) = 1.15$, *ns*, respectively. Please refer to Table 10 for descriptive statistics.

Table 10

Descriptive Statistics for NLD, NVLD, and GLD Groups on Total Expression of Facial Expressions Scores

Group	*n*	*M*	*SD*
NLD	23	19.39	3.79
NVLD	23	19.09	3.15
GLD	23	17.66	3.92

Note. NLD = No learning disability; NVLD = Nonverbal learning disability; GLD = General learning disability. Scores are out of 24.

To assess whether adolescents with NVLD as a group received lower certainty ratings in their ability to express facial expressions compared to adolescents without LD and with GLD, a one-way ANCOVA was conducted. Group (NVLD/GLD/NLD) served as the independent variable, the mean certainty ratings served as the dependent variable, and the CASS: S Cognitive Problems/Inattention and ADHD subscale scores served as covariates. Contrary to what was predicted, no significant difference was found between the NVLD (M = 3.24, SD = 0.63), GLD (M = 3.20, SD = 0.46), and NLD (M = 3.38, SD = 0.45) groups on the mean certainty ratings as given by the judges when rating the abilities of adolescents with NVLD, GLD, and without LD to express facial expressions of emotions, $F(2, 64) = 0.73$, *ns,* with effect size estimated by partial eta $\eta p^2 = .016$ (small effect). The covariates Cognitive Problems/Inattention and ADHD subscales were also not significant, $F(1, 64) = 0.256$, *ns* and $F(1, 64) = 0.536$, *ns*, respectively.

To assess whether adolescents with NVLD received more controversial ratings (i.e., as defined by disagreement between judges on the facial expression being made the participant) by the judges than adolescents without LD and those with GLD, a one-way ANCOVA was conducted with group (NVLD/GLD/NLD) serving as the independent variable, mean controversial ratings serving as the dependent variable, and scores on the CASS: S Cognitive Problems/Inattention and ADHD subscales serving as covariates. No significant effect for group was uncovered, $F(2, 25) = 0.03$, *ns,* with effect size estimated by partial eta $\eta p^2 = .002$ (small effect) thus not lending support to the hypothesis that the NVLD group

($M = 4.80$, $SD = 2.90$) would receive more controversial ratings when expressing facial expressions as compared to the GLD ($M = 5.70$, $SD = 1.89$) and NLD groups ($M = 5.20$, $SD = 2.90$). The covariates Cognitive Problems/Inattention and ADHD subscales were also not significant, $F(1, 25) = 0.005$, *ns* and $F(1, 25) = 0.94$, *ns*, respectively.

Expression of facial expression among NVLD, GLD, and NLD groups by emotions. To assess whether differences emerged among the groups (NVLD/GLD/NLD) in their ability to express the individual emotions, a one-way MANCOVA with repeated measures was conducted. Group (NVLD/GLD/NLD) served as the independent variable, the individual emotions (i.e., happy, sad, anger, fear, surprise, disgust) served as the within subjects factor being repeated and CASS: S Cognitive Problems/Inattention and ADHD subscales served as the covariates. Results revealed a significant overall multivariate main effect of Emotion, Wilks' Lambda, $\Lambda = 0.40$, ${}_{multi}F(5, 60) = 17.95$, $p < 0.001$; however, no significant main effect of group (NVLD/GLD/NLD), $F(2, 64) = 0.75$, *ns*, with effect size estimated by partial eta $\eta p^2 = .02$ (small effect) or emotion by group interaction Wilks' Lambda, $\Lambda = 0.92$, ${}_{multi}F(10, 120) = 0.52$, *ns,* was found. The covariates Cognitive Problems/Inattention and ADHD subscales were also not significant, $F(1, 64) = 2.01$, *ns* and $F(1, 64) = 0.98$, *ns*, respectively.

Understanding Facial Expressions of Emotions

Understanding of facial expressions of emotions among sample. In order to assess whether adolescents in general were more accurate at understanding the facial expression of happiness than any other emotion, a repeated measures MANOVA was conducted with the within subject factor, emotion being repeated.

Results revealed a significant overall multivariate effect for Emotion, Wilks' Lambda, $\Lambda = 0.54$, ${}_{multi}F(5, 64) = 10.83$, $p < 0.001$. Parameter t test estimates revealed significant differences for the emotions: happiness $t(68) = 29.1$, $p < 0.05$; sadness $t(68) = 51.9$, $p < 0.05$; anger $t(68) = 19.5$, $p < 0.05$; fear $t(68) = 16.1$, $p < 0.05$; surprise $t(68) = 16.9$, $p < 0.05$; and disgust $t(68) = 32.0$, $p < 0.05$. Least significant difference pairwise comparisons with Bonferroni Correction with probability set at 0.016 revealed the facial expression of sadness was significantly more accurately understood than any of the other emotions. Additionally, there was a significant difference between every emotion in terms of accuracy of understanding with the exception of the facial expressions of happiness and disgust, anger and fear, anger and surprise, disgust and sad, and fear and surprise, where no differences emerged. Please refer to Table 11 for descriptive statistics.

Table 11

Descriptive Statistics for Understanding of Facial Expressions of Individual Emotions

Emotion	HA	SA	AN	FE	SU	DI
HA	-----	1.90/1.71*	1.42/1.71*	1.36/1.71*	1.41/1.71*	1.77/1.71
SA	1.71/1.90*	-----	1.42/1.90**	1.36/1.90**	1.41/1.90**	1.77/1.90
AN	1.71/1.42*	1.90/1.42**	-----	1.36/1.42	1.41/1.42	1.77/1.42**
FE	1.71/1.36*	1.90/1.36**	1.42/1.36	-----	1.41/1.36	1.77/1.36**
SU	1.71/1.41*	1.90/1.41**	1.42/1.41	1.36/1.41	-----	1.77/1.41*
DI	1.71/1.77	1.90/1.77	1.42/1.77**	1.36/1.77**	1.41/1.77*	------

Note. Cells are equal to the mean understanding score (out of 2) of the emotion on the horizontal over the mean understanding score of the emotion on the vertical, horizontal entry/vertical entry. HA = Happy; SA = Sad; AN = Anger; FE = Fear; SU = Surprise; DI = Disgust.

*$p < 0.05$ for mean differences score, **$p < 0.001$ for mean difference score.

Understanding facial expressions of emotions among LD and NLD groups. In order to assess whether adolescents with LD as a group were less accurate overall at understanding facial expressions of emotion than adolescents without LD, a one-way ANCOVA was conducted with LD group (LD/NLD) serving as the independent variable, the mean total understanding scores serving

as the dependent variable, and the RADS raw scores and CASS: S Cognitive Problems/Inattention subscale scores serving as covariates. Contrary to what was predicted, no significant difference was found between the LD and NLD groups in their ability to understand facial expressions of emotions, $F(1, 65) = 2.72$, *ns,* with effect size estimated by partial eta $\eta p^2 = .040$ (small effect). The RADS and Cognitive Problems/Inattention subscale covariates were also non-significant, $F(1, 65) = 0.78$, *ns* and $F(1, 65) = 0.05$, *ns* respectively. Please refer to Table 12 for descriptive statistics.

Table 12

Descriptive Statistics for LD and NLD Groups on Understanding of Facial Expressions

Group	*n*	*M*	*SD*
LD	46	9.34	1.57
NLD	23	9.91	1.41

Note. LD = Learning disability; NLD = No learning disability. Scores are out of 12.

Understanding facial expressions of emotions among NVLD, GLD and NLD groups. In order to assess whether adolescents with NVLD as a group were less accurate overall at understanding facial expressions of emotion than adolescents without LD and with GLD, a one-way ANCOVA was conducted with LD category (NVLD/GLD/NLD) serving as the independent variable, the mean total understanding scores serving as the dependent variable, and CASS: S Cognitive Problems/Inattention and ADHD subscale scores serving as covariates. A significant group effect (NVLD/GLD/NLD) was uncovered, $F(2, 64) = 5.26$, $p = 0.008$, with effect size estimated by partial eta $\eta p^2 = .141$ (large effect). The Cognitive Problems/Inattention and ADHD subscales covariates were not significant, $F(1, 64) = 0.93$, *ns* and $F(1, 64) = 0.03$, *ns* respectively. Least significant difference pairwise comparisons with Bonferroni Correction with probability set at 0.016 revealed adolescents with GLD ($M = 8.83$, $SD = 1.45$) to be less accurate overall at understanding facial expressions of emotions than adolescents with NVLD ($M = 9.91$, $SD = 1.53$) and without LD ($M = 9.91$, $SD = 1.41$), (Mean difference between GLD and NLD = 1.33, $p = 0.005$ and between GLD and NVLD = 1.27, $p = 0.006$). No significant difference was found between adolescents with NVLD and without LD in their abilities to understand facial expressions of emotion. Please refer to Figure 6.

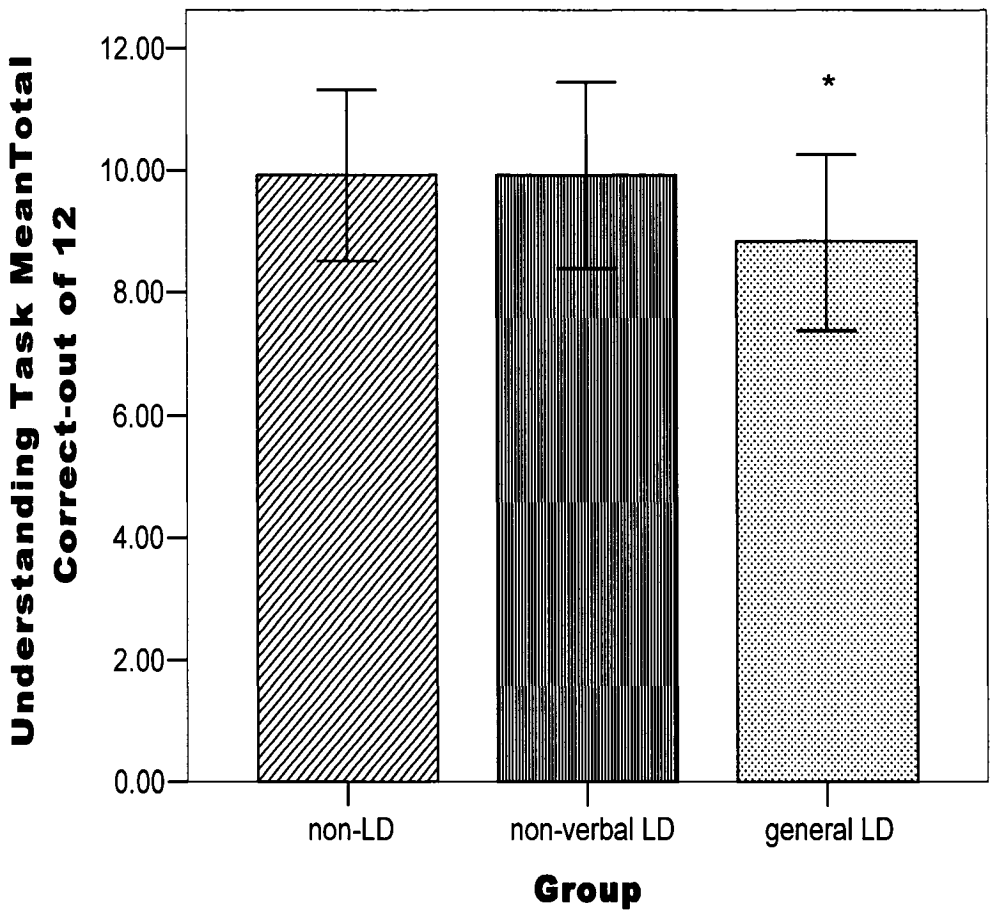

Figure 6. *Si*gnificant GLD group effect for understanding of facial expressions of emotions total correct score. Vertical lines (i.e., error bars) depict standard deviations.

*$p < 0.05$ significant difference between GLD and NVLD and NLD groups on understanding facial expressions of emotions.

Understanding of facial expression among NVLD, GLD, and NLD groups by emotions. To assess whether differences emerged among the groups (NVLD/GLD/NLD) on understanding the individual emotions, a one-way MANCOVA with repeated measures was conducted. Group (NVLD/GLD/NLD) served as the independent variable, the individual emotions (i.e., happy, sad, anger, fear, surprise, disgust) served as the within subjects factor being repeated and CASS: S Cognitive Problems/Inattention and ADHD subscale scores served as the covariates. Results revealed a significant overall multivariate effect for Emotion Wilks' Lambda, $\Lambda = 0.52$, ${}_{multi}F\,(5,\ 60) = 10.92$, $p < 0.001$. Univariate F test revealed a significant effect of group (NVLD/GLD/NLD) on understanding of facial expressions, $F(2,\ 64) = 5.54$, $p = 0.006$ with effect size estimated by partial eta $\eta p^2 = .148$ (large effect). No significant emotion by group interaction was uncovered. The Cognitive Problems/Inattention and ADHD subscales covariates were not significant, $F(1,\ 64) = 0.99$, *ns* and $F(1,\ 64) = 0.045$, *ns* respectively. Parameter *t* tests revealed a significant difference between the GLD and NVLD and NLD groups on only the facial expression of disgust, $t(64) = 2.40$ $p = 0.020$ and $t(64) = 2.51$ $p = 0.015$ respectively.

Social Functioning

Social Functioning among LD and NLD groups. To assess whether adolescents with LD displayed worse overall social skills and performed worse on the other individual areas of the social role-play rating scales than adolescents without LD, a one-way MANCOVA was conducted with group (LD/NLD) as the independent variable, mean scores on the individual scales of the social role-play rating scale serving as the dependent variables, and the RADS raw score and

CASS: S Cognitive Problems/Inattention subscale scores serving as covariates. Contrary to what was predicted, no significant difference was found between the LD and NLD groups on the overall social skills subscale or on any of the other individual scales of the rating system, Wilks' Lambda, $\Lambda = 0.83$, $_{multi}F(12, 54) = 0.93$, *ns* with effect size estimated by partial eta $\eta p^2 = .171$ (large effect). The RADS and Cognitive Problems/Inattention covariates were not significant, $F(12, 54) = 1.44$, *ns* and $F(12, 54) = 0.49$, *ns* respectively. The univariate F tests did not reveal any significant difference between the LD and NLD groups on the overall social skills subscale or on any of the other individual subscales.

Social functioning among NVLD, GLD and NLD groups. To assess whether adolescents with NVLD displayed poorer overall social skills and performed worse on the other individual areas of the social role-play rating scales than adolescents without LD and with GLD, a one-way MANCOVA was conducted with group (NVLD/GLD/NLD) as the independent variable, mean scores on the individual scales of the social role-play rating scale serving as the dependent variables, and CASS: S Cognitive Problems/Inattention and ADHD subscale scores serving as covariates. Results revealed no significant overall multivariate effect, Wilks' Lambda, $\Lambda = 0.63$, $_{multi}F(24, 106) = 1.18$, *ns* with effect size estimated by partial eta $\eta p^2 = .189$ (large effect). The Cognitive Problems/Inattention and ADHD subscale covariates were not significant, $F(12, 53) = 0.66$, *ns* and $F(12, 54) = 1.18$, *ns* respectively. In addition, univariate F tests did not reveal any significant difference between the NVLD, GLD and NLD groups on the overall social skills subscale or on any of the other individual subscales, thus not lending support to the hypothesis that the NVLD group would

display worse overall social skills and be worse on the individual subscales than the GLD and NLD groups on the social role-play scale. Please refer to Table 13 for descriptive statistics.

Table 13

Descriptive Statistics for NLD, NVLD, and GLD Groups on the Social Role-Play Rating System

Subscale		NLD	NVLD	GLD
	n	(23)	(23)	(23)
Overall Social Skill	*M*	7.04	6.83	6.57
	SD	0.93	0.98	0.95
Clarity	*M*	7.61	7.48	7.30
	SD	0.78	0.73	0.70
Fluency	*M*	6.96	6.83	6.78
	SD	0.88	1.40	1.04
Appropriate Affect	*M*	7.04	6.96	6.83
	SD	0.71	0.56	0.58
Flat Affect	*M*	6.61	6.78	6.17
	SD	1.56	1.04	1.40

Subscale		*n*	NLD (23)	NVLD (23)	GLD (23)
Gaze	*M*		6.87	6.87	6.57
	SD		1.18	0.55	1.31
Engagement	*M*		6.48	6.26	6.09
	SD		0.99	0.86	0.90
Meshing	*M*		6.87	6.96	7.0
	SD		1.14	1.02	0.90
Strangeness	*M*		1.09	1.04	1.0
	SD		0.29	0.21	0
Pleasantness of	*M*		7.23	7.09	6.78
Conversation	*SD*		0.95	0.73	0.9
Asks Questions	*M*		1.26	1.0	1.26
	SD		0.54	0	0.45
Social Anxiety	*M*		1.27	1.30	1.39
	SD		0.45	0.47	0.58

Note. NLD = No learning disability; NVLD = Nonverbal learning disability; GLD = General learning disability.

Neuropsychological Predictors of Facial Expression of Emotion Tasks: Exploratory Analyses

Neuropsychological predictors of recognition of facial expressions. To assess the degree to which the adolescents' scores on the visual-spatial/motor and phonetic discrimination tasks predicted their performance on the recognition task, a multiple linear regression analysis was conducted. Specifically, the model consisted of the Trail Making Test Part B, the Target Test, the Grooved Pegboard Test, and finally the Speech Sounds Perception Test. Using the Stepwise method, with $p <= 0.05$ to enter, contrary to what was predicted, results revealed that the Speech Sounds Perception Test significantly predicted the adolescents' performance on the recognition task, $F(1, 67) = 4.25, p = 0.043, r^2 = 0.060$. No other variables were found to be significant predictors of the adolescents' performance on the recognition task.

Neuropsychological predictors of expression of facial expressions. To assess the degree to which the adolescents' scores on the visual-spatial/motor and phonetic discrimination tasks predicted their performance on the expression task, a multiple linear regression analysis was conducted. Specifically, the model consisted of the Trail Making Test Part B, the Target Test, the Grooved Pegboard Test, and finally the Speech Sounds Perception Test. Using the Stepwise method, with $p <= 0.05$ to enter, contrary to what was predicted, no significant results emerged.

Neuropsychological predictors of understanding facial expressions of emotion. To assess the degree to which the adolescents' scores on the visual-spatial/motor and phonetic discrimination tasks predicted their performance on the understanding task, a multiple linear regression analysis was conducted. Specifically, the model consisted of the Trail Making Test Part B, the Target Test, the Grooved Pegboard Test, and finally the Speech Sounds Perception Test. Using the Stepwise method, with $p <= 0.05$ to enter, contrary to what was predicted, no significant results emerged.

Neuropsychological predictors of social functioning. To assess the degree to which the adolescents' scores on the visual-spatial/motor and phonetic discrimination tasks predicted their performance on the social role-play task, a multiple linear regression was conducted. Specifically, the model consisted of the Trail Making Test Part B, the Target Test, the Grooved Pegboard Test, and finally the Speech Sounds Perception Test. Using the Stepwise method, with $p <= 0.05$ to enter, the Grooved Pegboard Test Total Time Non-Dominant Hand significantly predicted the adolescents' performance on the social role-play rating system, $F(1, 67) = 7.22$, $p = 0.009$, $r^2 = 0.097$. No other variables were found to be significant predictors of the adolescents' performance on the social role-play task.

Breadth of Severity Findings: Proposed Explanation for Aspects of the Current Findings

Given the poorer performance of the GLD group on recognizing and understanding facial expressions of emotion as compared to the NVLD and NLD groups, a post hoc follow up examination of breadth of severity of LD was done.

Table 14

Breadth of Severity: Number of NVLD and GLD Adolescents who met LD Criteria Across Academic Areas

	One area on WRAT3 below 80	Two areas on WRAT3 below 80	Three areas on WRAT3 below 80
Group			
NVLD	23	6	0
GLD	12	5	6

Note. WRAT3 = Wide Range Achievement Test – Third Edition; NVLD = Nonverbal learning disability; GLD = General learning disability.

Chapter V: Discussion

The purpose of the current study was to investigate the abilities of adolescents with different subtypes of LD and without LD on different emotion processing tasks. Specifically, the ability to recognize, express, and understand six basic facial expressions of emotion was examined among adolescents with NVLD, GLD and without LD. In addition, the general social functioning of these adolescents during a casual conversational interview was assessed. The lack of previous studies assessing the abilities of adolescents with the NVLD subtype, with a GLD, and without LD on these variables was a marked advantage of the current study. The discussion of findings will focus on (a) preliminary analyses, (b) interpretation of the research hypotheses and findings, (c) limitations pertaining to the current study, and (d) implications for School Psychologists.

Preliminary Analyses

This section will discuss the findings pertaining to variables (i.e., Sex, Depression, and Attention) which have been shown to influence recognition, expression, and understanding of facial expressions of emotion.

Depression. Previous research in the area of recognition and expression of facial expressions has shown these emotion processing abilities to be influenced by depression (Kring, 2001). In addition, in the field of LD, existing literature generally indicates that children and adolescents with LD report higher levels of depressive symptoms and are at a greater risk for depression than those without LD (Bender, 1998; Heath, 1996; Heath & Ross, 2000; Heath & Wiener, 1996).

Consistent with previous literature, results of the current study revealed that adolescents with LD reported higher levels of depressive symptoms compared to adolescents without LD. However, when the LD groups were examined more homogeneously by NVLD and GLD groups, no significant differences in reported depressive symptoms emerged.

The differences between the LD/NLD groups were no longer maintained when examined by NVLD, GLD and NLD groups, as it is likely the depressive symptoms as reported by both the NVLD and GLD groups when compared separately to the NLD group which likely caused the LD/NLD difference. In fact when the GLD and NVLD groups were compared to the NLD group separately, a significant difference on the RADS between the GLD and NLD groups and between the NVLD and NLD groups emerged. Both the NVLD and GLD groups reported higher levels of depressive symptoms as compared to the NLD group. These findings suggest that the greater risk for depression previously associated with LD may not be limited to the NVLD subtype, which has been proposed (Rourke, Young, & Leenaars, 1989). Although findings from the present study are consistent with previous literature suggesting that the NVLD subtype is at greater risk for depression than students without LD (Rourke, Young, & Leenaars, 1989), students exhibiting a more generalized LD may also be at greater risk for further depression.

Attention. Consistent with previous literature (Barkely, 1998; Fletcher, Shaywitz, & Shaywitz, 1999; McKinney, Montague, & Hocutt, 1993; Reason, 1999; Robins, 1992; Tarnowski & Nay, 1989), that has found children and adolescents with LD to also have attention problems, findings from the present

study revealed that adolescents with LD reported more difficulties on the Cognitive Problems/Inattention subscale of the CASS: S as compared to those without LD. When the three group comparison (i.e., NVLD, GLD, NLD) was conducted adolescents with GLD reported more difficulties on the Cognitive Problems/Inattention and ADHD subscales of the CASS: S compared to adolescents without LD. However, no differences emerged between the NVLD and GLD nor between the NVLD and NLD groups on these subscales.

One possibility for the significant difference between the GLD and NLD groups and lack of difference between the NVLD and GLD groups and between the NVLD and NLD groups is that perhaps experiencing a GLD with more severe academic difficulties than an NVLD subtype is associated with increased problems with attention. Although the GLD groups may be experiencing more attention difficulties as compared to the NLD and NVLD groups, the GLD is likely not an Attention Deficit Disorder or an Attention Deficit Hyperactivity Disorder group given their self-reported indices on the CASS: S scales. Specifically, the GLD group did not report any of their attention difficulties to be within the clinical range, thus lending support to the notion that this group is primarily an LD group with associated attention difficulties. The observation that adolescents with NVLD reported symptom levels of inattention in between those reported by adolescents with NLD and GLD supports this contention. This suggests that perhaps adolescents with more severe LD, as demonstrated by the GLD group may place a student at an increased risk for attention difficulties.

Sex. Previous literature in the area of sex and the ability to recognize, express, and understand facial expressions of emotion has yielded mixed findings.

A few studies have generally found females to be superior to males (DePaolo & Rosenthal, 1978; Dimitrovsky et al., 2000; Hall, 1978, 1984), while others have found no significant sex differences (Buck, 1975, 1984; Custrini & Feldman, 1989; Dimitrovsky et al., 1998; Field & Walden, 1982; Holder & Kirkpatrick, 1991; Kirouac & Dore, 1985; Nabuzoka & Smith, 1995; Philippot & Feldman, 1990; Shields et al., 2001).

In the current study whether males and females differed in their ability to recognize, express, and understand facial expressions of emotion was examined. In addition, whether males and females differed in their social functioning was investigated. Results revealed a significant effect of sex limited to understanding of facial expressions of emotions, with females being significantly more accurate than males. The mixed results of the present study are reflective of the previous contradictory findings in the field of sex and emotion processing (Buck, 1975, 1984; Custrini & Feldman, 1989; DePaolo & Rosenthal, 1978; Dimitrovsky et al., 1998; Dimitrovksy et al., 2000; Field & Walden, 1982; Hall, 1978, 1984; Holder & Kirkpatrick, 1991; Kirouac & Dore, 1985; Nabuzoka & Smith, 1995; Philippot & Feldman, 1990; Shields et al., 2001). The fact that in the current study females were more accurate than males only on understanding facial expressions of emotion and not on recognition, expression, nor social functioning may also be partly due to the uniqueness of the sample, which consists of two-thirds LD. Future studies need to be conducted examining sex and recognition, expression, and understanding facial expressions of emotion, as well as social functioning among general and LD populations to provide further clarification.

Interpretation of the Research Hypotheses and Findings

Confirmation of groups. In the current study, adolescents with NVLD performed significantly worse than adolescents without LD on the Trail Making Test Part B and not on the Target Test or Grooved Pegboard Test. The significant difference between the NVLD and NLD groups on the Trail Making Test Part B used in this study is generally consistent with previous findings (Harnadek & Rourke, 1994) and provides further evidence for the accurate grouping of the adolescents into the NVLD category in the present study. In addition, the fact that no significant difference emerged between the GLD and NLD groups on the Trail Making Test Part B and that adolescents with GLD were more similar to those without LD on this measure than to adolescents with NVLD, provides additional support for group membership.

The non-significant findings between the NVLD, GLD, and NLD groups on the Target Test and the Grooved Pegboard test are inconsistent with previous research where differences emerged between children with NVLD and without LD on visual-spatial working memory and visual-spatial tasks (Cornoldi et al., 1999; Ozols & Rourke, 1988, 1991; Siegel & Linder, 1984; Siegel & Ryan, 1989). One explanation for these conflicting results may be that previous studies assessed differences on these tasks between children, whereas the present study employed a sample of adolescents. Specifically, adolescents are developmentally different from children and perhaps as children with NVLD develop, these areas which may have previously been deficits are no longer causing as much difficulty.

Another possible explanation for the contradictory findings from previous studies (Cornoldi et al., 1999; Ozols & Rourke, 1988, 1991; Siegel & Linder,

1984; Siegel & Ryan, 1989) is the different assessments that were used in the current study. Although the measures used in previous studies did assess general visual-spatial working memory and visual-spatial skills the Target Test and Grooved Pegboard Test were not specifically used. For example, in Cornoldi et al. (1999) the tasks that were used assessed both visual-spatial working memory and visual-spatial imagery, which required participants to recall the names and positions of familiar and unfamiliar objects, as well as mental imagery of familiar objects. In Siegel and Linder (1984) and Siegel and Ryan (1989), participants were asked to recall words and numbers when presented visually and verbally. Perhaps in completing the Target Test and the Grooved Pegboard Test different elements of visual-spatial skills were required as compared to those outlined in the previous studies.

The use of the Target Test and the Grooved Pegboard Test in the current study was based on a study by Harnadek and Rourke (1994) wherein they found these measures to correlate with part of the variance that discriminated an NVLD group from those whose LD was more within the language area among students 9 to 14 years of age. The older age range (i.e., 12-15 years) of the adolescent sample used in the current study may account for the divergent results from Harnadek and Rourke. Specifically, these particular measures may have been too easy for the adolescents in the present investigation given their age range and therefore all of the adolescents regardless of group (NVLD/GLD/NLD) performed well. In fact, when the specific mean scores were examined, a general ceiling effect emerged for all three groups on these measures. Perhaps at an older age of

development, the fundamental visual-spatial skills which are essential to the accurate completion of the Target Test and Grooved Pegboard Test are significantly improved. Given the maturation into the period of adolescence, the particular skills as measured by the Target Test and Grooved Pegboard Test may be less critical in causing the visual-spatial deficits that have been shown to occur in children. In future, studies could investigate the development of visual-spatial assets and deficits among LD and non-LD populations longitudinally using the Target Test and the Grooved Pegboard Test. In addition, future research could examine the visual-spatial skills among adolescents with NVLD relative to those with a more generalized LD and without LD using tasks more similar to the ones employed in previous studies (Cornoldi et al., 1999; Siegel & Linder, 1984; Siegel & Ryan, 1989).

In the current study, adolescents with GLD performed significantly worse on the Speech Sounds Perception Test compared to the NLD group. The significant difference that emerged between the GLD and NLD groups on this task further corroborates the accuracy of the groups (NVLD/GLD/NLD). In addition, the non-significant finding between adolescents with NVLD and without LD on this measure provides further support for the appropriateness of the groups. No significant difference was found between the NVLD and GLD groups on the Speech Sounds Perception Test; however, the adolescents with NVLD were more similar to adolescents without LD than adolescents with GLD, and thus their difficulties on this measure appear to lie somewhere in between these two groups.

Recognition of Facial Expressions

Recognition of facial expressions among sample. The hypothesis that the adolescents in general would be more accurate at recognizing the facial expression of happiness compared to the other emotions was supported. This finding is consistent with previous studies examining facial expression recognition accuracy among pre-school aged children (Field & Walden, 1982; Walden & Field, 1982), school-age children (Custrini & Feldman, 1989) and adults (Kirouac & Dore, 1983, 1985), which have found happiness to be the most easily recognized facial expression.

Even within the field of LD, children and adolescents regardless of LD/NLD group or subtype of LD have been found to be more skilled at recognizing the facial expression of happiness than the more difficult emotions of fear and disgust (Dimitrovsky et al., 1998; Holder & Kirkptarick, 1991; Nabuzoka & Smith, 1995), which is consistent with the results of this study. Nevertheless, the present finding serves to advance the field of LD by demonstrating that even among a sample of adolescents with NVLD, GLD, and without LD happiness still remains the most accurately recognized facial expression of emotion. Also the consistency of these findings with previous literature serves to corroborate the validity of the methodology of facial recognition used in the present study.

Recognition of facial expressions among LD/NLD groups and LD subtypes. The hypothesis that adolescents with LD would be less accurate overall at recognizing facial expressions of emotions than adolescents without LD was supported. This finding is in line with previous studies examining facial expression recognition within the field of LD, which have consistently found

children and adolescents with LD to be less accurate at recognizing facial expressions of emotion compared to those without LD (Holder & Kirkpatrick, 1991; Most & Greenbank, 2000; Nabuzoka & Smith, 1995). Yet, given the limited number of studies assessing recognition of facial expressions among adolescents with LD, the current finding adds to the present literature. Specifically, this result expands current research within the field of LD by providing more evidence and support that adolescents with LD when studied as a heterogeneous LD sample are less accurate at recognizing facial expressions of emotions than adolescents without LD.

The hypothesis that adolescents with NVLD would be less accurate overall at recognizing facial expressions of emotions compared to those with GLD or without LD was not supported. Contrary to the prediction, it was discovered that adolescents with GLD were significantly worse at recognizing facial expressions of emotions than adolescents with NVLD and without LD, with no difference between the NVLD and NLD groups. The lack of difference between the NVLD and NLD groups is inconsistent with previous studies that have found children with NVLD to be less accurate at recognizing facial expressions than children without LD (Dimitrovsky et al., 1998; Dimitrovsky et al., 2000; Petti et al., 2003).

One possible explanation for these conflicting results is the different age groups used in the current and previous studies. Specifically, the present study examined differences in recognizing facial expressions of emotions between adolescents aged 12 to 15 years with NVLD and without LD, whereas other studies have focused almost exclusively on children (Dimitrovsky et al., 1998;

Dimitrovsky et al., 2000; Petti et al., 2003). Although children with NVLD at a younger age (i.e., less than 12 years) have been found to experience difficulties in recognizing facial expressions of emotion, perhaps during the period of adolescence their difficulties in recognizing the six primary facial expressions are more subtle. Although adolescents with NVLD still likely exhibit difficulties in recognizing basic and more complex facial expressions, perhaps because of their strengths they have developed basic global skills, which diminish their difficulties in facial recognition. Thus, adolescents with NVLD tend to perform similarly to adolescents without LD in recognizing facial expressions of emotions. In future, longitudinal studies examining the developmental course of facial expression recognition among children and adolescents with NVLD and without LD could be conducted to further clarify these issues.

The significant finding that the GLD group was worse at recognizing facial expressions than the NVLD and NLD groups is inconsistent with previous studies, which have almost exclusively focused on children with LD subtypes in assessing facial expression recognition (Dimitrovsky et al., 1998; Dimitrovsky et al., 2000; Petti et al., 2003). Specifically, Dimitrovksy et al. and Dimitrovsky et al. found children with NVLD to be less accurate at recognizing facial expressions of emotion compared to those without LD and with verbal LD; however, children with NVLD were just as inaccurate as children with combined nonverbal and verbal LD. One possible explanation for the significantly poorer performance of the GLD group as compared to the NVLD group in the current study is the differences which emerged between the GLD and NVLD groups in terms of their severity of LD.

In an attempt to provide an explanation for the differences in facial expression recognition between the GLD and NVLD groups, the breadth of severity across areas (i.e., number of academic areas classified as LD) was examined. Specifically, it was observed that half of the GLD group displayed significant difficulties (i.e., Standard Scores 80 or below on the WRAT3) in at least two areas of academic achievement, whereas only one-third of the adolescents within the NVLD group exhibited such difficulties. By classification of the NVLD group, it was not expected that any of them would have difficulties in all three areas of academic achievement (as by definition the NVLD group had a Standard Score of 85 or above on the Reading subtest). However, given the classification of the GLD group (i.e., at least one area of academic achievement with a Standard Score below 80), it was not necessarily anticipated that half of the GLD group would experience significant difficulties in at least two areas of academic achievement. These findings indicate that the breadth of severity of LD across areas was greater for the GLD group and may explain their poorer performance at recognizing facial expressions of emotions as compared to the NVLD and NLD groups. Perhaps during the period of adolescence, the extent of the severity of an LD may be a more salient contributor to facial recognition difficulties than the specific LD subtype. Please refer to Table 14 in the results section for the breadth of severity between the GLD and NVLD groups.

In an effort to generate some results to support the hypothesis about the possible importance regarding the breadth of severity across academic areas in relation to facial expression recognition, the adolescents were grouped by severity and compared on the recognition task. In general, there was a significant

difference based on severity such that adolescents with three areas of academic achievement with a standard score of 80 or below were significantly worse at recognizing facial expressions of emotion as compared to those without LD or with one area of academic achievement with a standard score of 80 or below on the WRAT3. However, given the small sample size of the most severe LD group (n = 6), one must interpret this result with caution. Nonetheless, these findings suggest that severity of the breadth of LD may be an important factor in the ability to recognize facial expressions of emotions and demonstrates the value of assessing this variable as it relates to emotion processing in future studies.

These findings highlight the fact that children with a particular subtype (NVLD) of LD, which has previously been hypothesized as being the salient factor in leading to difficulties in reading nonverbal cues (i.e., facial expressions of emotions) may not be as important among a sample of adolescents with NVLD, GLD, and without LD. Perhaps during adolescence, the previous difficulties among children with NVLD are more subtle and may no longer be discernable. The breadth of severity of LD across academic areas of difficulty as displayed by the adolescents with GLD may be an important contributing factor to their current difficulties in facial expression recognition. Additionally, the fact that Dimitrovksy et al. (1998) and Dimitrovsky et al. (2000) and Petti et al. (2003) did not provide evidence of severity for the sample of LD subtypes used in their study highlights the possibility that during adolescence it is the students with the most severe LD who continue to have difficulties recognizing facial expressions of emotions regardless of subtype. In contrast, adolescents with NVLD at this age

may have developed general skills which reduce their previous difficulties in facial expression recognition or perhaps their LD is more mild in nature.

One possible explanation for the breadth of severity of LD across academic areas leading to more difficulty in recognizing facial expressions is the that perhaps there is a common cognitive mechanism that underlies the breadth of severity of academic difficulties that leads to their difficulties in recognizing facial expressions. This is not to say that it is the academic difficulties that leads to the increased difficulty in recognizing facial expressions of emotion among adolescents with GLD as compared to adolescents with NVLD and without LD, but perhaps a common cognitive element such as meta-cognition underlies such deficits. However, this remains purely a matter of conjecture.

Recognition of facial expressions among NVLD, GLD, and NLD groups by emotion. The hypothesis that adolescents with NVLD would be less accurate at recognizing the more difficult emotions than adolescents with GLD and without LD, whereas no differences would emerge among the groups in the recognition of the easier emotions was somewhat supported. Specifically, in terms of the easier emotions (i.e., happy, sad, anger) no differences emerged between the GLD, NVLD or NLD groups. This finding is consistent with previous literature, with the exception of the facial expression of anger where a difference was discovered between children with and without LD subtypes (Dimitrovsky et al., 1998). Nevertheless, the present finding serves to extend the field of LD by demonstrating that by adolescence students with NVLD, GLD, and without LD are able to recognize the easier facial expressions of emotions with a similar level of accuracy.

In terms of the more difficult emotions (i.e., fear, surprise, disgust) the GLD group was less accurate overall at recognizing the facial expressions of fear compared to the NVLD and NLD groups and disgust compared to the NVLD group. The NVLD and NLD groups did not differ from each other in recognizing any of the difficult facial expressions. This is somewhat consistent with previous studies in terms of the difficulty of the facial expression of emotion, but not in terms of the group effect (i.e., GLD/NVLD).

Specifically, Dimitrovsky et al. (1998) found children with NVLD to be poorer at recognizing the facial expressions of anger, surprise, fear, and disgust than children without LD and only on the facial expression of disgust compared to children with verbal LD. Similar to previous findings (Dimitrovsky et al., 1998) differences in the current study between the GLD and NVLD and NLD groups emerged for the more difficult facial expressions of fear and disgust. Therefore, the present findings are generally consistent to those of Dimitrovsky et al. such that group differences were observed for the type of facial expression, namely for the more difficult facial expressions of emotion.

The fact that Dimitrovsky et al. (1998) used children may explain why no differences were found in the present study between the GLD and NVLD and NLD groups for the facial expressions of anger and surprise. Previous studies within the general population in the area of facial expression recognition have shown this process to improve with age (Camras & Allison, 1985; Ekman & Oster, 1982; Monfries & Kafer, 1987). One possible explanation for the lack of difference between the groups on the facial expressions of anger and surprise is that adolescents were examined in the present study. There is evidence to suggest

that adolescents with and without LD have the most difficulty recognizing the facial expressions of fear and disgust (Holder & Kirkpatrick, 1991). Perhaps at this particular age of development it is the more subtle and difficult facial expressions such as fear and disgust that cause the most difficulty for adolescents with GLD.

Expression of Facial Expressions of Emotions

Expression of facial expressions among sample. The hypothesis that adolescents would be more accurate at expressing the facial expression of happiness compared to the other emotions was supported. This finding is consistent with previous studies examining facial expression abilities of pre-school age children (Boyatzis & Satyaprasad, 1994; Field & Walden, 1982; Walden & Field, 1990; Zuckerman & Przewuzman, 1979) and adults (Lewis et al., 1987) when asked directly to express facial expressions. Specifically, Field and Walden (1982) and Lewis et al. (1987) found pre-school age children and adults made fewer errors and easily conveyed the facial expression of happiness as compared to any of the other emotions (i.e., sadness, anger, fear, surprise, disgust), which is consistent with findings from the current study. In addition, children have also been shown to be more accurate at expressing the facial expression of happiness when looking at emotion-invoking scenarios (Custrini & Feldman, 1989).

The order of accuracy in expressing the facial expressions of emotion, namely happiness being the most accurately expressed followed by sadness, anger, disgust, surprise, and fear by the adolescents in the current study is also found to be generally consistent with previous findings using pre-school age

children (Boyatzis & Satyaprasad, 1994; Field & Walden, 1982; Walden & Field, 1990; Zuckerman & Przewuzman, 1979) and adults (Lewis et al., 1987). These findings demonstrate that even among a sample of adolescents with NVLD, GLD, and without LD, happiness remains the most accurately expressed facial expression of emotion.

Expression of facial expressions among LD/NLD groups and LD subtypes. Contrary to what was predicted, the hypothesis that adolescents with LD would be poorer at expressing facial expressions as compared to adolescents without LD was not supported. Additionally, no significant difference was found between the NVLD, GLD and NLD groups in their abilities to express facial expressions of emotion. These non-significant results between the groups were not a function of the adolescents feeling negatively towards expressing emotions. When asked directly about whether they felt it was 'good' or 'bad' to express emotions through their face, the majority (97%) of the adolescents felt it was positive to express facial expressions of emotion.

One possible explanation for the lack of significant difference between any of the groups may be the ease of this expression task for adolescents. Although previous studies have used this method of measuring facial expression abilities in the general population examining pre-school age children (Boyatzis & Satyapresad, 1994; Field & Walden, 1982; Walden & Field, 1990; Zuckerman & Przewuzman, 1979), this task may have been too easy for adolescents given their age. In fact, all of the adolescents regardless of group (NVLD/GLD/NLD) were rated by independent judges as being accurate at expressing the facial expressions of emotion (i.e., facial expression that the adolescent was asked to produce

corresponded to the facial expression as rated by judge) between 74% and 81% of the time.

In contrast, pre-school age children were found to have difficulty on this task (Boyatzis & Satyaprasad, 1994). Consequently, the difference in age between the sample used in the current study (i.e., adolescents) to those used in previous studies (i.e., pre-school) may explain the adolescents' performance and subsequently the lack of difference between the groups. In addition, qualitative informal comments from the judges indicated that they generally thought the adolescents facial expressions were to some extent exaggerated. Given the nature of the task (i.e., posed facial expressions) making exaggerated facial expressions may be more likely to occur during the developmental period of adolescence than in pre-school, as young children may not realize the possibility of exaggeration.

The non-significant finding between adolescents with NVLD, GLD, and without LD on their overall mean certainty ratings as given by the judges adds support to the explanation that the facial expression task may have been too easy for the adolescents. Specifically, the judges were equally certain in their ratings in terms of accuracy of expressing facial expressions of emotion between the NVLD, GLD, and NLD groups. Based on these findings, the judges overall mean certainty ratings generally ranged from Moderately Sure to Pretty Sure. This illustrates that the judges were generally certain about the accuracy of the adolescents' facial expressions. In addition, contrary to what was predicted no significant difference emerged between adolescents with NVLD and those with GLD and NLD on the number of controversial ratings given by the judges. The results that all three groups received a similar number of controversial ratings

(i.e., when two judges disagree about the facial expression being expressed) provides additional evidence that the adolescents performed similarly on this task based on the judges general agreement.

However, the lower mean Kappa values of the GLD group as compared to the NLD and NVLD groups may reflect to some extent either the more difficult nature in the judges being able to agree on the faces being produced by these adolescents or their somewhat poorer ability to express facial expressions of emotions. Given the ease of the expression measure as well as the notion that the adolescents were all generally good at expressing facial expressions, perhaps the expression measure was not sensitive enough to distinguish the subtle differences between the groups, which may be an indication of the lower mean Kappa values for the GLD group. In future, studies need to develop and use more challenging emotion expression tasks which will not suffer from the ceiling effect observed on the present task.

The hypothesis that adolescents with NVLD would be less accurate at expressing the more difficult emotions than adolescents with GLD and without LD, whereas no differences would emerge among the groups in the recognition of the easier emotions was somewhat supported. Specifically, in terms of the easier emotions (i.e., happy, sad, anger) no differences emerged between the GLD, NVLD or NLD groups. However, the lack of difference between the groups on expressing the easier emotions should be interpreted with caution given the ease of the task.

Understanding Facial Expressions of Emotions

Understanding of facial expressions of emotions among sample. Contrary to the hypothesis that happiness would be the most accurately understood facial expression among the adolescents, sadness was the most accurately understood. In terms of the order of accuracy, sadness was the most correctly understood emotion, followed by disgust, then happiness, anger, surprise, and fear. This finding is somewhat inconsistent with previous studies examining the understanding of facial expressions of emotion within the general population.

Specifically, Philippot and Feldman (1990) found happiness to be understood most easily (i.e., least amount of errors when assessed this emotion) in a sample of pre-school age children. Similarly, Ellis et al. (1997) found children and adolescents with emotional and behavioral disorders and Singh et al. (1998) found children with attention deficit hyperactivity disorder to understand facial expressions of emotion in generally the following descending order of accuracy: happiness, sadness, disgust, anger, surprise, and fear. Although the present study's findings are somewhat conflicting with these previous studies in terms of the exact order of accuracy, there are general similarities in terms of anger, surprise, and fear being the most difficult emotions to be understood and sadness, happiness, and disgust being the easiest.

One possible explanation for the variation in order found in the current study is the added visual component of the story, which was not present in previous studies. In addition to the typical verbal statement (e.g., "if your pet dog got run over by a car and died") the visual element (e.g., a picture of a dog underneath a car) may have accentuated the verbal story making facial

expressions that have been previously found to be more difficult to understand (i.e., sadness) more easily understood. Perhaps in the present study the use of two different modalities (i.e., verbal and visual) to represent a story enabled the adolescent to receive an amalgamated portrayal of the story, which would not be evident when using a single approach. The multipart depiction of the story may have helped the adolescents understand some of the emotions easier than others. Consequently, the increased understanding in the current study likely occurred for facial expressions of emotions that have been found to be more difficult when only a verbal piece was used (Ellis et al., 1997; Singh et al., 1998). Although the exact order of accuracy does tend to vary depending on the sample of participants being assessed, there is a common agreement that fear and surprise are the most difficult facial expressions of emotion to understand, which is consistent with the current findings.

Understanding facial expressions of emotions among LD/NLD groups and LD subtypes. The non-significant finding between the LD and NLD groups on understanding of facial expressions of emotion does not lend support to the hypothesis that adolescents with LD would be less accurate than adolescents without LD on this task. In addition, the hypothesis that adolescents with NVLD would be less accurate overall at understanding facial expressions of emotions compared to those with GLD and without LD was not supported. Contrary to what was predicted, adolescents with GLD were significantly worse at understanding facial expressions of emotions as compared to adolescents with NVLD and without LD, whereas no differences emerged between the NVLD and NLD groups. One possible explanation for the non-significant finding between the

LD and NLD groups is that the NVLD group performed similarly to the NLD group in their level of accuracy at understanding facial expressions of emotions. Consequently, when a two group (LD/NLD) comparison was conducted no differences emerged as it is solely the GLD group that experienced significant difficulties on this task.

The accuracy level of the NVLD group on the understanding task increased the overall mean score of the LD group, thus creating a non-significant LD/NLD group finding. Another possible explanation for the lack of difference between the LD and NLD groups is that in addition to the verbal component used in previous studies (Ellis et al., 1997; Singh et al., 1998), the current study had a visual piece in the understanding task. The extra modality, namely the visual depiction of the story, may have made it easier for adolescents with NVLD to understand facial expressions of emotion, thus diminishing any possible differences between the LD and NLD groups.

In contrast to the non-significant finding between the LD and NLD groups, a significant difference did emerge when the subtypes were examined. Specifically, adolescents with GLD were poorer at understanding facial expressions of emotion as compared to those with NVLD and NLD, with no difference between the NVLD and NLD groups. Although no studies have directly assessed the abilities of adolescents with NVLD, GLD, and without LD to understand facial expressions of emotion, one possible explanation for the current findings is the same as that given for the poor performance of GLD group on emotion recognition. Specifically, that it is the severity of the LD, not necessarily the particular subtype of LD that dictates such difficulties. Adolescents with GLD

also exhibited the most severe LD in terms of the breadth of LD (i.e., number of academic areas classified as LD). These findings serve to advance the field of LD by showing that the severity of an LD may play a role in both recognition and understanding of facial expressions of emotion among adolescents with LD.

Understanding of facial expression among NVLD, GLD, and NLD groups by emotions. The hypothesis that adolescents with NVLD would be less accurate at understanding the more difficult emotions than adolescents with GLD and without LD, whereas no differences would emerge among the groups in the understanding of the easier emotions was somewhat supported. Specifically, in terms of the easier emotions (i.e., happy, sad) no differences emerged between the GLD, NVLD or NLD groups.

In terms of the more difficult emotions (i.e., fear, surprise, disgust) the GLD group was less accurate overall at understanding the facial expressions of only disgust compared to the NVLD and NLD groups who did not differ from each other. The finding that the GLD group performed significantly worse than the NVLD and NLD groups on only the facial expression of disgust as opposed to even the more difficult facial expressions of emotions (i.e., fear or surprise) was somewhat surprising. One possible explanation for these findings is that in previous studies (Ellis et al., 1997; Singh et al., 1998) the understanding task solely used a verbal story, whereas the current study used both a verbal and visual representation of the story. The extra visual element may have made some of the stories easier to understand than others. Specifically, perhaps the understanding of disgust was more difficult for the GLD group because of the cognitive inference required. For example, the visual depiction accompanying the sadness story was

a dog lying underneath a car, whereas for disgust the visual depiction was a man exuding a smelly odor. Perhaps the GLD group had significant difficulty understanding disgust because of the complexity of the story and the deductive reasoning required, which may not have occurred for fear and sadness. No previous studies have directly examined the abilities of adolescents with NVLD, GLD, or without LD to understand facial expressions of emotion. Nevertheless these findings add to the field of LD by demonstrating that the subtleties in facial expressions influence the degree of understanding among adolescents with a NVLD subtype, a generalized LD, and without LD.

Social Functioning

Social functioning among LD/NLD groups and LD subtypes. The hypothesis that the LD group would display fewer overall social skills and perform worse on the other individual subscales on the role-play rating sheet as compared to the NLD group was not supported. No significant differences emerged between the LD and NLD groups on any of the subscales of this measure. In addition, contrary to what was predicted, that adolescents with NVLD would display poorer overall social skills and perform worse on the other individual subscales as compared to those with GLD and NLD, no significant differences were found between the adolescents with NVLD, GLD, and without LD.

One proposed explanation for the lack of significant difference between adolescents with and without LD, as well as between the adolescents with NVLD, GLD and without LD may be a result of the particular measure that was used. Specifically, social functioning in the current study was assessed using an

unstructured role-play test (i.e., a simulated casual social interview/interaction) similar to that described by Penn et al. (1995). Although Penn et al. did find a relationship between social skills and cognitive functioning when using a similar role-play rating sheet to the current study, the sample used by Penn et al. involved adults diagnosed with schizophrenia. Individuals with schizophrenia have consistently been found to have obvious impairments in social skills (Baum & Walker, 1992; Lenzenweger & Dworkin, 1996; Tien & Eaton, 1992; Walker, 1994) and deficits in social functioning are one of the key features of this disorder (American Psychiatric Association, 1994). Consequently, the broad nature of this role-play measure was likely sensitive to the obvious deficits in social functioning often seen among individuals with schizophrenia. However, it is possible that the lack of difference between the NVLD, GLD, and NLD groups in the current study may be a function of the measure not being precise enough to capture the subtle nonverbal and verbal social skill deficits of adolescents with and without LD subtypes.

The literature documenting the social skills of adolescents with LD using rating scale assessments suggest that adolescents with LD have poorer social skills as compared to adolescents without LD based on ratings from different informants (Bryan, 2005; Kavale & Forness, 1996; Most & Greenbank, 2000; Tur-Kaspa, 2002). In addition, in a study assessing the audio taped conversation and social problem solving skills of adolescents with and without LD, both groups were equally good at asking advice; however, adolescents with LD were found to have difficulty producing solutions to interpersonal problems (Hartas & Donahue,

1997). Although few studies have directly assessed the social skills of LD populations using an unstructured interview design, Bryan et al. (1980) in their study with children 9 to 11 years of age found those with LD had less eye contact when speaking with the interviewer and had more difficulty with the use of filled pauses as compared to children without LD.

Similarly, Gross-Tsur et al. (1995) demonstrated that a sample of medically referred children (M = 9.5 years) consisting of various diagnoses, including NVLD, exhibited flat or atypical prosody of speech and minimal eye contact during an unstructured interview. The method of measuring these indices of verbal and nonverbal social skills differed between these studies and the current study; however, the particular skills (i.e., eye contact, affect, degree of pauses) that were assessed were similar. The fact that the samples studied by Bryan et al. and Gross-Tsur et al. consisted mainly of children may account for such differences in findings from the current study. Specifically, as adolescents with LD have developed to some extent, they may have more subtle social skills difficulties as compared to those often exhibited by children with LD. In fact, in the present study the NVLD, GLD, and NLD groups were rated as generally exhibiting 'good' overall social skills on a 9-point likert-scale. Despite the scarcity of longitudinal studies directly examining the developmental trajectory of social functioning among LD populations, it has been suggested that students with LD do show improvements in relation to aspects of their social functioning as they age (Tur-Kaspa & Bryan, 1994; Wong & Donahue, 2002).

Neuropsychological Predictors of Recognition, Expression, Understanding and Social Functioning

The exploratory research questions as to whether the adolescents' performance on the Trail Making Test Part B, the Target Test, The Grooved Pegboard Test, and the Speech Sounds Perception Test predicts their performance on the Recognition, Expression, Understanding, and Social Functioning tasks was examined. Exploratory analysis revealed that the adolescent's performance on the Expression and Understanding Tasks were not predicted by his/her performance on any of the neuropsychological measures (i.e., Trail Making Test Part B, Target Test, Grooved Pegboard Test, Speech Sounds Perception Test). Although the adolescent's performance on the Grooved Pegboard Test based on his/her Non-dominant hand was a significant predictor of the Overall Social Skills subscale on the social role-play task, it accounted for quite a small proportion of the variance (8.4%). It was also observed that the adolescents' performance on the Speech Sounds Perception Test did significantly predict performance on the recognition task. However, the proportion of the variance that was accounted for by this variable was quite small (4.6%). This finding is not surprising considering the fact that adolescents who did poorly on the Speech Sounds Perception Test also did poorly on the recognition task.

The pattern of neuropsychological assets and deficits often exhibited by adolescents with NVLD has been widely delineated (Rourke, 1993; Rourke & Tsatsanis, 1996). The poor reading of non-verbal cues and recognition abilities has been suggested to be related to the particular deficits visual/perceptual/organizational skills often seen among adolescents with NVLD

(Rourke, 1999). Although there is limited research in this area, Williams (1996) examined the relationship between performance on visual-perceptual measures and recognition of facial expressions among children with NVLD. Specifically, the two measures of visual-perceptual ability used by Williams, in his doctoral dissertation did not predict performance on the facial expression recognition task. Although the visual-perceptual measures used in the current study were not the same measures, presumably they were measuring the same underlying construct of visual-spatial-perceptual abilities.

The results of the current study are consistent with those of Williams and suggest that these particular neuropsychological measures may be useful in terms of highlighting the particular areas where adolescents with NVLD may be having difficulty. However, given the small variances accounted for by the Grooved Pegboard Test and the Speech Sounds Perception Test these particular neuropsychological measures may not have much functional predictive value regarding an adolescent's performance on specific emotion tasks. In addition, consistent with previous findings current results suggest that the abilities of adolescents with NVLD, GLD, and without LD to recognize, express, and understand facial expressions of emotions, as well as their social functioning, may not be accounted for solely by their neuropsychological assets and deficits.

Conclusion

In summary, based on the literature reviewed combined with the results from the current study, a possible developmental pattern for children with NVLD may be proposed. Specifically, prepubertally children with NVLD have been shown to exhibit significant difficulties in recognizing facial expressions of

emotion (Dimitrovksy, et al., 1998; Dimitrovksy et al., 2000; Petti et al., 2003). However, findings from the current study would suggest that during the developmental period of adolescence, students with NVLD may no longer lag behind their non-LD peers on various indices of facial expression of emotion processing. Although adolescents with NVLD performed similarly to those without LD on the emotion processing tasks in the current study, adolescents with NVLD still likely experience subtle difficulties in these areas. This study in no way claims to suggest that adolescents with NVLD do not exhibit social difficulties. Based on the literature reviewed, there is a considerable amount of consistent evidence suggesting that adolescents with NVLD experience social difficulties and have trouble comprehending general nonverbal cues. This is merely one study and to provide further evidence would need to be replicated. However, the current study does offer a possible explanation that during the developmental period of adolescence with NVLD, their abilities within basic levels of emotion processing (i.e., recognition, understanding) may improve, but social difficulties within a larger situational context are likely still evident.

In contrast, the GLD group performed significantly worse than the NVLD and NLD groups on recognition and understanding facial expressions of emotion. This may in part be due to the severity of the GLD group in terms of their breadth of academic difficulties across areas. Perhaps when children with GLD develop into adolescents, the difficulties in these emotion processing tasks that they likely had as children still remain. These findings add to the field of LD by demonstrating that although examining a subtype of LD with assets and deficits is important, by adolescence severity of LD may be more critical than subtype of

LD in emotion processing skills. Thus, as Nabuzoka and Smith (1995) suggested there may well be a "social developmental lag' for children with NVLD.

Although it was suggested throughout the literature review that age may be an important factor within the area of processing of facial expressions of emotion, given the narrow age span within the NVLD, GLD, and NLD groups the possibility of an age difference on the dependent variables was not tested in the current study. However, to further elucidate the hypothesis set forth regarding the developmental lag in facial expression recognition among individuals with NVLD, future studies could address this issue by assessing these skills among NVLD groups with a larger age span, perhaps that straddles both childhood and adolescence (i.e., 8 to 15 years of age). In addition, future studies need to examine the severity of LD in conjunction with these emotion processing skills at a younger age. Further, examining recognition, expression, understanding of facial expressions of emotion, as well as social functioning using longitudinal studies may shed some light on these important issues.

Limitations of the Current Study

There are a number of limitations that must be mentioned. First, and most importantly, every attempt was made to obtain an adolescent verbal learning disability (VLD) comparison group; however, given the difficult nature of finding these particular adolescents, a GLD comparison group was used instead. This may be regarded as a limitation as previous studies examining facial expression recognition in LD subtypes have included a VLD comparison group, without investigating the nature of severity (Dimitrovsky et al., 1998; Dimitrovksy et al., 2000; Petti et al., 2003). Although one may view having a GLD group and not a

VLD group as a potential weakness, considering the findings of the current study it may also be considered a strength. Specifically, the adolescent GLD group in this study highlights the importance of examining the severity of an LD as related to aspects of emotion processing (i.e., recognition, expression, and understanding facial expressions, as well as social functioning).

Secondly, it is important to be aware of the ease with which the adolescents in this study performed on some of these measures (i.e., Target Test, Grooved Pegboard Test, Expression task). The use of these measures in the present study was based on previous research (Boyatzis & Satyapresad, 1994; Field & Walden, 1982; Harnadek & Rourke, 1994; Walden & Field, 1990; Zuckerman & Przewuzman, 1979); however, these studies focused mainly on children. Although the use of these measures may be considered a constraint, it may also be deemed an asset as it demonstrates the need for better developed measures to assess these skills in adolescents. The lower Kappa ratings for some of the emotions (i.e., fear, surprise, disgust) as compared to others (i.e., happy, sad, anger) within the expression measure is not particularly surprising given that there is much evidence to suggest that fear, surprise, and disgust are considered the more difficult facial expressions of emotions to read. However, in addition to the ease in which the adolescents performed on the expression measure, the lower Kappa values for some of the more difficult emotions as well as for the GLD group in general may have also confounded the results on this particular task.

Third, given the low return rate (17.9%) of the consent forms by the adolescents, a note of caution is necessary. Although the return rate was not typical of general research studies, given the adolescent population, the low return

rate was not surprising. In fact, after speaking with high school principals, they stated that a return rate of 10-20% was what they generally obtained for permission slips. Nonetheless, the low return rate is still considered a limitation as research, not necessarily studying adolescents, generally obtains higher return rates. In addition, as the majority of the adolescents within the present study were Caucasian (i.e., 85%), a note of caution is necessary is terms of generalizing the results to other ethnic and cultural groups. Subsequently, one must be careful to not misinterpret the present findings as being entirely applicable to adolescents from various ethnicities and cultures.

Fourth, the SES level of the adolescents within the study was assessed using their parent's occupations; however, SES generally encompasses more than income or occupation, such as level of education. This information was not attainable in the current study and the SES level of the adolescents was an approximation and subsequently one must be cautious in the interpretation of its meaning and generalization.

Finally, it could be argued that the NVLD group in the present study is generally an arithmetic disability group; however, the distinction between students with NVLD and arithmetic disabilities within the field of LD appears to be somewhat unclear. Specifically, studies using the semantic distinction of labeling their participants as either exhibiting a NVLD or an arithmetic disability have demonstrated that both groups tend to experience difficulties within the area of arithmetic and visual-spatial-organizational skills with strengths in reading and verbal abilities (Shafir & Siegel, 1994; Siegel & Ryan, 1989; Rourke, 1989, 1993). In the present study the fact that students who were classified as having a

NVLD were significantly worse on the Trail Making test Part B, which measures visual-spatial-organizational skills, provides confirmatory support for the classification of students with NVLD. However, the fact that the neuropsychological measures were not used as part of the original classification criteria for the NVLD group, apriori, when the groups were first established, could be considered as a limitation within the current study.

Implications for School Psychologists

Despite a great deal of media coverage and general information to the public on NVLD being at risk for social problems in adolescents (ldonline.org, nldontheweb.org), it may be that the more severe the breadth of the LD the greater the risk for the adolescent for social problems. The issue of adolescents with NVLD being severely at-risk for social difficulties may partly be a premature contention as research within this area is still limited. This has implications for school psychologists working with these adolescents in terms of their awareness of these issues.

Secondly, this study has implications for School Psychologists who conduct social skills groups. Specifically, the nature of the LD that an adolescent is experiencing could possibly be an important consideration in planning these groups. Additionally, adolescents with LD who are experiencing social difficulties may benefit from direct instruction in the specific aspects that underlie social functioning such as recognition, expression, and understanding prior to teaching very broad level social skills. If these adolescents are experiencing difficulties within these lower levels of processing, it seems likely that they would also exhibit problems within a larger social context.

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APPENDIX A: Parental Consent Forms

CONSENT FORMS: PARENT CONSENT FOR SCREENING PHASE:
Dear Parent(s)/Guardian(s):

My name is Elana Bloom and I am a graduate student in the Department of Educational and Counseling Psychology at McGill University, in Montreal, Quebec. Under the supervision of Dr. Nancy Heath, I am currently doing a research project for the completion of my graduate work. Through my practical experience working with adolescents, I have become very interested in factors that relate to the social and emotional adjustment of these students. Adolescence is a difficult age for students with many social and emotional demands and expectations from their peers, parents, and teachers. Previous researchers have found that one very important aspect related to how students do socially is their ability to recognize, express, and understand facial expressions of emotions. I am interested in examining the abilities of adolescents to recognize, express, and understand facial expressions of emotions and how these processes might be related to their social and possibly academic functioning. Therefore, I will be at XXXX school doing a project on how adolescents with different abilities in school (students who are doing well, students who are doing average and students who are having difficulty) recognize, express, and understand facial expressions of emotions. The project has two parts, the Screening Phase and the Full Phase of the project. This consent form is only for the Screening Phase. If your son/daughter is selected to participate in the Full Phase of the project, then you will be contacted again to obtain consent for the Full Phase.

In the Screening Phase students are chosen to participate in the Full Phase of the project based on how they are doing in a variety of school subjects. I need students who are having difficulty in certain subjects (e.g., Math, Reading, Spelling or any combination of difficulties), students who are doing okay, and students who are doing well for comparison. So in the Screening Phase, students will be asked to complete achievement measures that looks at their reading, math, and spelling skills, as well as a vocabulary and an object manipulation task, and questionnaires related to their mood and attention. All activities will be done individually and in strict confidence. All the results will be kept completely confidential and no individual results will be given to the parents or the school for ethical reasons. Furthermore, all measures will be identified with a confidential number and will not have your son/daughter's name on it to ensure confidentiality.

For each student, the Screening Phase will take a total of 1 hour, split up into two sessions of approximately 30 minutes each, which will be scheduled in agreement with your son/daughter's teacher. Your son/daughter's participation is completely voluntary. Your son/daughter's participation or non-participation in this project does not affect his/her or your relationship with your son/daughter's school in any way. Your son/daughter is free to withdraw from this project at any time. Everything that your son/daughter does or says while participating in this project will be completely confidential. All responses given by your son/daughter will be kept confidential and will be identified by code number, and not by name on the answer sheets throughout this project. Again, this consent is only for the

initial Screening Phase of 1 hour. If your son/daughter is selected to participate in the Full Phase of the project, you will be contacted again for consent. This consent is not consent for the Full Phase of the project. All participating students and their parents will receive an individualized summary sheet stating the areas of strengths and areas for improvement with specific strategies that are appropriate for the age and area of difficulty of the student, which the student can build on at home. No specific numerical scores will be given on this summary sheet for ethical reasons. In addition, all participating students and their parents will receive a summary of the group results upon completion of the project.

I would greatly appreciate your son/daughter's participation in order to help us to gain a better understanding of how adolescents recognize, express, and understand facial expressions of emotions. If you have any questions or concerns, please do not hesitate to contact me at (514) 398-1232 and I will return your call within 24 hours. Please complete the attached consent form and return it to your son/daughter's teacher or directly to myself regardless of your consent or not. Thank-you for your time and cooperation.

Sincerely,

Elana Bloom, M.Sc.
McGill University
Department of Educational and
Counseling Psychology

Nancy Heath, Ph.D.
McGill University
Department of Educational
and Counseling Psychology

Please check your choice, sign and return to your son/daughter's teacher Thank-you for your cooperation

____**YES** I give permission (freely consent and voluntarily agree for my son/daughter _____(Please Print Your Son/Daughter's Name) to participate in the Screening Phase for Elana Bloom's project under the supervision of Dr. Nancy Heath for McGill University on adolescent's abilities to recognize, express, and understand facial expressions of emotions. I know about the purpose of this project and about how there are no risks involved in this project. I know about the benefits and minimal inconvenience of the researcher scheduling my son/daughter's participation in this research project at the convenience of my son/daughter and his/her teacher. I understand that my son/daughter can withdraw at any time from the project without penalty or prejudice and that the total time is no more than approximately 1 hour. I know how confidentiality will be kept during this research project. I understand how the results will be used and that only group results will be shared with the public.

_____**NO** I do not give permission for my son/daughter _____(Please Print Your Son/Daughter's Name) to participate in the screening for Elana Bloom's project under the supervision of Dr. Nancy Heath for McGill University on adolescent's abilities to recognize, express, and understand facial expressions of emotions.

Signature of Parent(s)/Guardian(s):_____

Please Print Your Name: _____

Signature of Student (if 14 years or over): _____

Student's Date of Birth (MM/DD/YY): _____

Today's Date:_____

CONSENT FORMS: PARENT CONSENT FOR FULL PHASE OF PROJECT:

Dear Parent(s)/Guardian(s):

Your son/daughter participated in the Screening Phase of Elana Bloom's project under the supervision of Dr. Heath on adolescent's ability to recognize, express, and understand facial expressions of emotions, which looked at his/her reading, spelling, and math skills, as well as a vocabulary and an object manipulation task, and questionnaires about his/her mood and attention. Your son/daughter has been selected to participate in the Full Phase of the project. We chose students with difficulty in math (but okay in reading and spelling), difficulty in reading and spelling (but okay in math), students with a combination of difficulties (in reading, math, spelling), and students with no difficulty in any subject. I am now requesting consent for your son/daughter to participate in the Full Phase of the project on adolescents' abilities to recognize, express, and understand facial expressions of emotions.

The present project is trying to gain a better understanding of how adolescents process facial expressions of emotions. Below I have listed exactly what the project requires from the student. If your son/daughter wants to withdraw at any time from the project they are absolutely free to do so without penalty or prejudice. What would my son/daughter be asked to do?: The Full Phase of the project consists of four sessions of approximately 30 minutes each for a total time of 1 hour and 55 minutes. Specifically, in the first two sessions students will be asked to complete paper and pencil tasks, an object manipulation task (pegboard) and an auditory perception task (answering questions after hearing a tape). In the latter two sessions, students will be asked to complete the emotion processing tasks. Specifically, in the first session students will be asked to look at a series of slides depicting men and women displaying facial expressions of emotion and they will be asked to choose the emotion category depicted in the slide. All of this will be done individually in strict confidence and in agreement with your son/daughter's teacher. The second session, which is comprised of two tasks, students will be asked to express facial expressions of emotions while being videotaped by a video camera. Following this, the student will take part in a 3-minute informal interview, which will also be videotaped, where he/she will be asked questions about movies. In the second task, short stories will be read to the student, while he/she follows along and simultaneously looks at a visual display of the story. He/she will be asked to choose from an array of facial expressions of emotions the likely facial expression that would result from the main character in the story. Again, all of this will be done individually in strict confidence and in agreement with your son/daughter's teacher.

In summary, participating students will complete a total of approximately 1 hour and 55 minutes (45 minutes of paper and pencil/object manipulation tasks and 70 minutes of emotion tasks). The videotapes of the students' facial expressions of emotions will only be viewed by the immediate research team and will never be removed from the lab. Upon completion of the project, the videotapes will be destroyed. Your son/daughter's participation is completely voluntary. Your son/daughter's participation or non-participation in this project does not affect his/her or your relationship with your son/daughter's school in any

way. Your son/daughter is free to withdraw from this project at any time. Everything that your son/daughter says during this project will be confidential. All responses obtained from your son/daughter will be kept confidential and will be identified by code number, and not by name on the material used throughout this project. Following completion of the project, students who participated in the Full Phase of the project may have the possibility of participating in a free program to teach better emotion expression and recognition. The program will focus on recognizing, expressing, and understanding facial expressions of emotions. In addition, all participating students and their parents will receive an individualized summary sheet stating the areas of strengths and areas for improvement with specific strategies that are appropriate for the age and area of difficulty of the student, which the student can build on at home. No specific numerical scores will be given on this summary sheet for ethical reasons. All participating students and their parents will also receive a summary of the group results upon completion of the project. I would greatly appreciate your son/daughter's participation in order to help us to gain a better understanding of how adolescents recognize, express, and understand facial expressions of emotions.

If you have any questions or concerns, please do not hesitate to contact me at (514) 398-1232 and I will return your call within 24 hours. Please complete the attached consent form and return it to your son/daughter's teacher or to myself regardless of whether you consent or not. Thank-you for your time and cooperation.

Sincerely,

Elana Bloom, M.Sc.
McGill University
Department of Educational and
Counseling Psychology

Nancy Heath, Ph.D.
McGill University
Department of Educational
and Counseling Psychology

Please check your choice, sign and return
to your son/daughter's teacher
Thank-you for your cooperation

_____ **YES** I give permission (freely consent and voluntarily agree for my son/daughter _____(Please Print Your Son/Daughter's Name) to participate in the Full Phase of the project for Elana Bloom under the supervision of Dr. Nancy Heath for McGill University on adolescent's abilities to recognize, express, and understand facial expressions of emotions. I know about the purpose of this project and about how there are no risks involved in this project. I know about the benefits and minimal inconvenience of the researcher scheduling my son/daughter's participation in this project at the convenience of my son/daughter and his/her teacher. I understand that my son/daughter can withdraw at any time from the project without penalty or prejudice and that the total time is no more than approximately 1 hour 55 minutes. I know how confidentiality will be kept during this research project. I understand how the results will be used and that only group results will be shared with the public.

_____ **NO** I do not give permission for my son/daughter _____(Please Print Your Son/Daughter's Name) to participate in the Full Phase of the project for Elana Bloom under the supervision of Dr. Nancy Heath for McGill University on adolescent's abilities to recognize, express, and understand facial expressions of emotions.

Signature of Parent(s)/Guardian(s):_____

Please Print Your Name: _____

Signature of Student (if 14 years or over): _____

Student's Date of Birth (MM/DD/YY): _____

Today's Date:_____

APPENDIX B: Student Consent Forms

CONSENT FORMS: STUDENT CONSENT FOR SCREENING PHASE:

Dear Student:

My name is Elana Bloom and I am a graduate student in the Department of Educational and Counselling Psychology at McGill University, in Montreal, Quebec. Under the supervision of Dr. Nancy Heath, I am doing a research project for the completion of my graduate work. Through my practical experience working with adolescents, I have become very interested in factors that relate to their social and emotional adjustment. Adolescence is a difficult age for students with many social and emotional demands and expectations from their peers, parents, and teachers. Previous researchers have found that one very important aspect related to how students do socially is their ability to recognize, express, and understand facial expressions of emotions. I am interested in examining the abilities of adolescents to recognize, express, and understand facial expressions of emotions and how these processes might be related to their social and academic functioning. Therefore, I will be at XXXX school doing a project on how adolescents with different abilities in school (students who are doing well, students who are doing average and students who are having difficulty) recognize, express, and understand facial expressions of emotions. The project has two parts, the Screening Phase and the Full Phase of the project. This consent form is only for the Screening Phase. If you are selected to participate in the Full Phase of the project you will be contacted again to obtain consent for the Full Phase of the project.

In the Screening Phase students are chosen to participate in the Full Phase of the project based on how they are doing in a variety of school subjects. I need students who are having difficulty in certain subjects (e.g., Math, Reading, Spelling or any combination of difficulties), students who are doing okay, and students who are doing well for comparison. So in the Screening Phase, you will be asked to complete achievement measures that look at your reading, math, and spelling skills, as well as a vocabulary and object manipulation task, and questionnaires related to your mood and attention. All activities will be done individually and in strict confidence. All the results will be kept completely confidential and no individual results will be released to your parents or the school for ethical reasons. Furthermore, all measures will be identified with a confidential number and will not have your name on it to make sure that everything is kept confidential.

For each student, the Screening Phase will take a total of 1 hour, split up into two sessions of approximately 30 minutes each, which will be scheduled in agreement with you and your teacher. Your participation is completely voluntary. Your participation or nonparticipation in this project does not affect your relationship with your school in any way. You are free to withdraw from this project at any time. Everything you say and do that is related to this project will be kept confidential. All responses obtained from you will remain confidential and will be identified by code number, and not by name on the material associated with the project. Again, this consent is only for the initial Screening Phase of 1 hour. If you are selected to participate in the Full Phase of the project, we will contact you again for consent. This consent is not consent for the Full Phase of the project. All participating students and their parents will receive an individualized

summary sheet stating the areas of strengths and areas for improvement with specific strategies that are appropriate for the age and area of difficulty of the student, which the student can build on at home. No specific numerical scores will be given on this summary sheet for ethical reasons. In addition, all participating students and their parents will receive a summary of the group results upon completion of the project.

I would greatly appreciate your participation in order to help us to gain a better understanding of how adolescents recognize, express, and understand facial expressions of emotions. If you have any questions or concerns, please do not hesitate to contact me at (514) 398-1232 and I will return your call within 24 hours. Please complete the attached consent form and return to your teacher or myself regardless of your consent or not. Thank-you for your time and cooperation.

Sincerely,

Elana Bloom, M.Sc.
McGill University
Department of Educational and
Counseling Psychology

Nancy Heath, Ph.D.
McGill University
Department of Educational
and Counseling Psychology

Please check your choice, sign and return
to your teacher or myself
Thank-you for your cooperation

_____ **YES** I _____(Please Print Your Name) wish to participate (freely consent and voluntarily agree) in the Screening Phase for Elana Bloom's project under the supervision of Dr. Nancy Heath for McGill University on adolescent's abilities to recognize, express, and understand facial expressions of emotions. I know about the purpose of this project and about how there are no risks involved in this project. I know about the benefits and minimal inconvenience of the researcher scheduling my participation in this project at my and my teacher's convenience. I understand that I can withdraw at any time from the project without penalty or prejudice and that the total time is no more than approximately 1 hour. I know how confidentiality will be kept during this research project. I know how the results from this research project will be used and how only group results from this research project will be shared with the public.

_____ **NO** I _____(Please Print Your Name) do not wish to participate in the Screening Phase for Elana Bloom's project under the supervision of Dr. Nancy Heath for McGill University on adolescent's abilities to recognize, express, and understand facial expressions of emotions.

Signature of Parent(s)/Guardian(s):_____

Please Print Your Name: _____

Signature of Student (if 14 years or over): _____

Your Date of Birth (MM/DD/YY): _____

Today's Date:_____

CONSENT FORMS: STUDENT CONSENT FOR FULL PHASE OF PROJECT:

Dear Student:

You participated in the Screening Phase of Elana Bloom's project under the supervision of Dr. Heath on adolescent's ability to recognize, express, and understand facial expressions of emotions, which looked at your reading, spelling, and math skills, as well as vocabulary, manipulation of objects, and your mood and attention. I am now ready to do the Full Phase of the project and you have been selected as a participant. We chose equal groups of students with difficulty in math (but okay in reading and spelling), difficulty in reading and spelling (but okay in math), students with a combination of difficulties (in reading, math, and spelling), as well as students with no difficulty in any subject. I am now requesting your consent to participate in the Full Phase of the project on adolescents' abilities to recognize, express, and understand facial expressions of emotions.

The present project is trying to gain a better understanding of how adolescents process facial expressions of emotions. Below I have listed exactly what the project requires from you, the student. If you wish to withdraw from the project at any time you are absolutely free to do so without penalty or prejudice. What would you be asked to do?: the Full Phase of the project consists of four sessions of approximately 30 minutes each for a total time of 1 hour and 55 minutes. Specifically, in the first two sessions you will be asked to complete paper and pencil tasks, an object manipulation task (pegboard) and an auditory perception task (answering questions after hearing a tape). In the latter two sessions, you will be asked to complete the emotion processing tasks. Specifically, in the first session you will be asked to look at a series of slides depicting men and women displaying facial expressions of emotion and asked to choose the emotion category depicted in the slide. All of this will be done individually in strict confidence and in agreement with your teacher. In the second session, which is comprised of two tasks, you will be asked to express facial expressions of emotions while being videotaped by a video camera. Following this, you will take part in a 3-minute informal interview, which will also be videotaped, where you will be asked questions about movies. In the second task, short stories will be read to you while you follow along and simultaneously look at a visual display of the story. You will be asked to choose from an array of facial expressions of emotions the likely facial expression that would result from the main character in the story. Again, all of this will be done individually in strict confidence and in agreement with your teacher.

In summary, participating students will complete a total of approximately 1 hour 55 minutes (45 minutes of paper and pencil/object manipulation tasks and 70 minutes of emotion tasks). The videotapes of your facial expressions of emotions will only be viewed by the immediate research team and will never be removed from the lab. Upon completion of the project, the videotapes will be destroyed. Your participation is completely voluntary. Your participation or non-participation in this project does not affect your relationship with your school in

any way. You are free to withdraw from this project at any time. Everything that you say or do during this project will be kept confidential. All responses obtained from you will remain confidential and will be identified by code number, and not by name on the material used throughout this project. Following completion of this project, those students who participated in the entire project may have the possibility of participating in a free program to teach better emotion expression and recognition. The program will focus on recognizing, expressing, and understanding facial expressions of emotions. In addition, all participating students and their parents will receive an individualized summary sheet stating the areas of strengths and areas for improvement with specific strategies that are appropriate for the age and area of difficulty of the student, which you can build on at home. No specific numerical scores will be given on this summary sheet for ethical reasons. All participating students and their parents will also receive a summary of the group results upon completion of the project. I would greatly appreciate your participation in order to help us to gain a better understanding of how adolescents recognize, express, and understand facial expressions of emotions.

If you have any questions or concerns, please do not hesitate to contact me at (514) 398-1232 and I will return your call within 24 hours. Please complete the attached consent form and return it to your teacher or myself regardless of whether you consent or not. Thank-you for your time and cooperation.

Sincerely,

Elana Bloom, M.Sc.
McGill University
Department of Educational and
Counseling Psychology

Nancy Heath, Ph.D.
McGill University
Department of Educational
and Counseling Psychology

Please check your choice, sign and return
to your teacher or myself
Thank-you for your cooperation

_____**YES** I _____(Please Print Your Name) wish to participate (freely consent and voluntarily agree) in the Full Phase for Elana Bloom's project under the supervision of Dr. Nancy Heath for McGill University on adolescent's abilities to recognize, express, and understand facial expressions of emotions. I know about the purpose of this project and about how there are no risks involved in this project. I know about the benefits and minimal inconvenience about the researcher scheduling my participation in this project at my and my teacher's convenience. I understand that I can withdraw at any time from the project without penalty or prejudice and that the total time is no more than approximately 1 hour and 55 minutes. I know how confidentiality will be kept during this research project. I know about how the results of this project will be used and how only group results from this project will be shared with the public.

_____**NO** I _____(Please Print Your Name) do not wish to participate in the Full Phase for Elana Bloom's project under the supervision of Dr. Nancy Heath for McGill University on adolescent's abilities to recognize, express, and understand facial expressions of emotions.

Signature of Parent(s)/Guardian(s):_____

Please Print Your Name: _____

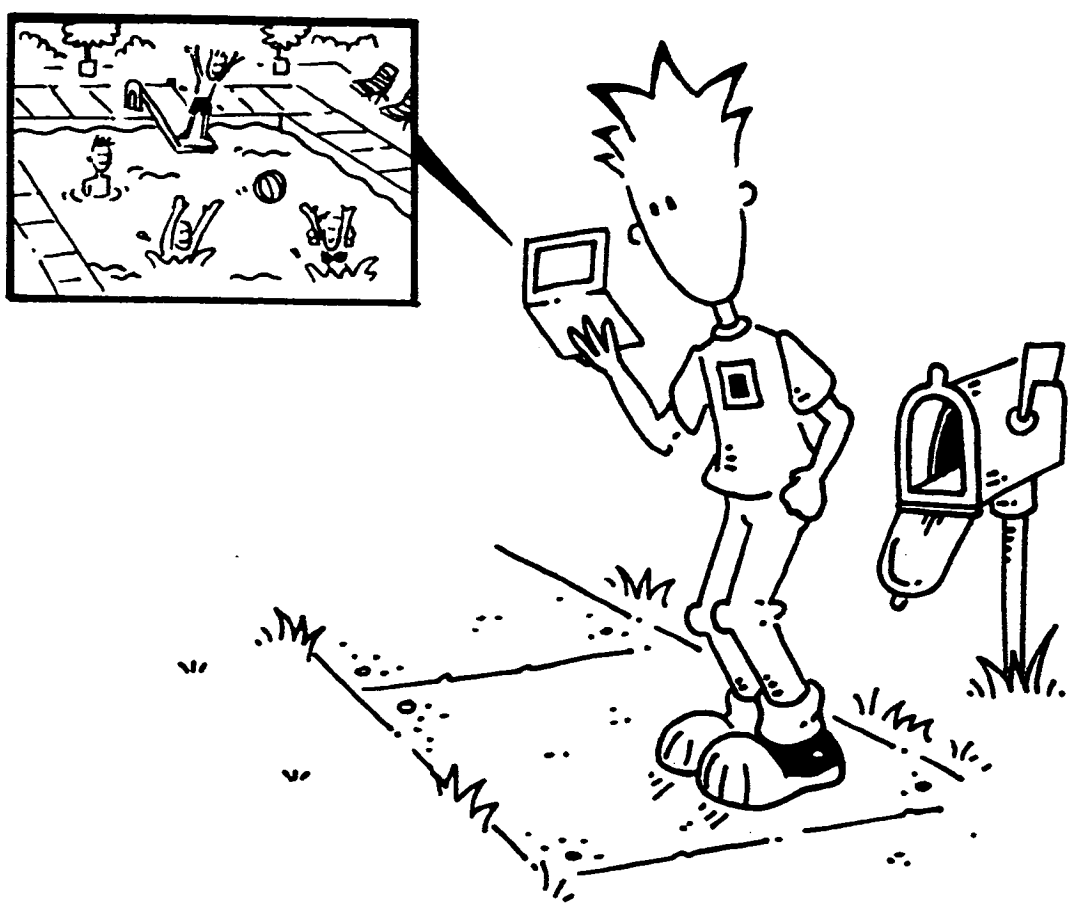
Signature of Student (if 14 years or over): _____

Your Date of Birth (MM/DD/YY): _____

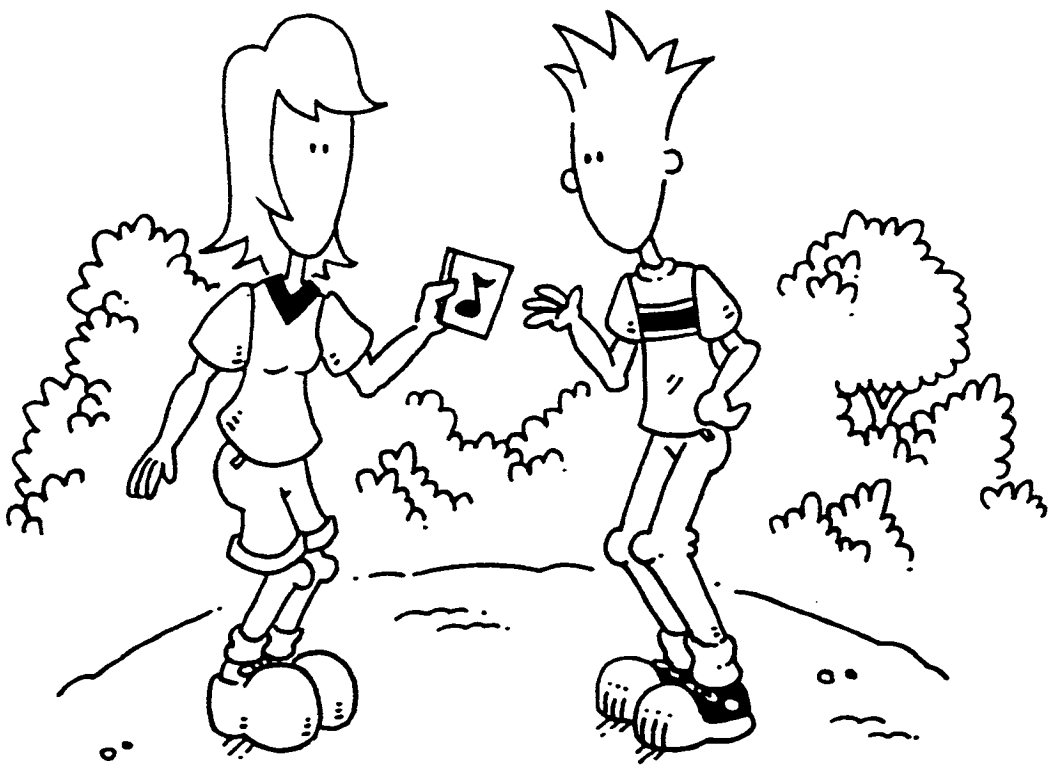
Today's Date:_____

APPENDIX C: Verbal and Visual Short Stories for the Understanding Task

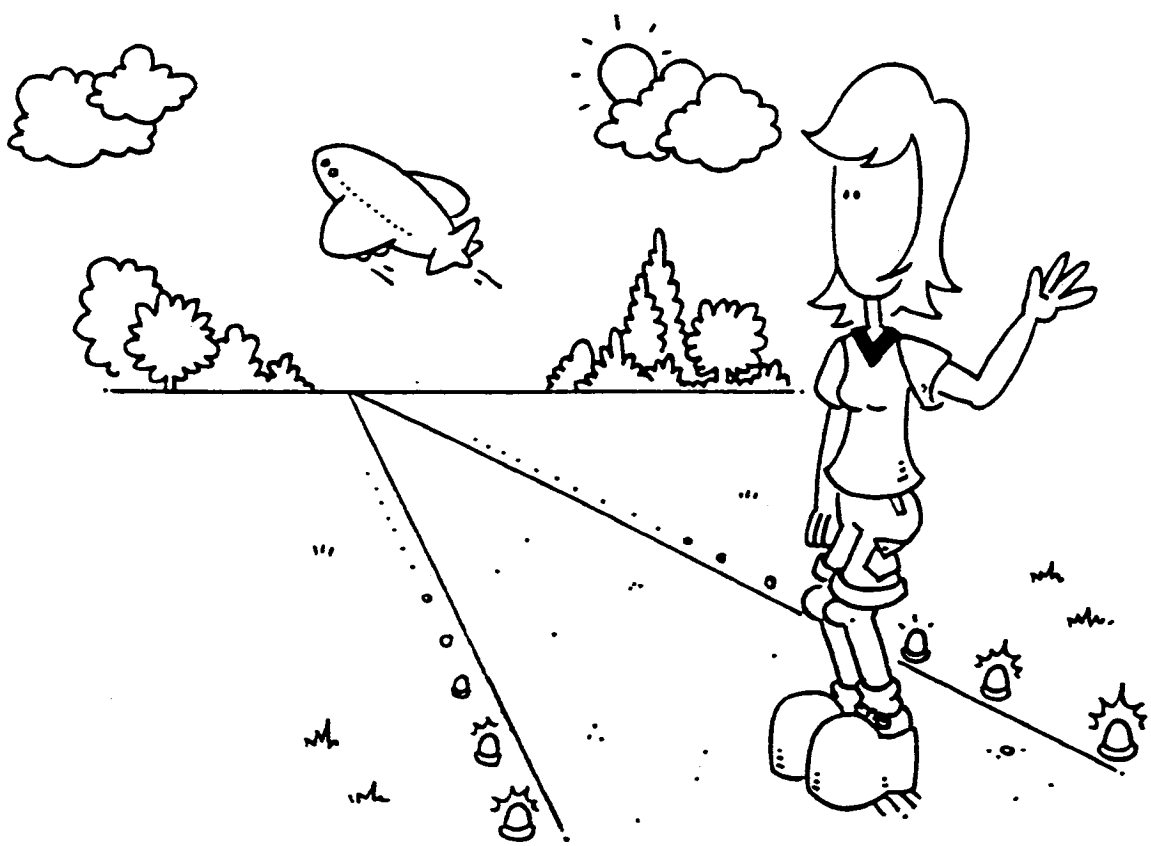
"IF YOU REALLY LIKED SWIMMING AND RECENTLY RECEIVED AN INVITATION TO A REALLY COOL SWIMMING PARTY".



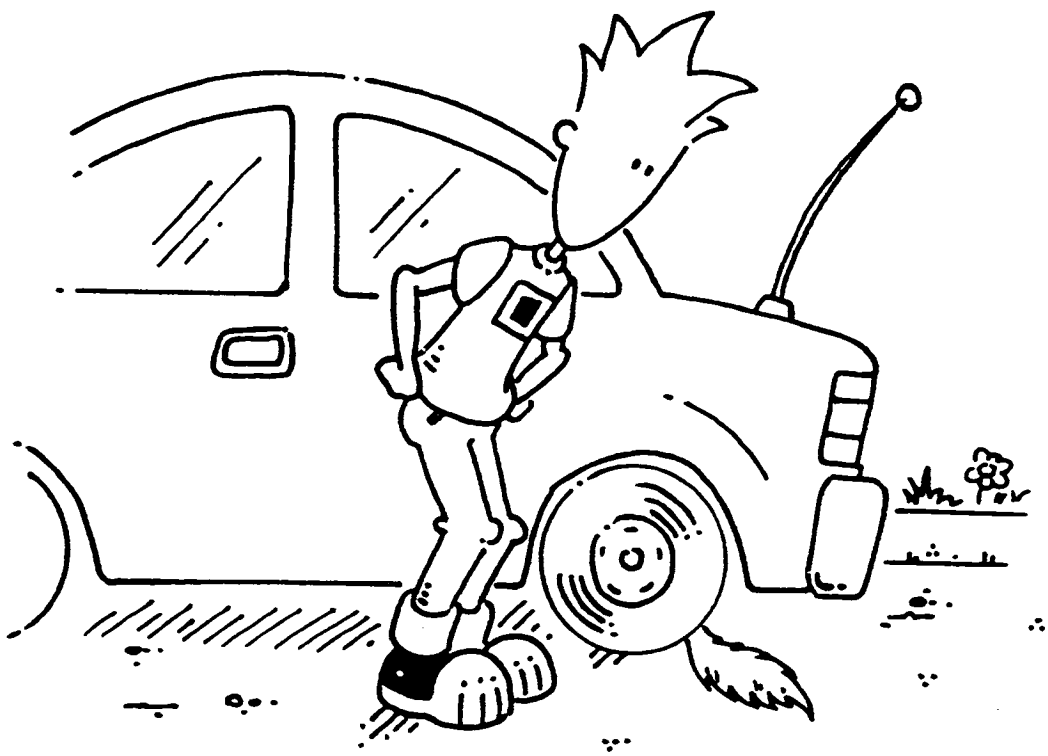
"IF SOMEONE JUST GAVE YOU A NEW CD THAT YOU HAD WANTED FOR A REALLY LONG TIME".



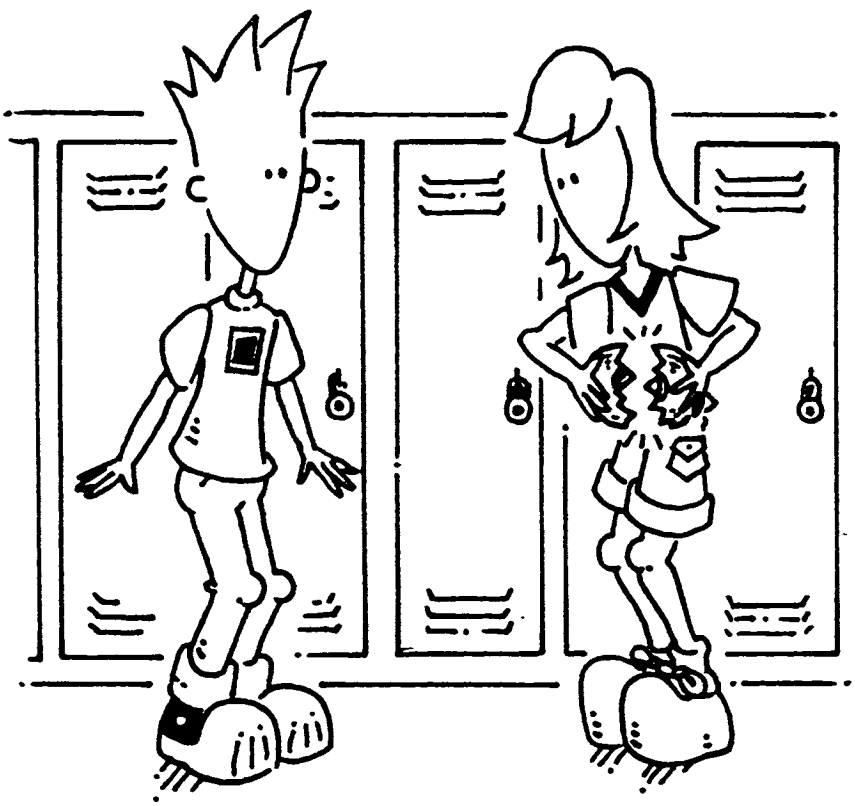
"IF YOUR BEST FRIEND MOVED AWAY TO ANOTHER COUNTRY AND YOU WOULD NOT SEE HIM/HER FOR A LONG TIME".



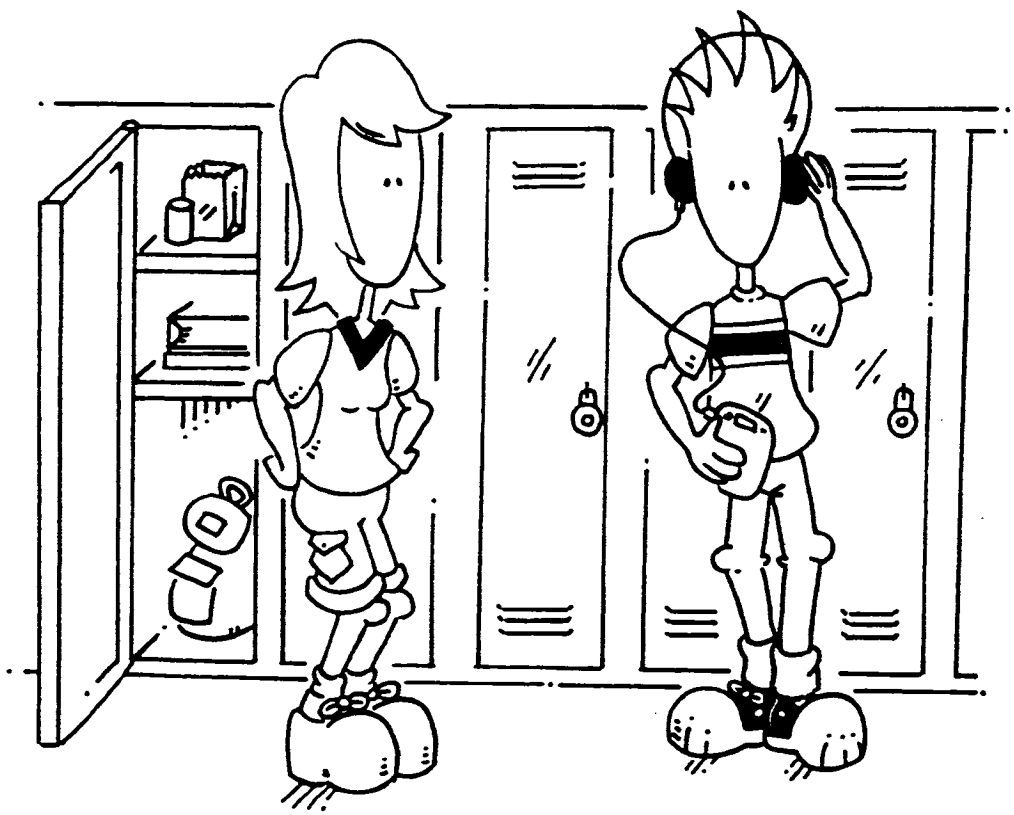
"IF YOU HAD A PET DOG THAT GOT RUN OVER BY A CAR AND DIED".



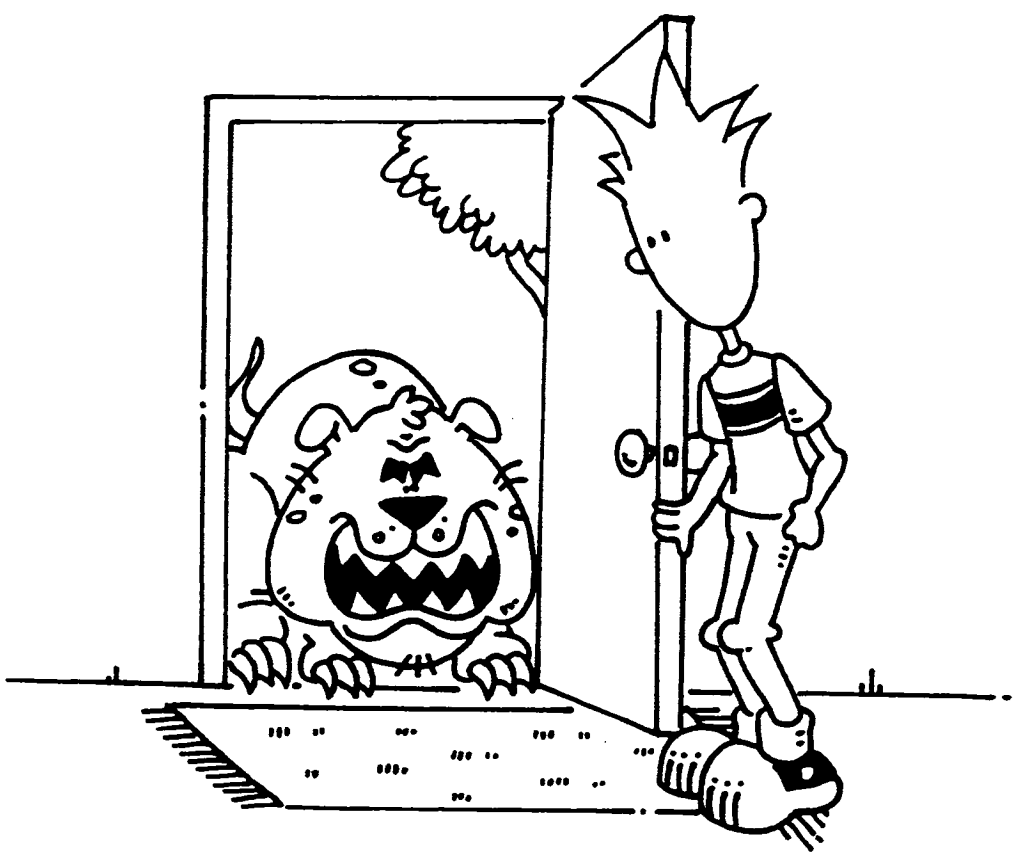
"IF YOU SAW YOUR FRIEND BREAK YOUR FAVORITE CD RIGHT IN FRONT OF YOU".



"IF YOU TOLD YOUR FRIEND NOT TO PLAY WITH YOUR WALKMAN AND THEN HE/SHE DOES IT RIGHT IN FRONT OF YOU".

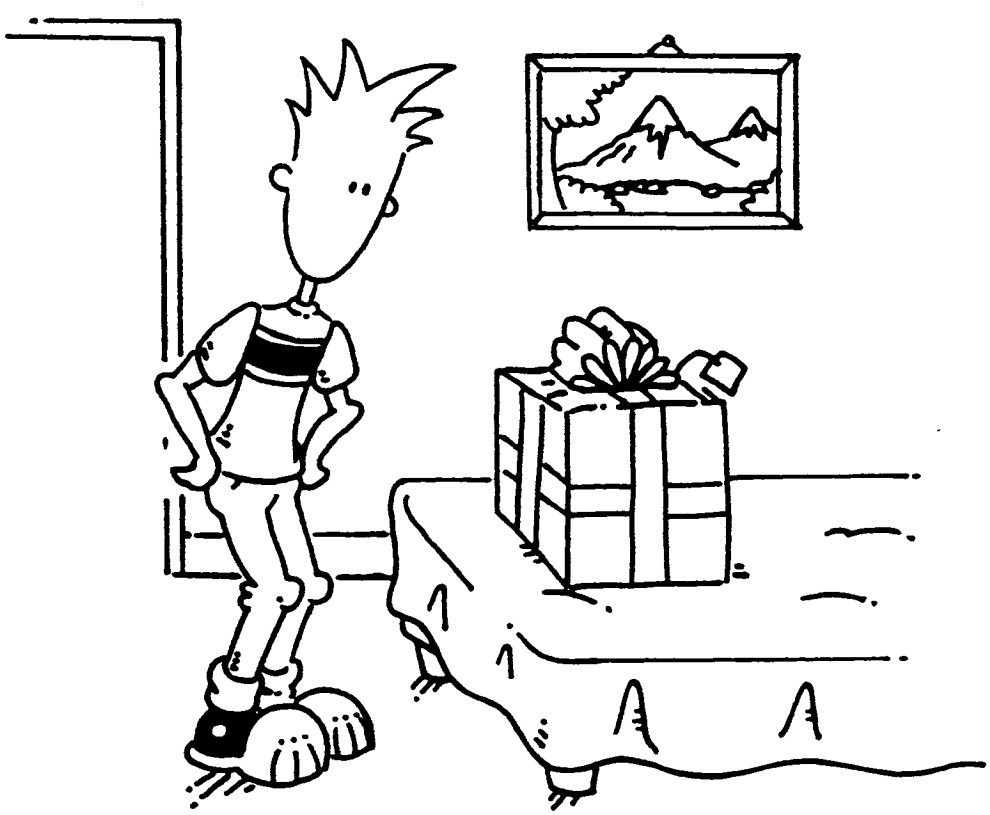


"IF YOU WERE A PERSON WHO REALLY DOESN'T LIKE DOGS AND ONE DAY WHEN YOU OPENED THE BACK DOOR THERE WAS A BIG FIERCE DOG STANDING THERE GROWLING".

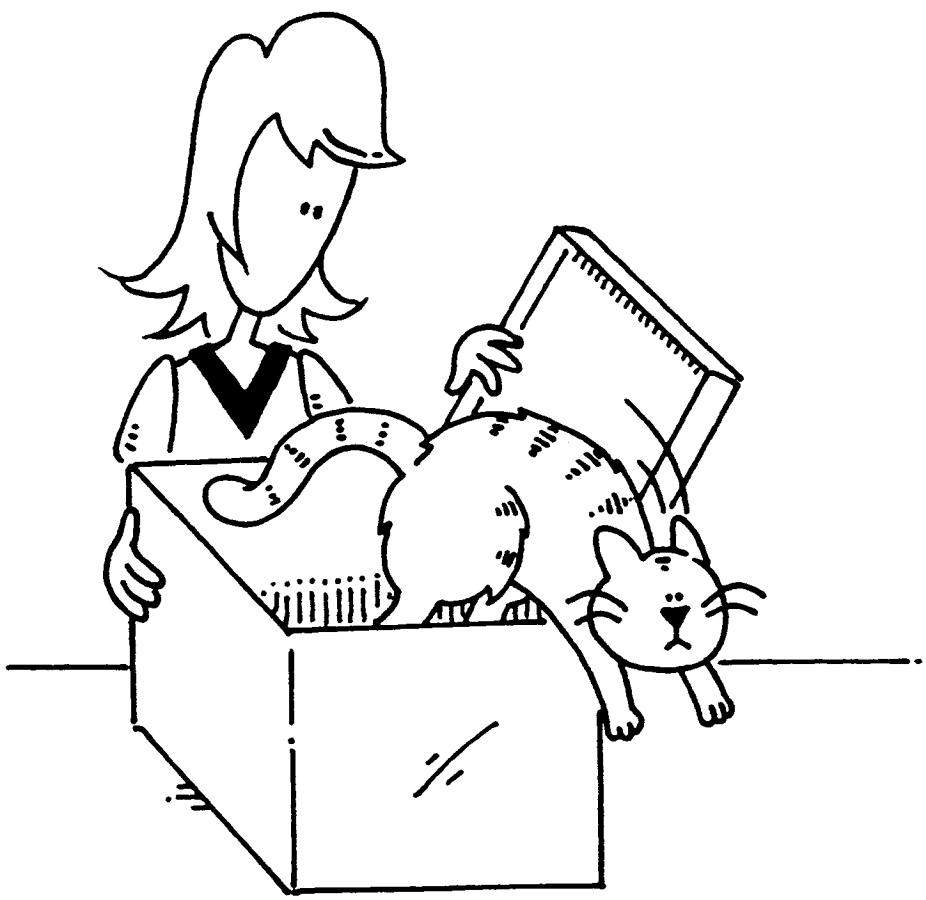


"IF YOU REALLY DID NOT LIKE BEING ALONE IN THE COUNTRY AND ONE NIGHT YOU WERE ALONE IN A HOUSE IN THE COUNTRY WITH NO OTHER HOUSES AROUND FOR MILES".

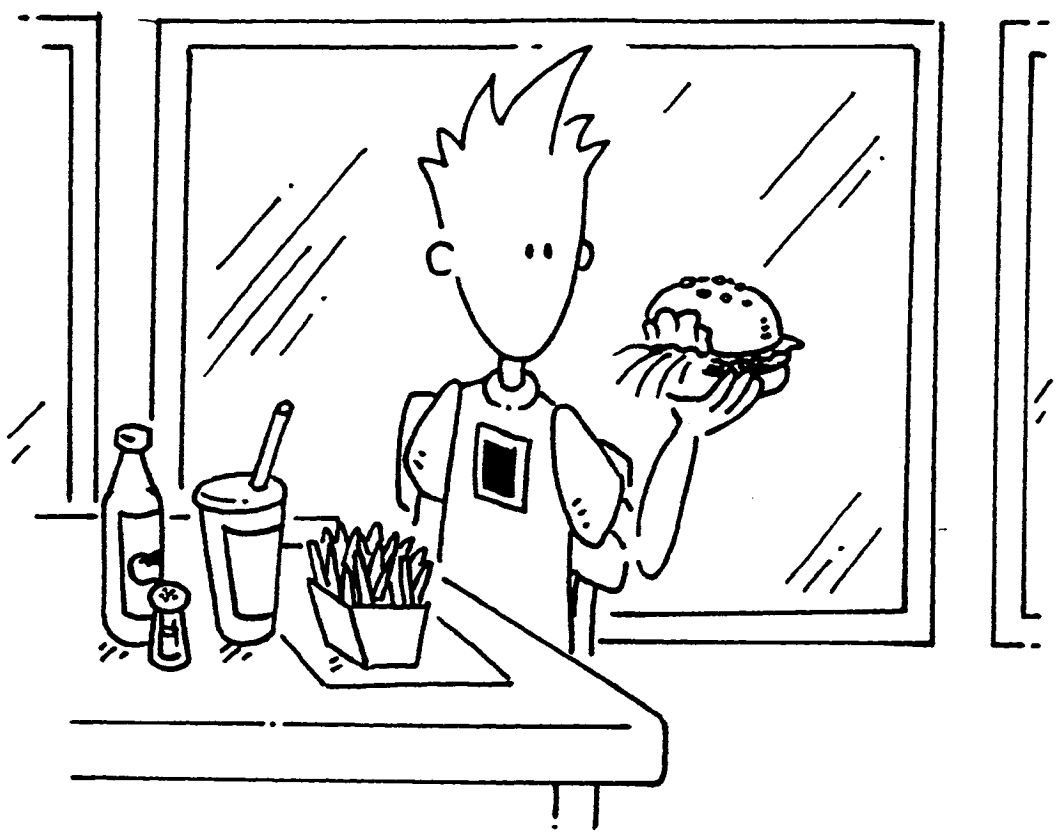
"IF ONE DAY WHEN YOU WENT INTO YOUR ROOM YOU FOUND A BIG PRESENT ON THE EDGE OF YOUR BED THAT YOU WERE NOT EXPECTING".



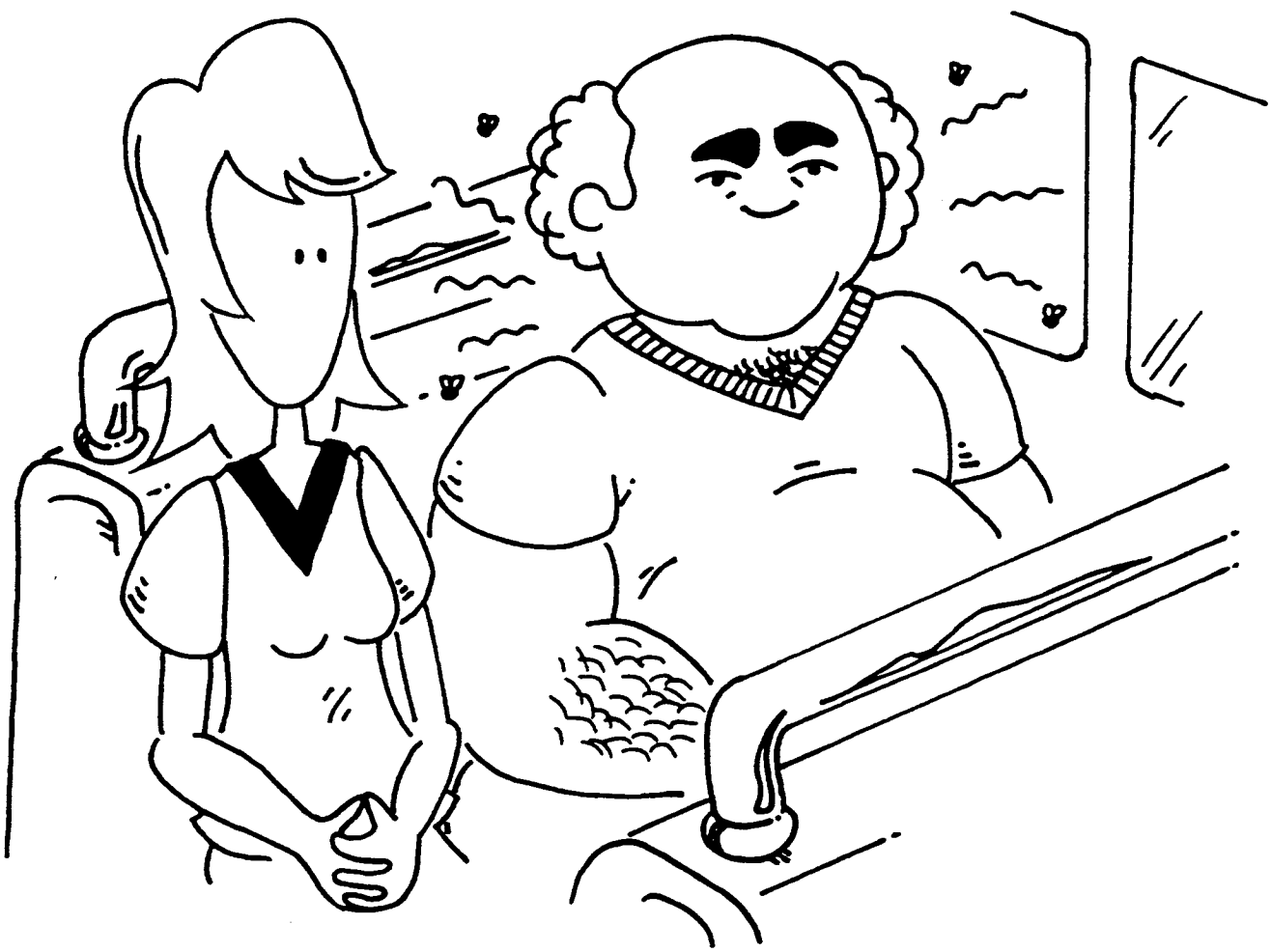
"IF ONE DAY YOU OPENED A BOX AND YOU WERE NOT EXPECTING ANYTHING TO BE INSIDE THE BOX AND A CAT JUMPED OUT".



"IF YOU BIT INTO WHAT YOU THOUGHT WAS A JUICY HAMBURGER AND FOUND A BUNCH OF HAIR IN IT".



"IF YOU SAT BESIDE SOMEONE ON A BUS WHO HADN'T TAKEN A SHOWER IN A WEEK AND SMELLED AWFUL".



APPENDIX D: University Certificate of Ethical Approval