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COMPREHENSION OF AFFECT IN CHILDREN
WITH PERVASIVE DEVELOPMENTAL DISORDERS:
SPECIFIC DEFICITS IN PERCEPTUAL MATCHING TASKS

by

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of Doctor of Philosophy
in Psychology

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ABSTRACT

This study compared the performance of children with Pervasive Developmental Disorders (PDD) to that of two control groups: one matched by Verbal Mental age (VMC) and one by Performance Mental age (PMC) on tests designed to assess the perception of faces, facial expression, and affective situations. Children with PDD had more difficulty selecting the appropriate facial expressions for cartoons depicting social interactions compared to the PMC group but not the VMC group. However, they did not differ from either control group on a comparable test which excluded the affective component. Moreover, children with PDD showed specific areas of difficulty in their perception of faces and facial expressions. For example, they had more difficulty matching non-identical faces relative to identical faces, and tended to match by identity rather than facial expression. These findings suggest that these children possess specific deficits in processing affective/perceptual material. Future research might include the use of more ecologically valid measures to allow manipulation of additional variables that are likely to influence the comprehension of affective stimuli.

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I would like to dedicate this to my parents, Catherine Kinney and the late Luther R. Kinney, Jr., without whose support this would not have been possible. Since the beginnings of my academic career, they have always been there, providing inspiration, encouragement and unyielding support. Because of them, I learned early on that anything was possible. For this, I owe them my eternal gratitude.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Review of the Literature

The Pervasive Developmental Disorders (PDD) are defined as a group of severe, early developmental disorders characterized by impairments in cognitive, social, and adaptive domains. The Diagnostic and Statistical Manual of Mental Disorders fourth edition (DSM-IV; American Psychiatric Association, 1994) divides the PDD's into five classes. They include Autistic Disorder, Rett's Disorder, Childhood Disintegrative Disorder, Asperger's Disorder, and PDD-not other wise specified or PDD-NOS. An "autistic spectrum" proposed by Wing and Gould (1979) underscores the central problem in these disorders as an intrinsic impairment in the ability to engage in reciprocal social interaction. At one end of the spectrum is PDD-NOS with intellectually higher-functioning persons who have mild deficits in socialization, followed by Kanner autism cases with mild to moderate mental retardation, and then lastly, autism with lower functioning, severely and profoundly retarded individuals at the other end.

Behavioral symptoms of Autistic Disorder occur early in life and include both cognitive and affective deficiencies (i.e., language, communication, social interaction, and play). Deficits in verbal language sometimes include a failure to acquire language at the expected age. Even when language acquisition is adequate, all children with autism have some type of developmental language disorder (Allen, 1988).

In addition to deficits in verbal language, children with autism show deficiencies in nonverbal communication. With respect to social interaction, for example, those who are verbal, lack skills that would allow them to participate in conversations. They typically are unable to maintain a topic of conversation, fail in their social exchange, and have difficulty interpreting tone of voice, facial expressions, and body language (Rapin, 1991). Moreover, those who are not verbal, rarely use gestures or pantomime to get their point across. For example, instead of pointing at a desired object, they typically get it for themselves or will take the hand of a caregiver and put it on the desired object (Rapin, 1991). Children with autism also typically show some deficit in body use and in their use of objects in play activities. Some regularly display repetitive movements like hand flapping, twirling, rocking, or head banging. They may also resist changes in their routines or environment and have an unusual tolerance for monotony. Imaginative play is absent; instead children with autism show a preference for manipulating, lining up, or classifying their toys (Rapin, 1991). It is important to point out here that the range and intensity of symptoms vary between individuals such that in the milder forms of autism, only subtle behavioral symptoms exist in a few areas. On the other hand, in more severe cases, a child may possess many symptoms across a variety of areas.

At present there are several theories with regard to the core symptoms of autism. Some of these theories regard autistic features as secondary to deficits in cognitive and language functioning. One such theory emphasizes attentional deficits as the primary deficit (Courchesne, Lincoln, Kilman, & Galambos, 1985; Courchesne, Lincoln, Yeung-Courchesne, Elmasian, & Grillon

1989; Damasio & Maurer, 1978; Ornitz, 1985); another theory emphasizes language and memory deficits (Bauman & Kemper, 1985; Delong, 1978); while others propose deficits in auditory processing (Novick, Kurtzburg, & Vaughn, 1979; Novick, Vaughn, Kurtzberg, & Simson, 1980); selective attention mechanisms (Courchesne et al., 1989; Grillon, Courchesne, & Akshoomoff, 1989); and complex information processing (Minshew, Goldstein, & Payton, 1989; Minshew, Payton, & Sclabassi,1986).

Another group of theories emphasize deficiencies in social or affective systems as the core deficit in autism (Braverman, Fein, Lucci, & Waterhouse, 1989; Denckla, 1986; Fein, Lucci, Braverman, & Waterhouse, 1992). The argument for the saliency of a social deficit in autism is based on research findings suggesting that compared to other children with different disorders but similar cognitive deficits, children with autism have specific difficulty with tasks that have an affective or social component. For example, compared to children with mental retardation, Jennings (1973) found that children with autism preferred to match photographs on the basis of accessories rather than affect. In addition, they performed more accurately on tasks that required the use of nonemotional cues than on tasks that required discrimination between facial expressions.

Along similar lines, Hobson (1986a, 1986b) performed a series of experiments testing the ability of children with autism to match facial expressions to emotional gestures, vocalizations, or contexts. A control task consisted of matching comparable features on inanimate objects, such as a train. The children with autism were unimpaired on the object-matching task, but performed worse than normal matched controls on all parts of the

emotional task, and less well than matched nonautistic retarded children on all but the "contexts" condition. As the author recognized, there was a possible confounding factor in interpreting these results because the inanimate control task was not matched to the affective task for level of difficulty; in fact, both groups performed at ceiling on the former task. A similar study is reported by Tantem, Monaghan, Nicholson, and Stirling (1989) who reported that children with autism were significantly worse than children without autism at finding an odd face and the odd facial expression out of a set of photographs of faces. They also did poorly at labelling facial expressions depicting various emotions.

A study by Braverman, Fein, Lucci, and Waterhouse (1989) looked at affect comprehension in children with pervasive developmental disorders (PDD). This study used photographs of objects and people in a simultaneous matching format. The control task (equated for difficulty to the experimental task) consisted of matching photographs of common objects. To determine whether any deficit found in the ability to match facial expressions of affect would apply also to face recognition (where facial configuration but no affective information is used), the children were given a face matching task. Results showed that the children with PDD performed significantly worse than a normal control group on the affect matching and affect comprehension tasks. Children with PDD also showed impairments on social and affect matching tasks relative to matching of inanimate objects, whereas the normal controls did not.

Ozonoff, Pennington, and Rogers (1990) replicated the findings by Braverman et al. (1989). They found deficits in affect matching when

children with autism were compared to normal children matched for non-verbal mental age (MA). They also found the children with autism deficient in matching faces for identity rather than emotion. Contrary to other findings, neither of the above studies found significant group differences when the autistic/PDD children were compared to children matched on verbal, rather than non-verbal mental age.

In a study by Fein et al., (1992), children with PDD were compared to mental age matched normal children on a task that required identifying an emotion appropriate for a specific situation. They found while the PDD group did not differ from either the verbal matched or the non-verbal matched control groups on this task, children with PDD were significantly impaired on this task relative to a non-social task equated for difficulty. There were no such differences found in either control group. This supports again, the difficulty autistic/PDD subjects have with affective stimuli relative to non-affective stimuli.

Given that in general children with autistim/PDD appear to have difficulty with affective tasks, one might ask whether this deficit reflects a developmental lag or a specific deficit in face processing? If for example, these difficulties reflect a developmental lag, then one might expect that older children with autism would perform better than their younger counterparts on affective tasks or that they would perform similar to younger children who do not have autism. On the other hand, if autistic subjects do not improve on these tasks with age, then it might be concluded that their difficulties reflect a persisting deficit. To begin answering these questions, it is necessary to

study the development of face recognition and comprehension in normal children.

Studies with normal children have shown that the ability to categorize facial expressions (using verbal labels and/or pictorial representations) increases gradually as a function of age until late childhood when scores tend to level off (Fechner, 1978). Specifically, Klinnert, Campos, Sorce, Emde, & Svejda (1983) report that there are several stages in the development of infants receptivity to facial expressions of emotion. During the first stage (birth to 1- 1/2 months), infants pay little attention to the internal features of faces (Hainline, 1978; Haith, Bergman, & Moore, 1977; Maurer & Salapatek, 1976). Hence, during this period, infants probably do not discriminate consistently, if at all, between facial expressions. At around 1-1/2 to 2 months of age, however, infants begin to focus on the internal features of faces. They can discriminate among facial expressions (Barrera & Maurer, 1981a, 1981b; Oster, 1981; Young-Browne, Rosenfeld, & Horowitz, 1977) and can even distinguish variations of a single expression by three months of age (Kuchuk, Vibbert & Bornstein, 1986). By five months, infants can discriminate between the facial expressions of anger, fear, and sadness (Schwartz, Izard, & Ansul, 1985).

As Lamb and Bornstein (1987) point out, however, the ability to discriminate between facial expressions does not mean that the child understands the emotional meaning conveyed by that expression. Only in the third stage (4 or 5 to 8 or 9 months), is there evidence that emotional expressions are both distinguishable and meaningful (Klinnert et al., 1983).

Infants now react with appropriate emotion to the emotional displays of others.

The ability to recognize faces and facial expressions continues to develop through childhood. Kolb, Milner, and Taylor (1983) performed a study looking at face perception and comprehension in children (ages 6-15) and adults (over 18). On the first test, subjects were given two composite symmetrical faces made from the left or right half of a normal face; the subjects' task was to indicate which of the composite faces looked most like the original face. In the second test, subjects had to match the facial expressions on a series of photographs to six key photographs, depicting one of six facial expressions (happy, sad, angry, fear, disgust, or surprise). The third test required subjects to choose a target photograph that was appropriate for the face of a faceless cartoon character in an emotional situation. Results indicated that on the composite faces test, all age groups processed the faces in a similar manner. It can be concluded that those cognitive processes needed for this task appear to be fully developed by the age of six years. The results of the other two tests indicated that the ability to perceive facial expressions improved between 6 and 8 years, remained stable until about 13 years, and again improved to adult performance at about 14.

Since adequate processing of faces is presumed to be necessary for adequate comprehension of affect, several investigators have studied face processing in children with autism. These findings have shown that while face processing is relatively normal in some respects, it is abnormal in others. For example, Volkmar, Sparrow, Rende, and Cohen (1989) report that children with autism can perceive faces at the same level of normal control children. It

has also been shown that children with autism can recognize their own faces in a mirror and can recognize faces of classmates (Spiker & Ricks, 1984; Langdell, 1978). However, it appears that children with autism achieve recognition in an unusual way. For example, in contrast to normal children who attended to the eyes, the older children with autism attended to the lower facial features (Langdell, 1978).

To summarize, results from these developmental studies suggest that by the age of one year, children can recognize the facial expressions of others and can make meaningful responses to such expressions. Moreover, normal children can perceive faces as well as adults by the age of six. They can also match facial expressions and can make some inferences about the appropriateness of various expressions for a given situation, and by about 14 years or so, children's performance equals the performance of adults. It also appears that children with autism may adopt an abnormal strategy for face recognition. It is not clear, however, if this atypical strategy has an impact on their perception and comprehension of affect.

Given the above findings, it is possible that in some respects children with autism may suffer a deficiency in their face processing skills which ultimately affects their performance on facial comprehension tasks. On the other hand, it is equally likely they lack the cognitive capacity to process complex affective material, and these difficulties are secondary to their cognitive deficits and not to specific problems in understanding affect. For example, face and affect matching tasks require the child to first comprehend the concept of matching variants of a single thing (person, emotion, object), to then sustain attention, then scan all choices, and then point or otherwise

indicate a choice, in addition to the specific perceptual processes involved in recognizing a person, object, or emotion. The situation matching task requires that the child adopt a somewhat hypothetical attitude (i.e., what would the child be feeling), possibly involving more of a "theory of mind" concept (Baron-Cohen, Leslie, & Frith, 1985) than simply matching facial expressions. The task then requires the child to verbalize or visualize the appropriate response, and then search the choice expressions, matching each to the internally held correct response. Thus, relative to face and affect matching tasks, situation matching tasks involve more complex cognitive processes.

Statement of the Problem

This study attempted to delineate those areas of difficulty in comprehension of facial and affective stimuli in a sample of children with PDD compared to two matched control groups. Experimental subjects included high functioning children with autism/PDD (Full Scale IQ of 60 or higher) who were between six and twelve years of age. High functioning children were selected to minimize the effects of limited cognitive skills on their performance on the various affective tasks.

One of the experimental tasks was an affect matching test in which subjects were required to match a target photograph of a child displaying one of six facial expressions to another photograph of a different child displaying the same facial expression. To determine whether any deficit found in the ability to match facial expressions would apply also to face recognition (where affective information is kept constant), the children were also given a face matching test inwhich they were required to look at a photograph of a target child and then asked to select another photo of the same child. Additionally,

an age matching test was developed to control for stimulus complexity. The age matching task required the children to select the photograph depicting a person who was of approximately the same age as a person in the target photograph. An assumption was made that the ability to match faces by expression required a similar level of abstraction involved in matching faces by approximate age.

To determine if children with PDD responded differently to social situations relative to non-social situations, another experimental task (Situations Test) was developed which required the children to choose the cartoon face which showed the emotion most appropriate for a given situation. A parallel task was also developed to control for the social/affective component in the Situations Test and required the children to complete a cartoon by identifying a missing essential feature.

Statement of the Hypothesis

The main objective of this study was to determine if children with PDD have difficulty understanding affective situations and if so, to determine whether these difficulties are secondary to deficits in processing faces, facial expressions and/or complex cognitive material.

Main Hypothesis:

1) Children with PDD will show deficits in processing cartoon situations which contain social content relative to those which lack social content.

Secondary hypotheses generated from control tasks:

2) Children with PDD will not differ from control groups on their performance on face processing skills as measured by matching photographs of faces by identity or by age.

3) Children with PDD will not differ from control groups on their performance on processing facial expressions as measured by matching photographs of faces by expression.
4) Children with PDD will not differ from control groups on their performance on a completion task requiring subjects to identify an essential missing feature in a cartoon situation.

CHAPTER II

METHOD

Subjects

An experimental group and two control groups participated in this study with each group including 15 males and 7 females. The experimental group consisted of 22 children with Pervasive Developmental Disorders (PDD) who ranged in age from six to twelve years. The group included twenty Caucasian children, one African American child, and one Asian American child. They participated in a comprehensive study looking at attention capacities and received tests measuring their intelligence, academic achievement, language, and affect comprehension. These children met DSM-III-R (American Psychiatric Association, 1987) criteria for either autistic disorder or pervasive developmental disorder--not otherwise specified (PDD-NOS). They also scored above the cut-off for autism on The Childhood Autism Rating Scale (CARS; Schopler, Reichler & Renner, 1988). Diagnostic information was obtained from parental interviews, review of the records, and observations of the child.

Traditionally, high functioning autism is used to describe those individuals with a diagnosis of PDD who perform within normal limits on individually administered IQ tests or on measures of adaptive functioning. Researchers have chosen different cut off points as an indicator of high functioning autism. They include Performance IQ's above 70 (Freeman, Lucas, Forness & Ritvo, 1985); Full Scale IQ's above 80 (Rumsey, Rapoport & Sceery,

1985); Full Scale IQ's above 70 (Asarnow, Tanguay, Bott, & Freeman, 1987); Full Scale IQ's above 65 (Gillberg, Steffenburg, & Jakobsson, 1987); or Full Scale IQ's above 60 (Gaffney & Tsai, 1987). In this study, intelligence was assessed with the WISC-III (Wechsler, 1991) using a cutoff of a Full Scale IQ of 60. The final sample included 22 children with PDD who had a mean verbal IQ of 74, a mean performance IQ of 83, and a mean full scale IQ of 76 (see Table 1). Children with autism or PDD-NOS were recruited through the Autism Society of America, special education schools in the area, and local newspaper advertisements.

Table 1
Mean Ages for the three groups

	PDD (N=22)	VMC (N=22)	PMC (N=22)	Pvalue
Chronological Age	8.5 yrs SD=1.9	5.8yrs SD=1.5	6.5yrs SD=1.6	<.001a,b
Verbal Mental Age	6.2yrs SD=1.86	6.2yrs SD=1.93	7.0yrs SD=1.9	NS
Performance Mental Age	7.0yrs SD=1.79	6.2yrs SD=2.0	7.0yrs SD=1.9	NS

*
a = PDD > PMC group
b = PDD > VMC group

Two groups of controls were formed. One group matched the PDD group by verbal mental age (VMC group) and the other matched the PDD group by performance mental age (PMC group). Specifically, each PDD subject matched with a control group subject on gender, race, and within six months mental age. As seen in Table 1, children with PDD were the oldest of the three groups with a mean age of 8.5 years. The verbal matched group was considerably

younger with a mean age of only 5.8 years while the performance matched group was in the middle with a mean age of 6.5 years.

Each control group consisted of 22 children between the ages of about 3 1/2 to 9 years. These children were recruited from area schools and a church, and were screened to exclude anyone on medication, or who had hearing, medical or other psychiatric impairments.

Procedures

Parents of potential experimental subjects were contacted and given a preliminary screening to determine their child's eligibility for the study (Appendices A & B). Basic demographic information, medical history, schooling, and previous testing history were requested as well as information that might exclude subjects' participation (i.e, psychiatric disorders and hearing impairments). Those subjects who were eligible after screening were called back and an appointment was made for testing. Children with autistic disorder or PDD were administered all tests at the Laboratory of Psychology and Psychopathology of the National Institutes of Mental Health (NIMH) in Bethesda, Maryland. Normal controls were initiallytested at their homes or schools, and then at NIMH. Examiners were supervised by a licensed psychologist and included a clinical psychology Ph.D. candidate and both bachelor and master's level research assistants. Each child on average received eight hours of testing. Those children who received all of the tests at NIMH typically completed testing in two days. Some control children, however, required three days of testing because some measures could only be administered at NIMH. All children had signed parental consent to participate in the study and were paid for their participation.

Measures

Diagnostic Measures

Two measures were used for diagnostic purposes--the DSM-III-R and the Childhood Autism Rating Scale. With the DSM-III-R (American Psychiatric Association, 1987), the child had to meet criteria for PDD/autism. The Childhood Autism Rating Scale (CARS; Schopler et al.,1988) is a rating scale targeting 14 areas of adaptive behavior. The rater is required to observe each child, and then within each area, rate the behaviors relevant to each item. The various areas include relating to people; imitation; emotional response; body use; object use; adaptation to change; visual response; listening response; taste, smell, and touch response and use; fear or nervousness; verbal communication; nonverbal communication, activity level; and level and consistency of intellectual response. Children were given a cumulative score categorizing them as either non-autistic, mildly-moderately autistic, or severely autistic. The children's scores ranged from 27.5 to 42.5 with the majority scoring between 30.7 and 33.9.

Tests of Academic Achievement

Each child was given the Letter-Word Identification, Passage Comprehension, Calculation, and Applied Problems subtests of the Woodcock-Johnson Psycho-Educational Battery-Revised (Woodcock & Johnson, 1990). The Letter-Word Identification subtest measures symbolic learning or the ability to match a rebus (pictographic representation of a word) with an actual picture of the object. More advanced items measure decoding skills (i.e., identifying isolated letters and words). Initial items of the Passage Comprehension subtest require the subject to point to the picture represented by a phrase. More

advanced items measure the subject's reading comprehension by his/her ability to identify a missing key word. The mathematics subtests include Calculation and Applied Problems. The former measures the subject's skill in performing mathematical calculations. Addition, subtraction, multiplication, division, and combinations of these basic operations are included, as well as some geometric, trigonometric, logarithmic, and calculus operations. The latter measures the subject's skill in analyzing and solving practical problems in mathematics. These tests were scored according to standard scoring procedures described in the Woodcock-Johnson manual.

Tests of Language Ability

To assess language ability, the Receptive One Word Picture Vocabulary Test (Gardner, 1985), the Expressive One Word Picture Vocabulary Test (Gardner, 1990), and the Test of Auditory Comprehension of Language (TACL; Carrow-Woolfolk, 1985) were administered. In the Receptive vocabulary test, the child is presented with pictures of three different objects and is required to point to the object named by the examiner. In the Expressive vocabulary test, the child is presented with one picture at a time and is asked to name that object. The TACL measures the child's comprehension of language. Individual subtests measure understanding of simple nouns, verb modifiers, and two- and three-word relations between them; of prepositions and pronouns within the context of a sentence; and of elaborated sentences which include combinations of more difficult grammatical structures. Tests were scored according to standardized procedures described in the respective manuals.

Tests of Emotion

Parents of the children whose photographs served as stimuli gave permission to take photographs of their children by signing a consent form (Appendices C & D). Boys and girls up to 12 years of age from varied ethnic/racial backgrounds were used for these photographs. In addition, several infants, adults, and elderly subjects were used for the age matching test described below. All individuals were photographed straight on against a white background using the same type of black and white film.

Affect Matching Test

An experimental test was developed to test the children's ability to match facial expressions. Stimuli consisted of 30 sets of black-and-white photographs of children displaying one of the six basic emotions (happy, sad, fear, anger, disgust, surprise; Ekman, Friesen, & Ellsworth, 1972). In previous studies of affect comprehension, stimulus materials developed by Ekman were used, however, these stimuli included only pictures of adults. In the present study, on the other hand, pictures of children were used as the experimenters believed that they might be more familiar for the subjects.

Photographs included in this test were identified by six adults as those best representative of the six emotions among a pool of 163 photographs. The adults were asked to first sort the photos by facial expression. Once sorted, they then ranked each photograph on how "good" a representation of the expression it was. Those photographs receiving the highest mean rankings within each emotion were used in the final test. The final matching for

expression test included 120 stimulus pictures--30 sets with five trials each of the six emotions.

The target was a photograph of a child displaying one of the six emotions; another photo of a different child displaying the same emotion had to be selected from three choices. In addition to the correct response, the other choices included a picture of the target child displaying another emotion and a different child displaying a different emotion but wearing either the same (19 sets) or a different accessory than the target (11 sets). These latter photographs were designated as an "other" option because they did not involve matching for identity, facial expression, or accessory. The target emotion and the position of the correct choice photograph was randomized. Moreover, selection of a particular child and accessory was also randomized. In 16 sets, the target child was a boy and in 14 sets, a girl.

Scores derived for the expression matching test included the total number of both correct and incorrect responses; the number of correct responses within each affect (i.e., happy, sad, angry, afraid, surprised, and disgusted); the number of responses matching by identity; the number of responses matching by accessory; and the number of correct and incorrect responses matching by "other", meaning matching for neither, identity, facial expression, nor accessory. This last category was added to determine if the absence of an accessory was associated with any particular pattern of responding.

Identity Matching Test

An experimental control test was developed to measure the children's ability to match photographs of faces by identity. Stimuli consisted of 30 sets of black-and-white photographs of children's faces. Photographs were taken under the same conditions as in the expression matching test. The target was a photograph of a child and the subject had to select another photo of the same child from three choices. In six of the sets, the choice photowas identical or congruent to the target photo. In the other 24 sets, the choice, the same child but in a different pose, also differed from the target by the presence or absence of either eyeglasses or a hat worn by children in the photos; these were designated as incongruent photographs. In half of the sets, the target photographs were pictures of males, while the other half were females. In each set, facial expressions were kept constant and the position of the correct choice photo was randomized.

Scores derived for the identity matching test included total number of correct responses; number of congruent correct responses; number of incongruent correct responses; number of incorrect responses due to matching for accessory; and number of incorrect responses matching for something other than accessory or identity.

Age Matching Test

Young adults and senior citizens were recruited for this test and all gave verbal consent to be photographed. This test was used to control for stimulus complexity in the expression matching test. Matching faces for expression requires the ability to extract information other than the person's identity and

then match by it. In order to tease out this component from the affective component, this task was developed by the experimenter. Black and white photographs were taken of persons representing four distinct age groups--infants, children, adults, and senior citizens. Each person was photographed against a white background and all identifying accessories were removed.

In the age matching test, children were presented with 16 sets of pictures including a target photograph and three other choices and had to select from among the choice photographs that person who was in the same age group as the target person. The affective component was excluded in this test by keeping facial expressions constant.

Derived scores for the age matching test included the total number of correct responses; number of correct responses within each of the four age groups; number of errors as a result of matching infants with children or adults with seniors or vice versa; and the number of errors as a result of any other paired matchings.

Situations Matching Test

This test was modelled after a similar test used by Fein, Lucci, Braverman, and Waterhouse (1992). It included 40 sets of cartoons depicting different affective situations. In each situation, the main character had his face blanked out and the subjects had to choose the cartoon face that most clearly showed the emotion appropriate for that situation. The cartoons were developed by the experimenter and included both social and non-social situations. Social situations (n=24) included those in which the target character was shown interacting with another character and who appeared to

be in a social relationship with that character. The social interaction determined which affect was appropriate for that situation. Non-social situations (n=16) included the target character alone or with another character but in the absence of a social relationship with that character. To prevent possible confusion subjects might have in labelling emotion for different cartoon characters, the target character in each cartoon was the same and subjects only had to point to the correct face. Additionally, facial expressions from which the subjects selected were posed by the same character as the target's face.

Scoring for the Situations test was determined by the responses given by the normal controls. For each stimulus cartoon, the percentage of control children responding with a given affect was computed. These percentages were then used as scoring weights. Each child was then given a weighted score for each of the 40 stimulus cartoons and then given a cumulative score. A description of the situations, the most common responses, and scoring weights are shown in Table 2.

Table 2
Descriptions, Identified Affect, and Weighted Scores for the Situations Test

Situation	Affect	Score
1. fight with another male character	angry	.93
2. falling down stairs	sad	.56
3. being yelled at by woman	angry	.54
	sad	.32
4. eating "worm" sandwich	disgusted	.68
5. hugging another male character	happy	.75
6. passing snowman who has angry face	happy	.38
	surprised	.27
7. with sick man in hospital	sad	.46
8. passing snowman who has happy face	happy	.77
9. given birthday cake by woman character	happy	.43
	surprised	.54

Table 2 (cont'd)

10. almost hit by car	afraid	.64
11. at gravesite of tiger	sad	.63
12. being taunted by tiger who has ice cream cone	happy	.54
	angry	.29
13. sharing book with another male character	happy	.64
14. dog leaving trail of poop	disgusted	.50
15. broken lamp, woman with happy face turned away from him	sad	.57
	afraid	.21
16. doll in refrigerator	happy	.36
	angry	.21
17. knocked from seesaw by girl with happy face	sad	.21
	angry	.29
	afraid	.29
18. patted on head by man with happy face	happy	.86
19. icecream fell from cone	sad	.69
20. broken lamp, woman with happy face turned toward him	sad	.50
	happy	.31
21. playing in snow	happy	.64
22. exchange of worm sandwich with girl character	disgusted	.50
23. found gold	happy	.50
24. watching girl throw up	disgusted	.70
25. jumping into pool	happy	.46
	afraid	.21
26. witch yelling at him	afraid	.75
27. raised in air by man with happy face	happy	.75
28. given a bottle	happy	.75
29. in the way of army tank	afraid	.71
30. kissed by girl	disgusted	.54
31. broken lamp, woman turned toward him with angry face	sad	.74
32. lion growling	afraid	.73
33. woman smiling at him	happy	.78
34. patted on head by man with angry face	happy	.63
35. fight with tiger	angry	.44
	happy	.22
	afraid	.22
36. sitting in corner	happy	.44
	sad	.37
37. at top of stairs to dark basement	afraid	.89
38. raised in air by man with angry face	happy	.37
	afraid	.33
39. fell off seesaw, rock	sad	.32
	surprised	.25
40. kicked out of window	afraid	.41
	sad	.33

Completion Test

This test was used as a control task for the Situations test. It required a similar skill in synthesizing several pieces of information in the cartoon and being able to extract particular information requested by the examiner. In this test, however, affect was kept constant by blanking out the face of the main character as was done in the Situations test. The Completion test included 22 selected cartoons from the Situations test and required subjects to complete the cartoon by identifying a missing essential feature. Stimuli were identical to their counterparts in the Situations test, except for the missing feature. For example, in the Situations test, if a character whose face is blanked out was holding an object, the same character was shown in the Completion test with his face again blanked out, but he is no longer holding that object. Keeping faces blank, and therefore expressionless, prevented subjects from using that cue in aiding in their identification of the missing feature. To equate this test with the Situations test on task demands, selected cartoons also included both social and non-social situations.

Scoring for the Completion test was also determined by the responses given by the normal controls. For each of the stimulus cartoons, the percentage of children giving a particular response was tallied. A point value of either 0, 1, or 2 was then assigned to each of the responses. The most common response received a 2 point value, while the next most common response received a 1 point value. If responses to a given cartoon were given by 10% or less of the children responding, these were assigned a 0 point value. In some cases, stimuli had two 1 point responses because the same percentage of children responded with two different answers. In other cases, there were

no 1 point responses because the majority of children gave only one response. All subjects then received two total scores--a cumulative tally of point values as well as a tally of the corresponding weighted scores. The weighted scores were determined the same way as in the Situations test. For each cartoon, the percentage of control children responding with a given missing feature was computed. These percentages were then used as scoring weights and subsequently tallied to give a cumulative score. A description of responses, point totals, and scoring weights are shown in Table 3.

Table 3
Descriptions, Point values, and Scoring Weights for Completion Test

Identified missing feature	Points	Weight
1. part of Beetle (arms, neck, sleeves)	2	.18
Calvin's belt	1	.11
2. steps	2	.21
grass or sidewalk	1	.14
something inside the house (people, furniture)	1	.14
3. fork	2	.37
food	1	.11
arm	1	.11
4. medicine (in the bag or spoon)	2	.21
something in the room (window, door, water)	1	.14
5. snowman's face (eyes, mouth, etc)	2	.80
part of snowman's body (scarf, arms, etc)	1	.13
6. candles	2	.57
desk legs	1	.18
7. part of the car (driver/tire/other part)	2	.41
part of Calvin (shoes/fingers/arm)	1	.28
8. stems	2	.45
lid to coffin	1	.31
9. the book or something looking at or part of the couch	2	.33
Dennis' arm	1	.11

Table 3 (cont'd)

10. something on the other side (a person or something)	2	.39
part of the board (e.g., handles)	1	.11
11. icecream	2	1.00
12. snowman's face (mouth/hat/pipe)	2	.50
snowman's body (hands, etc)	1	.29
13. part of toilet (seat/flusher/water)	2	.38
Calvin's arm or hand	1	.17
14. arms	2	.97
15. hand	2	.86
16. top of tank	2	.76
17. part of the heart or dress	2	.43
18. broken dish	2	1.00
19. bars of cage	2	.79
20. arms	2	.61
Calvin's foot/shoe: snow by foot	1	.18
21. person behind eyes	2	.36
other side of stairs	1	.14
22. broken glass	2	.39
man's foot	1	.21

For the Identity, Expression, and Age matching tests, photographs were presented in a looseleaf photo album with the pages turning vertically, so that the target stimulus was on the upper page and the three choices were on the lower page. For the Situations and Completion tasks, cartoons occupied one page each of a looseleaf binder consisting of individually plastic covered sheets. For the Situations test, the six choices displaying the various facial expressions were on a separate sheet so that if subjects wished to hold it themselves, they were free to do so.

All response sheets included a section for the examiner to record any comments made by the child. In addition, the identity, expression, and age matching response sheets were developed in such a way as to reveal any pattern of incorrect responding. Both of these steps were expected to aid in

the interpretation of the final results by providing possible explanations for any trends or significant findings.

It is not possible to give reliability or validity coefficients of the experimental tasks since they were developed specifically for use in this study. However, given they were patterned after similar tasks already in use in other studies measuring affective and perceptual processes in children with PDD/autism, it appears that they have construct validity. Moreover, given that the objective of this study was to develop tasks that would discriminate between the experimental and control groups, and to this end, they were successful. The PDD subjects indeed differed from the normal controls on some of the measures.

In terms of overall findings, there were no ceiling or floor effects observed on any of the experimental tasks suggesting that they were neither too difficult nor too easy for any of the groups. Additionally, the performance matched controls consistently outperformed the verbal matched controls on all measures suggesting that, as expected, the tasks were easier for the older subjects.

CHAPTER III

RESULTS

Data Analyses

T-tests were done to determine any significant differences between the PDD and matched normal controls. The first group of t-tests were done to test the main hypothesis looking at group differences between those situations depicting social content relative to those lacking social content. To correct for Type 1 error inherent in using multiple t-tests, a Bonferroni correction was used and we identified our alpha level at $p<.05$. The remaining four hypotheses looking at possible group differences on the Identity, Age, Affect, and Completion tests were analyzed as a separate group using a separate Bonferroni correction.

Cognitive Tests

As seen in table 4, children with PDD were relatively high functioning in that their VIQ, PIQ and FSIQ's were all above 70. Additionally, their scores on the verbal comprehension, perceptual organization, and freedom from distractibility indices of the WISC-III were all above 70. Both control groups received average scores on all three of the WISC-III indices.

Scores on the Woodcock-Johnson indicated a deficit in the PDD group's ability for mathematical concepts relative to their reading skills. While they scored within the average range in the Reading Cluster (95.0), they obtained a mean score of only 79.5 for the Math Cluster ($p<.0001$). No such differences

were found within either control group with the verbal matched controls scoring solidly average in these skills and the performance matched controls scoring slightly above average in these areas.

Table 4
Mean WISC-III Scores by Group

	PDD	VMC	PMC	Pvalue
VIQ	73.5	105.9	108.2	.001 a,b
PIQ	83.3	106.9	109.2	.001 a,b
FSIQ	76.3	107.1	109.9	.001 a,b
Verbal Comprehension	76.9	108.2	109.5	.001 a,b
Perceptual Organization	85.8	107.5	106.1	.002 a,b
Freedom from Distractibility	80.0	103.9	106	.001 a,b

*
a = PDD < PMC group
b = PDD < VMC group

Interestingly, all three groups showed the same pattern of scoring on the Receptive One Word Picture Vocabulary Test (ROWPVT) and the Expressive One Word Picture Vocabulary Test (EOWPVT). All groups showed significantly better performance on the expressive task than on the receptive task ($p<.0003$, $p<.008$, and $p<.034$ for the PDD, VMC, and PMC groups, respectively). On the ROWPVT, the PDD subjects, the verbal matched controls, and the performance matched controls obtained mean scores of 84.2, 108.3, and 108, respectively. However, on the EOWPVT, their mean scores were 94.9, 118.1, and 115.9, respectively.

On the Test for Auditory Comprehension of Language (TACL), PDD subjects' scores declined slightly as they moved from understanding simple nouns and verb modifiers, to understanding prepositions and pronouns within the context of a sentence, to understanding more elaborated sentences which included combinations of more difficult grammatical structures (mean scores of 86.1, 83.9 & 80.4, respectively). Both control groups performed in the average range on these subtests.

Tests of Emotion

Identity Matching Test

Children with PDD did not differ from either the VMC or the PMC groups on their ability to match faces by identity when both the target and the correct choice photograph were identical. However, PDD subjects made more errors than both control groups when none of the choice photographs was identical to the target (VMC: $t(42)=-3.38$, $p<.03$; PMC: $t(42)=-3.10$, $p<.04$; see table 5). Additionally, PDD subjects more frequently matched for accessory compared to the control subjects. Compared to the VMC group, if a target appeared wearing either glasses or a hat, the PDD subjects were significantly more likely to use this accessory as the salient feature for matching (VMC-glasses and hat: $t(42)=3.25$, $p<.03$ and $t(42)=3.34$, $p<.03$, respectively). Compared to the PMC group, children with PDD were significantly more likely to match for a hat ($p<.03$) and showed a trend when matching for glasses ($p<.08$). See table 5.

Table 5
Percent Mean Scores on Five Face Matching Tests

	PDD Percent	VMC Percent	PMC Percent	Pval
Identity Matching				
Correct Identical	97	98	97	NS
Correct Non-Identical	70	89	88	.04 a,b
Incorrect glasses	25	4	7	.03 b
Incorrect Hat	43	15	14	.03 a,b
Age Matching				
Infants	92	98	98	NS
Children	83	90	91	NS
Adults	56	74	81	.03 a
Seniors	69	85	88	.03 a
Affect Matching				
Happy	84	91	94	NS
Sad	74	89	91	NS
Angry	65	85	85	NS
Afraid	64	65	73	NS
Surprised	88	93	93	NS
Disgusted	84	92	94	NS
Situations Task				
Social	64	70	74	.03 a
Non-social	65	67	73	NS
Completion Task	53	57	60	NS

*
a = PDD < PMC group

b = PDD < VMC group

Age Matching Test

Children with PDD did not differ from either control group in matching photographs by approximate age when the target was either an infant or a child ($p>.05$). They did, however, have more difficulty compared to the PMC group when the target photograph was different in age from themselves (i.e,

adult or senior citizens). For adult targets, PDD subjects obtained a mean correct score of 2.23 out of 4.0 compared to 3.23 for the PMC group ($p<.03$). For senior citizen targets, the means were 2.77 and 3.5 for the PDD and PMC groups, respectively ($p<.03$). PDD subjects also made unusual matching errors consisting of matching target photographs of infants or children to choice photographs of adults or seniors. Compared to the PMC group, this difference was significant ($p<.002$), but compared to the VMC group, it failed to reach significance ($p<.08$).

Affect Matching Test

Children with PDD performed as well as the control subjects when matching faces by the six different facial expressions. However, when errors were made, experimental subjects were significantly more likely than the PMC group to match by identity or "other," and showed a similar trend when matching by accessory ($p<.031$, $p<.05$, and $p<.07$ for identity, "other," and accessory categories, respectively). Children with PDD showed a similar trend when compared to the VMC group ($p<.078$; $p<.062$, and $p<.065$ for identity, "other," and accessory categories, respectively).

Situations Matching Test

Children with PDD performed as well as the comparison groups on matching faces to an appropriate cartoon situation in those cases in which interpretation of its social context was not required ($p>.10$). However, in those instances where interpretation of the situation's social context was required, children with PDD performed poorer than their performance matched controls ($t(41)=-2.29$, $p<.05$), but not their verbal matched controls (NS: $p>.05$). See figure 1.

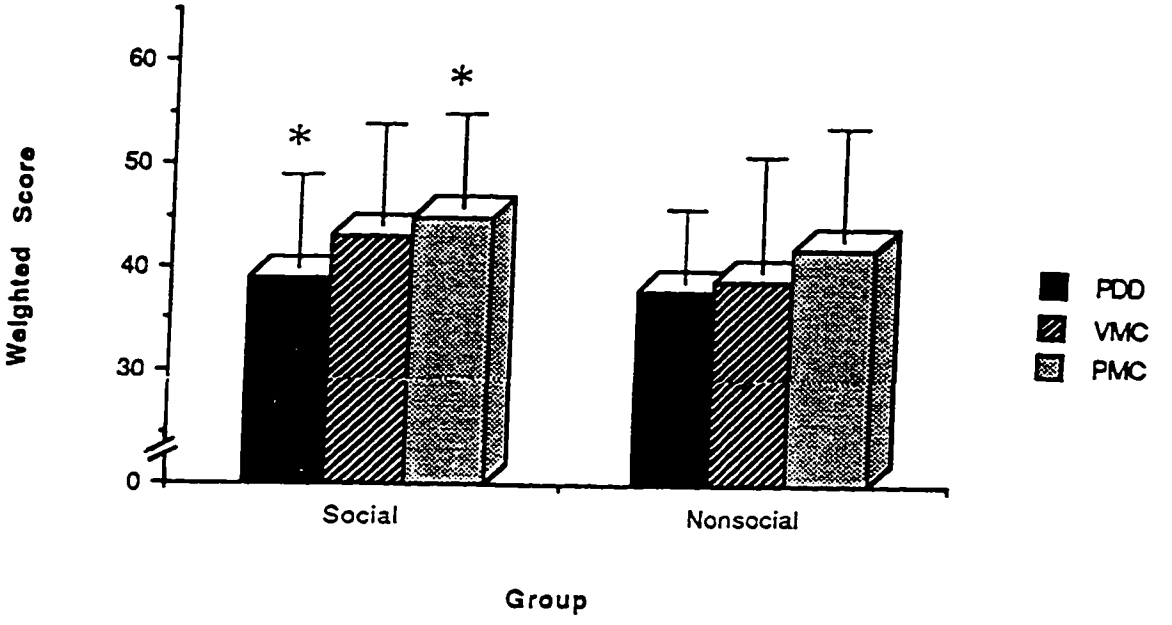

Figure 1
Group Differences on Social versus Non-Social items in the Situations Task

* PDD < PMC @ p < .05

Further analyses to determine whether matching by different affects had any effect on responses revealed some differences between groups. Compared to the VMC group, children with PDD showed significantly poorer performance when matching angry faces to the appropriate cartoon situation ($t(41)=-2.18$, $p<.035$). There were no differences when matching sad, happy, disgusted, surprised, or afraid faces to the appropriate situation. Compared to the PMC group, however, children with PDD showed more difficulties. Similar to the comparison with the VMC group, children with PDD showed significantly poorer abilities than the PMC group in matching angry faces ($t(41)=-3.00$; $p<.014$). However, the PDD subjects also showed a trend toward poorer performance when matching disgusted and afraid faces to the appropriate situation ($p<.057$ and $p<.089$, respectively).

Completion Test

There were no significant differences between groups in their abilities to identify which essential feature was missing in a cartoon situation (see table 5).

CHAPTER IV

DISCUSSION

The purpose of the present study was to investigate the parameters of affect comprehension in a sample of high functioning children with Pervasive Developmental Disorder (PDD). Previous research has shown a deficit in children with PDD/autism on a variety of affect comprehension tasks (Braverman et al., 1989; Fein et al., 1992; Ozonoff et al., 1990). The present study sought to add to the existing literature in two ways--first, to determine if high functioning children would exhibit the same deficits as previous researchers have reported, and second, to investigate the performance of these children on a variety of control tasks to determine whether putative deficits in affect comprehension are secondary to specific deficits in face processing.

The present study compared the performance on tests designed to assess the perception of faces, facial expression, and affective situations, of children with PDD to that of two control groups: one matched by Verbal Mental age and one by Performance Mental age. In general, the children with PDD had difficulty matching the appropriate facial expressions to a cartoon depicting a social context. In contrast, they showed no differences from the control subjects on comparable control tasks that required the children either to match facial expressions or to identify a missing essential feature in a cartoon (i.e., affect-matching and completion tasks, respectively). This suggests that children with PDD can distinguish between the facial expressions of various

emotions. They appear to have more difficulty, however, selecting the appropriate facial expression for a particular social situation. The PDD subjects' difficulty with affect in social situations did not appear to be the result of an inability to understand the cartoon situation, since they performed adequately on the completion task, a task that included the same situations.

The first specific question posed by this study, asked whether or not children with PDD could process faces, while the second asked if children with PDD could select the appropriate facial expression for a cartoon situation. In reference to the first question, PDD subjects displayed variable performance. On one hand, these children showed no difficulties in simply matching facial expressions, performing as well as the control subjects. On the other hand, children with PDD could only match facial identities when both the target and the correct choice photograph were identical. When the correct choice was not identical, the PDD subjects more often matched incorrectly by accessory (e.g., glasses, hat). Second, when required to match faces according to approximate chronological age, these children only had difficulty with targets that depicted people who were greatly different from their own age (i.e., adults and senior citizens).

These findings suggest that children with PDD have difficulty processing specific kinds of facial information. For example, they appear to be able to match facial expressions. This finding is in contrast to previous research that found global deficiencies in children with PDD/autism in affect-matching tasks, including the ability to match facial expressions, compared to non-verbal matched control subjects (Braverman et al., 1989; Jennings,1973;

Ozonoff et al., 1990). This discrepancy between findings could be the result of differences in either sample characteristics and/or the affective stimuli.

High-functioning children with PDD were used in the present study. Neither the Braverman et al., (1989) or the Ozonoff et al., (1990) studies report including only high functioning children in their PDD/autistic sample. Thus, it is quite likely that these samples included children with a wider range of cognitive abilities and probably included more subjects with lower functioning than was the case in the present study. It is conceivable that, given relative lower functioning, PDD/autistic subjects in the previous studies may have had more difficulty in affect-matching tasks. The children in the present study, however, did not appear to show such difficulty and performed as well as the control subjects in matching facial expressions. It is postulated then, that the higher functioning children displayed deficits that are probably related specifically to PDD rather than the secondary result of general problems in overall functioning.

In terms of affective stimuli, the present study used photographs of children for the affect-matching task while previous research used photographs of adults. Perhaps PDD subjects in the present study found photographs of children more engaging and/or easier to interpret than photographs of adults. In fact, the results of the age-matching task suggests that these children have more difficulty processing the faces of older individuals (i.e., adults and senior citizens). Perhaps a future study should be done comparing the responses to photographs of children and adults to determine any possible effects on responding.

Perhaps the facial expressions in the present study were better representations of the various emotions and therefore easier for the PDD subjects to interpret. Hence, the differences in research findings may be an artifact of differences in stimulus materials. It is important to note, however, that neither control group performed at ceiling on the affect-matching task suggesting that this task was not too easy.

Children with PDD appear to be able to process identical faces better than non-identical faces. When the correct choice was not identical to the target, the PDD subjects more often matched by accessory (e.g., glasses, hat). Thus, when these children were no longer able to use identical poses in determining the correct response, the presence of an accessory became the salient feature. Perhaps this deficit is related to the children's ability to carefully scan facial features in order to arrive at a correct response. As suggested by Ellis' (1992) results, it is possible that when presented with pictures of faces, PDD subjects scan external features like the hair and chin lines or focus on what the subject is wearing, instead of focusing on those internal features like the eyes and nose. This would result in their being able to match identical poses, since doing so does not necessarily involve scanning internal features.

The simplest explanation for this differential performance would be that the children with PDD are not processing the stimuli as faces at all. Instead they are perceiving them simply as complex, visual stimuli. Nevertheless, they can match facial expressions; therefore, it seems unlikely that they have some sort of global inability to process faces. Matching by identity requires that the child form the concept that the person in the

photograph is an entity and that the entity remains constant even when the specific physical features are altered. Thus successful performance on this task requires that the child recognize that a different pose of the same person or an altering of physical features by adding glasses or a hat does not change the perception of that person as an entity. Perhaps it is a difficulty in understanding this concept of "person constancy" that lies behind the PDD subjects' difficulties in matching non-identical faces. When matching identical faces, however, a child does not encounter an altering of physical features and therefore is not required to maintain a sense of "person constancy."

Children with PDD also seem able to process faces when matching by approximate age only when the targets were not greatly different from their own age (i.e., infants and children). When they encountered target photographs of either adults or senior citizens, they were significantly more likely than control subjects to make atypical errors like matching adults and/or senior citizens to infants and/or children.

A question was raised regarding whether the differences in responses may have been due to slight differences in the size of the stimuli in the age-matching task. Unfortunately, not all target photographs were taken from the exact same distance, and therefore, some subjects may appear larger or smaller than others. While this may have been the case, there is no evidence in their responses to this task that the experimental subjects were responding systematically to these differences. Given the fact that any size discrepancies would have been spread out across all four age groups, plus the fact that both control subjects and PDD subjects had more difficulty matching target

photographs of adults and senior citizens, it is not likely that these children were consistently responding to the size of the subject in the photographs. Therefore, it appears that the differential responses to the older subjects is not a result of the size of the target, but rather the result of some other phenomenon as suggested below.

The fact that the PDD children had significantly more difficulty with the adult and senior citizen targets might be attributed to developmental differences. As Ellis (1992) suggests, a child's ability to match faces increases as a function of age. In other words, with experience comes the increased ability to discriminate between persons of different ages. One could assume that at this age, all of the experimental subjects have more experience discriminating between individuals their own age and younger, than between young or middle age adults and senior citizens. This is supported by the finding that both control groups had relative difficulty matching older targets compared to younger ones. In addition, the PDD subjects did not differ significantly from the VMC subjects. While the children with PDD were significantly older in chronological age than the VMC subjects, it appears, that on this task, they seemed more developmentally similar. Therefore, the difference in performance on this task probably reflects a developmental delay rather than some sort of specific deficit peculiar to PDD.

The second major question guiding this study asked if children with PDD could select the appropriate facial expression for cartoon situations. PDD subjects, relative to performance-matched controls only, showed a deficit in matching faces if they were required to interpret social context. For example, when the PDD subjects encountered cartoon situations depicting an

interaction between characters, they had difficulty selecting the appropriate facial expression for that situation. On the other hand, they showed no such deficit relative to the control groups when selecting facial expressions for those cartoons that did not depict a social relationship between characters. Moreover, on a comparable control task (Completion Test), equated with the Situations Test for stimulus complexity, but without the affective content, the children with PDD performed as well as the control subjects.

The results of these findings suggest that PDD subjects understood what was required of them--namely to synthesize information in the cartoon situation, to determine what was missing, and to select the most appropriate response. Additionally, the fact that there were no significant group differences on the Completion Test suggests these children appear to be able to interpret information embedded within a social context. However, when the social context required the additional application of affective information, PDD subjects have more difficulty. This finding seems to support previous research that children with autism/PDD have deficits in a specific aspect of social cognition--that of attributing beliefs and other mental states to other people. This deficit is characterized as an impairment in the child's "theory of mind" (Baron-Cohen, Leslie, & Frith, 1985).

In non-social situations, the PDD subjects seemed as capable as the control subjects in attributing the appropriate emotion to the cartoon character. It seemed as if these children were able to put themselves in the character's place. When adding the dimension of a social relationship, however, they faltered. It seemed as if in response to the non-social cartoons, these children may have said something like, "I can see how I might feel if

that were me." In these cases, interpretation of the appropriate emotion depended only on one character and the PDD children could put themselves in that character's shoes. But in the social situations, they may have said something like, "I am not sure how I would feel with that other person present" because they now had to interpret their own feelings based on the feelings of another. This second situation appears to involve a second step that these children appear unable to comprehend.

The children with PDD seemed to have a particular difficulty with identifying angry faces in the social cartoon situations even though they could match angry facial expressions in the affect-matching task. It is possible that, given their language impairments, PDD subjects may have an especially difficult time dealing with negative affect because of their limitations in verbalizing their feelings. For example, it is postulated that the frustration caused by an inability to express one's feelings adequately is likely to increase feelings of anger. In contrast, suppressing the expression of sadness, happiness, or fear is more likely to result in a decrease rather than an increase in subjective experience (Baron & Byrne, 1991).

In summary, it appears that, compared to verbal and performance matched controls, the difficulties of children with PDD in comprehending affect in social situations are not due exclusively to pervasive cognitive deficits or developmental delays. Specifically, these children had fairly adequate intelligence and verbal skills. Additionally, they do not seem to suffer a general deficiency in their face processing skills, as suggested by their performance on the identity, age, and affect-matching tasks. Nor does it appear that they lack the cognitive capacity to process complex visual

material as suggested by their performance on the Completion Test and the non-social portion of the Situations Test. Secondly, in some cases, the deficits shown by children with PDD were not observed in the VMC group, suggesting that developmental differences could not account for these observed deficits exclusively.

Research by Fein et al., 1992 reported a deficit in children with PDD/autism in processing affective stimuli relative to non-affective stimuli. These researchers found that, relative to their own performance on matching the appropriate facial expression to non-social situations, children with PDD performed worse on the social situations. However, these researchers did not find between group differences on the situations task. As suggested earlier, sample characteristics (i.e., high functioning versus low functioning children) and/or experimental stimuli may explain these contrasting findings. For example, photographs of children were used in the situation task in the Fein et al. study compared to cartoon situations in the present study. Perhaps the use of cartoon situations made processing of affective information more difficult for the PDD subjects. Maybe cartoons do not mirror "real life" social interactions for these subjects; perhaps, pictures of children engaging in social interactions would have been easier to process.

The results of the present study, while discussed within a framework of social deficits for children with PDD, can also be related to general theories of cognitive development--namely the information processing approach and Piaget's cognitive development theory. The information-processing approach posits that the human intellect functions like a computer (Kuhn, 1988). Specifically, selective attention or the ability to pay attention is said to be an

important part of human intellect or cognition. Without that ability to attend only to the relevant features of an object, individuals would become overwhelmed by extraneous stimuli. Since we are inundated daily with more information than is possible to process, in order for us to use any of this information effectively, we have to become efficient in focusing our attention only on that which is relevant.

The results of the Identity Test could be explained within an information processing framework. We assumed, and possibly incorrectly so, that this task was the simplest relative to the other experimental tasks. For example, from an adult perspective, we assumed that matching faces by identity would not require complex processes. We assumed that relative to the age and affect-matching tasks, the identity-matching task was the least abstract since successful performance did not require that the child process anything other than the identity. However, on the age and affect-matching tasks, the child supposedly had to perceive some additional quality other than facial identity. However, in hindsight, from a child's point of view, encountering non-identical stimuli may have increased task demands because the child then had to attend to more irrelevant or discrepant details than when faced with identical stimuli. It is quite likely that, due to the number of discrepant cues in matching non-identical poses, the child found it more difficult to determine what information was relevant in helping select the correct response. Thus, when matching non-identical photographs, these children may have simply been overwhelmed with extraneous information explaining their tendency to match by accessory rather than identity. This hypothesis is also in line with the fact that the children with PDD scored more

poorly on the freedom from distractibility index of the WISC-III ($\bar{X}$=80 compared to 103.9 and 106 for the VMC and PMC groups, respectively).

An essential cornerstone of Piagetian theory is that increases in cognitive development are a result of both maturational and experiential processes (Piaget, 1971). It appears then that the PDD subjects, given their mental age and IQ, should have acquired some perspective-taking skills (Flavell, 1992) and thus suggests that they are in the stage of concrete operational thinking. However, given their performance on the Situations Test, relative to the PMC children's performance, it appears that the children with PDD are probably not as far along this stage of cognitive development as are the PMC children. Thus the PDD children do not appear to have the readiness and/or the practice that would allow them to be successful in their perspective-taking abilities. It is also postulated that a cognitive deficit in perspective-taking skills is further compounded by deficits in social interaction. This could explain the performance of the PDD subjects, particularly on the social portion of the Situations Test, in which they performed significantly poorer on matching the appropriate facial expression to a social cartoon situation.

Given these findings, further research is needed in this area to understand affective perception in children with PDD. The present tasks made it possible to tease apart several components related to the comprehension of affect. By designing various control tasks, I was able to determine the relative influence of stimulus complexity and social context in affect comprehension. However, these tasks do not assess all types of possible social interaction and are therefore a limited set. Specifically, they may pose a threat to external

validity. To improve on this, more ecologically valid tasks (i.e., videotapes and/or naturalistic observations) are needed that can simulate affective exchanges. For example, requiring children to respond to videotaped social exchanges would allow experimenters to manipulate variables like non-verbal information, voice inflection and intonation, and possible degree of affect to determine what effect, if any, these may have on the comprehension of affect. Similarly, observing children in natural settings would help in determining what other cues contribute to the understanding of affect. While such tasks might prove more ecologically valid, they have one main disadvantage--namely, the loss of experimental control. Thus, a complete understanding of this phenomenon requires implementation of both types of studies.

Along similar lines, it might prove worthwhile to use photographs instead of cartoons in the Situations and Completion Tests since the identity, age, and affect-matching tasks utilized photographs. It is possible, that responding to cartoons is in some way inherently different than responding to photographs.

It is also important to determine empirically, the construct validity of these experimental tasks. While they were patterned after similar tasks already in use in other studies measuring affective and perceptual processes in children with PDD (e.g., Fein et al., 1992, Ozonoff et al., 1990), it still needs to be determined empirically if these tasks correlate well with those tasks. Conversely, how well do they discriminate these constructs from others that may be similar? Once validated, reliability studies could then determine if, in fact, the experimental tasks are consistently measuring these constructs.

These findings do have more long range implications. If future studies support the existence of specific rather than pervasive areas of affective/social deficits, this would hopefully lead psychologists and educational specialists to develop specific compensatory strategies that would enable them to intervene more effectively with this population. Furthermore, such efforts would also assist parents in the management of these children resulting in a continuous, consistent, and hopefully ideal integration of effective treatment intervention.

Concluding, the present study showed that children with PDD had difficulty selecting the appropriate facial expression for a particular social situation but had no difficulty in simply matching facial expressions. Moreover, the PDD subjects showed no differences from control subjects on a control task requiring them to identify a missing essential feature in a cartoon (completion task). Finally, children with PDD, in some cases, performed as well as control subjects on the identity and age-matching task. What this suggests, is that for this sample of high-functioning children with PDD, pervasive cognitive deficits or developmental delays do not account completely for their difficulty in comprehending affect in social situations. As indicated by their performance on the identity, age, and affect-matching tasks, they do not seem to suffer a general deficiency in face processing skills. Nor does it appear that they lack the cognitive capacity for processing complex visual stimuli as suggested by their performance on the Completion Test and the non-social potion of the Situations Test. Thus the deficits shown appear to be more specific in nature and related to the understanding of affect within a social context.

APPENDIX A

Date:_____
Interviewer:_____
Subject #_____

SCREENING FORM FOR AUTISTIC SUBJECTS

CHILD'S NAME:_____
DATE OF BIRTH:___/___/___ AGE:_____ SEX:_____
SCHOOL:_____ GRADE:_____

PARENT'S NAMES_____
ADDRESS: _____
_____
_____

DAYTIME PHONE:(____)_____
EVENING PHONE:(____)_____

IS CHILD CURRENTLY A VOLUNTEER IN ANY OTHER NIH PROTOCOLS?
NO YES

IF YES, INSTITUTE _____
IF YES, INVESTIGATOR _____
IF YES, DESCRIBE STUDY _____
_____

HAS CHILD EVER PARTICIPATED IN NIH PROTOCOLS? NO YES

IF YES, INSTITUTE _____
IF YES, INVESTIGATOR _____
IF YES, DESCRIBE STUDY _____
_____

HANDEDNESS: RIGHT_____ LEFT_____

RACE: ASIAN HISPANIC
BLACK NATIVE AMERICAN
CAUCASIAN OTHER

IS CHILD ENGLIGH SPEAKING?: NO____ YES____

PRIMARY LANGUAGE SPOKEN AT HOME: ENGLISH_____
SPANISH_____
OTHER(specify)_____

HAS YOUR CHILD EVER BEEN DIAGNOSED OR TREATED FOR:

			DATE(S)	TREATMENT
HEARING LOSS	NO	YES	_____	_____
SEIZURES	NO	YES	_____	_____
HEAD INJURY	NO	YES	_____	_____
NEURO DISORDER	NO	YES	_____	_____
If YES, specify:	_____			
PSYCHIATRIC COND	NO	YES	_____	_____
LEARNING DISABILITY	NO	YES	_____	_____
ADD	NO	YES	_____	_____
MENTAL RETARDATION	NO	YES	_____	_____
BEHAVIORAL PROB.	NO	YES	_____	_____
If YES, specify:	_____			
ALLERGIES	NO	YES	_____	_____
ASTHMA	NO	YES	_____	_____
DIABETES	NO	YES	_____	_____
OTHER	NO	YES	_____	_____
If YES, specify	_____			

HAS YOUR CHILD EVER HAD ANY PSYCHOLOGICAL TESTING? NO____ YES____

If yes, when, what kind and what were results?

1._____
2._____
3._____

HAS YOUR CHILD EVER BEEN ON MEDICATION?: NO____ YES____

If yes, what kinds, what is dosage, and for how long?

1._____
2._____

HAS YOUR CHILD EVER BEEN HOSPITALIZED?: NO____ YES____

If, YES, specify:_____

IS YOUR CHILD PRESENTLY MAINSTREAMED IN REGULAR CLASSES OR ATTENDING SPECIALIZED AUTISTIC CLASSES?

1._____

BRIEFLY DESCRIBE YOUR CHILD'S LANGUAGE FUNCTIONING

_____
_____
_____

PREVIOUS MEDICAL TESTING? (FRAGILE X, MRI, ETC)

_____
_____
_____

OTHER FORMS OF TREATMENT (AUDITORY TRAINING)

_____
_____
_____

APPENDIX B

Date:_____
Interviewer:_____
Subject #_____

Screening Form for Normal Controls and LD Subjects

CHILD'S NAME:_____
DATE OF BIRTH:___/___/___ AGE:_____ SEX:_____
SCHOOL:_____ GRADE:_____

PARENT'S NAMES_____
ADDRESS: _____
_____
_____

DAYTIME PHONE:(____)_____
EVENING PHONE:(____)_____

IS CHILD CURRENTLY A VOLUNTEER IN ANY OTHER NIH PROTOCOLS?
NO YES

IF YES, INSTITUTE _____
IF YES, INVESTIGATOR _____
IF YES, DESCRIBE STUDY _____
_____

HAS CHILD EVER PARTICIPATED IN NIH PROTOCOLS? NO YES

IF YES, INSTITUTE _____
IF YES, INVESTIGATOR _____
IF YES, DESCRIBE STUDY _____
_____

HANDEDNESS: RIGHT_____ LEFT_____

RACE:
ASIAN
BLACK
CAUCASIAN
HISPANIC
NATIVE AMERICAN
OTHER

IS CHILD ENGLIGH SPEAKING?: NO____ YES____

PRIMARY LANGUAGE SPOKEN AT HOME: ENGLISH_____
SPANISH_____
OTHER(specify)_____

HAS YOUR CHILD EVER BEEN DIAGNOSED OR TREATED FOR:

			DATE(S)	TREATMENT
HEARING LOSS	NO	YES	_____	_____
SEIZURES	NO	YES	_____	_____
HEAD INJURY	NO	YES	_____	_____
NEURO DISORDER	NO	YES	_____	_____
If YES, specify:				
PSYCHIATRIC COND	NO	YES	_____	_____
LEARNING DISABILITY	NO	YES	_____	_____
ADD	NO	YES	_____	_____
MENTAL RETARDATION	NO	YES	_____	_____
BEHAVIORAL PROB.	NO	YES	_____	_____
If YES, specify:				
ALLERGIES	NO	YES	_____	_____
ASTHMA	NO	YES	_____	_____
DIABETES	NO	YES	_____	_____
OTHER	NO	YES	_____	_____
If YES, specify				

HAS YOUR CHILD EVER HAD ANY PSYCHOLOGICAL TESTING? NO____ YES____

If yes, when, what kind and what were results?

1._____
2._____
3._____

HAS YOUR CHILD EVER BEEN ON MEDICATION?: NO____ YES____

If yes, what kinds, what is dosage, and for how long?

1._____
2._____

HAS YOUR CHILD EVER BEEN HOSPITALIZED?: NO____ YES____

If, YES, specify:_____

HAS YOUR CHILD EVER RECEIVED SPECIAL SERVICES AT SCHOOL?

			If YES, when?
SPECIAL CLASS	NO	YES	_____
RESOURCE ROOM	NO	YES	_____
TUTORING	NO	YES	_____
COUNSELING	NO	YES	_____

DOES YOUR CHILD:

HAVE DIFFICULTY WITH OTHER CHILDREN	NO	YES
OFTEN INITATE FIGHTS	NO	YES
HAVE TROUBLE ACCEPTING AUTHORITY	NO	YES
OFTEN BREAK THE RULES	NO	YES

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

National Institutes of Health
Bethesda, Maryland 20892
Building : 10
Room : 4C110
(301) 496- 7672

APPENDIX C

PERMISSION FOR TAKING PHOTOGRAPHS

1) I hereby consent that photographs may be taken of my son or daughter by the Laboratory of Psychology and Psychopathology of the National Institute of Mental Health/American University. This is a collaborative project coordinated by Dr. Bryan Fantie (Samara's father) and Dr. Daisy Pasqualevaca.

2) Such photographs may be published, shown, exhibited or otherwise used for any purpose of education or research.

3) I understand that neither my son or daughter will be identified by name in conjunction with any public use of this material.

4). I grant this consent as a voluntary contribution and I waive any and all rights I may have to royalties or other compensation with any such use.

_____
(Print Name of Minor Child)

_____
(Signature of Parent/Guardian)

_____
(Signature of Witness)

Date:_____

Please return this release form by Wednesday April 7, 1993. Thank you in advance for your help.

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

National Institutes of Health
Bethesda, Maryland 20892
Building : 10
Room : 4C110
(301) 496- 7672

APPENDIX D

PERMISSION FOR TAKING PHOTOGRAPHS

1) I hereby consent that photographs may be taken of my son or daughter by the Laboratory of Psychology and Psychopathology of the National Institute of Mental Health/American University.

2) Such photographs may be published, shown, exhibited or otherwise used for any purpose of education or research.

3) I understand that neither my son or daughter will be identified by name in conjunction with any public use of this material.

4). I grant this consent as a voluntary contribution and I waive any and all rights I may have to royalties or other compensation with any such use.

_____
(Print Name of Minor Child)

_____
(Signature of Parent/Guardian)

_____
(Signature of Witness)

Date:_____

REFERENCES

Allen, D.A. (1988). Autistic spectrum disorders: Clinical presentation in preschool children. Journal of Child Neurology, 3, 48-56.

American Psychiatric Association (1987). Diagnostic and Statistical Manual of Mental Disorders (rev. 3rd ed). Washington, D.C.: American Psychiatric Association.

American Psychiatric Association (1994). Diagnostic and Statistical Manual of Mental Disorders (4th edition). Washington, D.C.: American Psychiatic Association.

Asarnow, R.F., Tanguay, P.E., Bott, L., & Freeman, B.J. (1987). Patterns of intellectual functioning in non-retarded autistic and schizophrenic children. Journal of Child Psychology and Psychiatry, 28(2), 273-280.

Baron, R. & Byrne, D. (1991). Social psychology: Understanding human interaction (6th ed). (pp. 88-133). Needham Heights MA: Allyn & Bacon.

Baron-Cohen, S., Leslie, A.M., & Frith, U. (1985). Does the autistic child have a "theory of mind"? Cognition, 21, 37-46.

Barrera, M.E. & Maurer, D. (1981a). The perception of facial expressions by the three-month -old child. Child Development 52, 203-206.

Barrera, M.E. & Maurer, D. (1981b). Recognition of mother's photographed face by the three-month-old- infant. Child Development, 52, 714-716.

Bauman, M. L. & Kemper, T. L. (1985). Histoanatomic observations of the brain in early infantile autism. Neurology, 35, 866-874.

Braverman, M., Fein, D., Lucci, D., & Waterhouse, L. (1989). Affect comprehension in children with pervasive developmental disorders. Journal of Autism and Developmental Disorders, 19(2), 301-316.

Bukatko, D. & Daehler, M. (1995). Child Development (2nd ed.). Boston MA: Houghton Mifflin.

Carrow-Woolfolk, E. (1985). Test for Auditory Comprehension of Language, D.L.M. Teaching Resources, Allen Texas.

Courchesne, E., Lincoln, A.J., Kilman, B.A., & Galambos, R. (1985). Event-

related brain potential correlates of the procesing of novel visual and auditory information in autism. Journal of Autism and Developmental disorders, 15(1), 55-76.

Courchesne, E., Lincoln,, A.J., Yeung-Courchesne, R., Elmasian, R., & Grillon, C. (1989). Pathophysiologic findings in non-retarded autism and receptive developmental language disorders. Journal of Autism and Developmental Disorders, 19, 1-17.

Damasio, A.R. & Maurer, R. G. (1978). A neurological model for childhood autism. Archives of Neurology, 35, 777-786.

DeLong, G.R. (1978). A neuropsychological interpretation of infantile autism. In M. Rutter & E. Schopler (Eds.), Autism. New York: Plenum.

Denckla, M.B. (1986) Editorial: New diagnostic criteria for autism and related behavioral disorders--guidelines for research protocols. Journal of the American Academy of Child Psychiatry, 25, 221-224.

Ekman, P., Friesen, W.V., & Ellsworth, P. (1972). Emotion in the Human Face. New York: Pergamon.

Ellis, H. (1992). The development of face processing skills. Phil. Trans. R. Soc. Lond. 335, 105-111.

Fechner, E.H. (1978). Children's understanding of the nonverbal communcation of emotion in the visual, vocal, and gestural modes. Dissertational Abstracts International, 39, 2568-2569.

Fein, D., Lucci, D., Braverman, M.,& Waterhouse, L. (1992). Comprehension of affect in context in children with pervasive developmental disorders. Journal of Child Psychology and Psychiatry, 33, 1157-1167.

Freeman, B.J., Lucas, J.C., Forness, S. R., & Ritvo, E. R. (1985). Cognitive processing of high-functioning autistic children: Comparing the K- ABC and WISC-R. Journal of Psychoeducational Assessment, 4, 357-362.

Gaffney, G. R. & Tsai, L.Y. (1987). Magnetic resonance imaging of high level autism. Journal of Autism and Developmental Disorders, 17, 433-438.

Gardner, M.F. (1985). Receptive One Word Picture Vocabulary Test, Academy Therapy Publications, Novak CA.

Gardner, M.F. (1990). Expressive One Word Vocabulary Test, Academy Therapy Publications, Novak CA.

Gillberg, C., Steffenburg,S., & Jakobsson, G. (1987). Neurobiological findings in 20 relatively gifted children with Kanner-type autism or Asperger's syndrome. Developmental Medicine and Child Neurology, 29, 641-649.

Grillon, C., Courchesne, E., & Akshoomoff, N. (1989). Brainstem and middle latency audiroty evoked potentials in autism and developmental language disorder. Journal of Autism and Developmental Disorders, 19(2), 255-269.

Hainline, L. (1978). Developmental changes in visual scanning of face and nonface patterns by infants. Journal of Experimenal Child Psychology, 25, 90-115.

Haith, M.M., Bergman, T., & Moore, M. (1977). Eye contact and face scanning in early infancy. Science, 198, 853-855.Hobson, R. P. (1986a). The autistic child's appraisal of expression and emotion: Journal of Child Psychology and Psychiatry and Allied Disciplines, 27, 321-342.

Hobson, R. P. (1986b). The autistic child's appraisal of expression and emotion: A further study. Journal of Child Psychology and Psychiatry and Allied Disciplines, 27, 671-680.

Jennings, W. (1973). A study of the preference of affective cue in autistic children. Dissertation Abstracts, 34, 4045-4046.

Klinnert, M. Campos, J., Sorce, J., Emde, R. & Svejda, M. (1983). Emotions as behavior regulators: Social referencing in infancy. In R. Plutchik and H. Kellerman (Eds.), Emotions in Early Development. Academic Press: New York.

Kolb, B., Milner, B., & Taylor, L. (1983). Perception of faces by patients with localized cortical excisions. Canadian Journal of Psychology, 37, 8-18.

Kuchuk, A., Vibbert, M., & Bornstein, M. H. (1986). The perception of smiling and its experiential correlates in 3-month-old infants. Child Development, 57, 1054-1061.

Kuhn, D. (1988). Cognitive development. In M.H. Bornstein and M.E. Lamb (Eds.), Developmental Psychology: An Advanced Textbook (2nd ed.). (pp. 205-260). Hillsdale, N.J: Lawrence Erlbaum.

Lamb, M.E. & Bornstein, M.H. (1987). Development in Infancy (2nd ed.). Random House: NewYork.

Langdell, T. (1978). Recognition of faces: An approach to the study of autism. Journal of Child Psychology and Pyschiatry, 19, 255-268.

Maurer, D. & Salapatek, P. (1976). Developmental changes in the scanning of faces by young infants. Child Development, 47, 523-527.

Minshew, N.J., Goldstein, G., & Payton, J.B. (1989). Abstraction and memory deficits in non-retarded autistics: A fundamental deficit? Neurology, 39(1), 136

Minshew, N.J., Payton, J.B., & Sclabassi, R.J. (1986). Cortical neurophysiologic abnormalities in autism. Neurology, 36(1), 194-195.

Novick, B., Kurtzberg, D., & Vaughn, H.G. (1979). An electrophysiologic indication of defective information storage in childhood autism. Psychiatry Research, 1, 101-108.

Novick, B., Vaughn, H.G., Kurtzberg, D., & Simson, R. (1980). An electrophysiologic indication of autditory processing deficits in autism. Psychiatry Research, 3, 107-114.

Ornitz, E. M. (1985). Neurophysiology of infantile autism. Journal of the American Academy of Child Psychiatry, 24(3), 251-262

Oster, H. (1981). "Recognition" of emotional expression in infancy? In M. Lamb & L. Sherrod (Eds.), Infant Social Cognition: Empirical and Theoretical Considerations. Lawrence Erlbaum Associates: Hillsdale, NJ.

Ozonoff, S. & Pennington, B.F., & Rogers, S. J. (1990). Are there emotion perceptions deficits in young autistic children? Journal of Child Psychology and Psychiatry, 31, 343-361.

Rapin, I. (1991). Autistic children: Diagnosis and clinical features. In M. Denckla & S. James (Eds.), An Update on Autism: A Developmental Disorder. Pediatrics, 87, 751-771.

Rumsey, J. M., Rapoport, J. L., & Sceery, W. R. (1985). Autistic children as adults: Psychiatric, social and behavioral outcomes. Journal of the American Academy of Child Psychiatry, 24, 465-473.

Schopler, E., Reichler, R.J., & Renner, B.R. (1988).CARS: The Childhood Autism Rating Scale, Western Psychological Services: Los, Angeles CA.

Schwartz, G.M., Izard, C.E. & Ansul, S.E. (1985). The 5-month-old's ability to discriminate facial expressions of emotion. Infant Behavior and Development, 8, 65-77.

Spiker, D & Ricks, M. (1984). Visual self-recognition in autistic children's developmental reltionships. Child Development, 55, 214-225.

Tantam, D., Monaghan, L., Nicholson, H., & Stirling, J. (1989). Autistic children's ability to interpret faces: A research note. Journal of Child Psychology and Psychiatry, 30(4), 623-630.

Volkmar, F.R., Sparrow, S.S., Rende, R.D. & Cohen, D. J. (1989). Facial perception in autism. Journal of Child Psychology and Psychiatry, 30, 591-598.

Vurpillot, E. & Ball, W. A. (1979). The concept of identity and children's selective attention. In G. Hale & M. Lewis (Eds.), Attention and Cognitive Development. New York: Plenum

Wechsler, D. (1991). Wechsler Intelligence Scale for Children (3rd ed). Psychological Corporation, New York.

Wing, L. & Gould, J. (1979). Severe impairments of social interaction and associated abnormalities in children: Epidemiology and classification. Journal of Autism and Developmental Disorders, 9, 11-29.

Woodcock, R.W. & Johnson, M.B. (1990). Woodcock-Johnson Psycho-Educational Battery -Revised, Riverside Publishing Co., New York.

Young-Browne, G. Rosenfeld, H.M. & Horowitz, F.D. (1977). Infant discrimination of facial expressions. Child Development, 48, 555-562.