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# Individuals with Autism Spectrum Disorders

*Teaching, Language, and Screening*

BY

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## ABSTRACT

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The present dissertation on autism spectrum disorders (ASD) addressed several questions. First, the behavioral symptoms of speaking and mute individuals with ASD were compared on the Autism Behavior Checklist (ABC), a commonly used diagnostic instrument. In addition, questions about the construction of the ABC were investigated. In Study I it was found that although the two groups did not significantly differ on the total ABC score, the mute group demonstrated significantly more pathology on 21 of 57 items and 3 of 5 subscales. The speaking group obtained significantly higher scores on only 8 items and 1 subscale (Language). The appropriateness of providing greater pathology scores to speaking, rather than mute, individuals with ASD was called into question. In addition, it was speculated that the expressive language items are weighted too heavily, on both the Language subscale and the total score.

Second, because the 57 items of the ABC were categorized into 5 subscales on a subjective basis, an empirical investigation of the factor structure of the ABC was performed. In Study II, a 5-factor model that contained 39 of the items accounted for 80% of the total variance in the checklist. No support was found for classifying the 57 items into the existing 5 subscales.

Finally, the two most common forms of instruction to teach children with ASD, discrete-trial teaching and incidental teaching, were assessed. In Study III it was ascertained that discrete-trial teaching was more efficient and produced faster acquisition and initially, greater generalization. However, by follow-up, the incidental teaching methods resulted in equal retention, greater generalization, and equal or greater spontaneous usage. The findings indicate that although it takes a longer time for children with autism to learn with incidental teaching procedures, once they have acquired an ability, it may be more permanent.

*Key words:* Autism, autism spectrum disorders, Autism Behavior Checklist, language, test construction, factor analysis, teaching, discrete-trial, incidental teaching, generalization, spontaneous usage.

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*In memory of my brother Bill (1944-1991)*



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- III Miranda-Linné, F. M., & Melin, L. (1992). Acquisition, generalization, and spontaneous use of color adjectives: A comparison of incidental teaching and traditional discrete-trial procedures for children with autism. *Research in Developmental Disabilities*, 13, 191-210.

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## INTRODUCTION

### BACKGROUND

Autism is a developmental disorder whose behavioral characteristics range on a continuum from mild to severe. It is characterized by an impairment in the development of reciprocal social and communication skills, abnormal language development, and a restricted repertoire of behaviors and interests. Autism is typically not diagnosed prior to age 2 or 3 years and the prognosis is often poor. Because autism seriously affects multiple domains, it is a challenging disorder to understand and treat.

The relatively short history of autism has been characterized by controversy and theoretical confrontations regarding diagnosis, etiology, and treatment. The more recent emphasis on the empirical investigation of autism has fortunately resulted in a more rational and scientific approach to the field (Schreibman, 1988).

In the early 1940s, Leo Kanner (1943) and Hans Asperger (1944/1991) independently described childhood disorders that were characterized by impaired social relationships, abnormal language, and restricted and repetitive interests. Kanner was the first to identify “early infantile autism” as a distinct diagnostic entity when he portrayed the behavioral characteristics of 11 children he had seen at the Johns Hopkins University. He gave a detailed description of each of the children, who were remarkably alike in several behavioral categories, but were different from other recognized child clinical populations. Specifically, all of the children were unable to develop normal relationships to people (“extreme autistic aloofness”); showed a delay in speech acquisition or if speech did develop, it was noncommunicative in nature (e.g., echolalia); had repetitive and stereotyped play activities; a compulsive need for the maintenance of sameness in the environment; a lack of imagination and fantasy; a good rote memory; a normal physical appearance; and abnormalities that appeared already in infancy (e.g., lack of response when held). Although the diagnostic criteria have been debated and have varied over the years, Kanner’s original behavior description remains almost unchanged in all versions of diagnostic criteria.

In 1944, Asperger described a similar, but less impaired group of four children. He named the disorder “autistic psychopathology.” Similar to Kanner (1943), Asperger described the children’s difficulties in social interaction, affective expression, and communication. There were some differences, however, Asperger’s cases had developed good language abilities by the time they entered school, even though they sometimes showed pedantic, adult-like speech. Although they had adequate language abilities, they were impaired in conversational skills and had unusual volume, tone, and flow of speech. In addition, Asperger noted that these children often displayed original thought, and tended to be excessively preoccupied with unusual interests. Because Asperger had written his paper in German, Asperger’s syndrome did not receive much

international attention until the 1980s, when Wing (1981a) provided a clinical description of Asperger's syndrome in English.

Although Kanner (1943) was the first to describe the clinical diagnosis, autism had certainly existed long before it was officially recognized. Already in 1801, Itard (1801/1962) wrote about Victor, the "Wild Boy of Aveyron," whom he considered retarded but from his description, most likely also had autism.

Kanner's (1943) use of the term "autism" originally caused some confusion in the field, because of its association with the same term used by Bleuler (1919, 1950) to describe the withdrawal into an active fantasy life found in some adult schizophrenics. As Wing (1976) pointed out, however, Kanner's concept of autism was the opposite of Bleuler's, in that it is a lack of any creative fantasy life that characterizes the withdrawal of children with autism. The years immediately following the publication of Kanner's article reflected the uncertainty in the field, as a number of new labels were introduced, including symbiotic psychosis (Mahler, 1952), borderline psychosis (Ekstein & Wallerstein, 1954), and childhood schizophrenia (Bender, 1956). No consensus was achieved on how to differentiate children with these labels, which were devised according to each author's view on the etiology and nature of autism (Schopler & Rutter, 1978). This resulted in difficulties in communication between researchers, when from report to report it was unclear what sort of disorder was being studied. Over time, with the introduction of the diagnostic criteria for autism in the *Diagnostic and Statistical Manual of Mental Disorders* (DSM; American Psychiatric Association [APA]), the diagnostic disagreements were reduced, when children with autism were described by criteria that were understandable and replicable by all.

## THE DSM SYSTEM

### **Autistic Disorder**

There has been much discussion over the past 20 years about how broad a range the autism diagnosis should encompass and to what degree autism ought to be subcategorized (Rescorla, 1988). The *Diagnostic and Statistical Manual of Mental Disorders*, 3rd edition (DSM-III; APA, 1980) was the first edition to classify autism spectrum conditions as "Pervasive Developmental Disorders" (PDD) instead of "Psychoses with Origins Specific to Childhood." Three subgroups were described: Infantile Autism (IA; onset before 30 months of age), Childhood Onset Pervasive Developmental Disorder (COPDD; onset between 30 months and 12 years of age), and Atypical Pervasive Developmental Disorder (Atypical PDD). COPDD differed from IA by later onset and less severe impairments and Atypical PDD was to be used for children who had a Pervasive Developmental Disorder, but did not fulfill all of the criteria for IA or COPDD.

The *DSM-III* (APA, 1980) system was criticized, because the clinical descriptions overlapped, with the exception of age of onset. Volkmar, Stier, and Cohen (1985) suggested that in the *DSM-III*, “age of onset” might be more appropriately termed “age of recognition.” The authors noted that IA and COPDD patients were behaviorally indistinguishable, that parental report often showed poor reliability, and that the cutoff point (30 months) was arbitrary.

The *DSM-III-R* (APA, 1987) had just two categories: Autistic Disorder (AD; the age of onset requirement was removed) and PDD Not Otherwise Specified (PDD-NOS), for children who did not meet the criteria for autism, but appeared to have a Pervasive Developmental Disorder. The *DSM-III-R* diagnostic criteria for Autistic Disorder are listed in Table 1.

The *DSM-III-R* (APA, 1987) received criticism for its lack of guidelines for subclassifying children with autism (Newsom, Hovanitz, & Rincover, 1988). The AD diagnosis provided only one label for a very heterogeneous group. In addition, the *DSM-III-R* criteria were found to be overly broad, resulting in too many false positives, especially among individuals with severe mental retardation (Volkmar, Bregman, Cohen, & Cicchetti, 1988).

The data collection in all three studies in this dissertation was begun in 1990. The 490 participants in Study I had an age range from 2-44 years. Therefore, the study included adults who first came to the attention of psychiatrists in the late 1940s, shortly after Kanner (1943) first published his report and before the publication of the first edition of the *DSM* (APA, 1952) to children diagnosed with the broader criteria found in the *DSM-III-R* (APA, 1987). The parent-reported diagnoses of the participants reflected the history of autism, and included the myriad of diagnoses that were prevalent in the 1950s, 1960s, and 1970s in the adults to the *DSM* diagnoses in the children. The sample included the full spectrum of autism and autistic-like disorders. The 383 subjects in Study II were a subsample of the participants in Study I, and included only individuals aged 5-22 years. Most of these children, adolescents and young adults had *DSM* diagnoses. Study III, which was completed first, contained two children, aged 10 and 12 years, with *DSM-III* diagnoses.

Although none of the children in this dissertation were diagnosed with the *DSM-IV* (APA, 1994) criteria, they are included to show the present “State-of-the-Art” and because the *DSM-IV* is the only *DSM* version to specifically include other well-known disorders within the autism spectrum, such as Childhood Disintegrative Disorder and Asperger’s Disorder. In an attempt to rectify the problem of the overly broad criteria found in the *DSM-III-R* (APA, 1987), the *DSM-IV* is not a revision of the *DSM-III-R* criteria, but a somewhat shortened version of the criteria in the *International Classification of Diseases*, 10<sup>th</sup> revision (*ICD-10*; World Health Organization, 1992). The *ICD-10* criteria had the best combination of sensitivity (the proportion of true cases meeting the criteria) and specificity (the proportion of true noncases failing to meet the criteria), as well as the highest level of agreement with clinicians’ diagnoses, in comparison to the *DSM-III* and *DSM-III-R* (Volkmar et al., 1994). The *DSM-IV*

Table 1  
*DSM-III-R (1987) Diagnostic Criteria for Autistic Disorder*

At least eight of the following sixteen items are present, these to include at least two items from A, one from B, and one from C.

**Note:** Consider a criterion to be met *only* if the behavior is abnormal for the person's developmental level.

- A. Qualitative impairment in reciprocal social interaction as manifested by the following:  
 (The examples within parentheses are arranged so that those first mentioned are more likely to apply to younger or more handicapped, and the later ones, to older or less handicapped, persons with this disorder.)
- (1) marked lack of awareness of the existence or feelings of others (e.g., treats a person as if he or she were a piece of furniture; does not notice another person's distress; apparently has no concept of the need of others for privacy)
  - (2) no or abnormal seeking of comfort at times of distress (e.g., does not come for comfort even when ill, hurt, or tired; seeks comfort in a stereotyped way, e.g., says "cheese, cheese, cheese" whenever hurt)
  - (3) no or impaired imitation (e.g., does not wave by-bye; does not copy mother's domestic activities; mechanical imitation of others' actions out of context)
  - (4) no or abnormal social play (e.g., does not actively participate in simple games; prefers solitary play activities; involves other children in play only as "mechanical aids")
  - (5) gross impairment in ability to make peer friendships (e.g., no interest in making peer friendships; despite interest in making friends, demonstrates lack of understanding of conventions of social interaction, for example, reads phone book to uninterested peer)
- B. Qualitative impairment in verbal and nonverbal communication, and in imaginative activity, as manifested by the following:  
 (The numbered items are arranged so that those first listed are more likely to apply to younger or more handicapped, and the later ones, to older or less handicapped, persons with this disorder.)
- (1) no mode of communication, such as communicative babbling, facial expression, gesture, mime, or spoken language
  - (2) markedly abnormal nonverbal communication, as in the use of eye-to-eye gaze, facial expression, body posture, or gestures to initiate or modulate social interaction (e.g., does not anticipate being held, stiffens when held, does not look at the person or smile when making a social approach, does not greet parents or visitors, has a fixed stare in social situations)
  - (3) absence of imaginative activity, such as playacting of adult roles, fantasy characters, or animals; lack of interest in stories about imaginary events
  - (4) marked abnormalities in the production of speech, including volume, pitch, stress, rate, rhythm, and intonation (e.g., monotonous tone, questionlike melody, or high pitch)
  - (5) marked abnormalities in the form or content of speech, including stereotyped and repetitive use of speech (e.g., immediate echolalia or mechanical repetition of television commercial); use of "you" when "I" is meant (e.g., using "You want cookie?" to mean "I want a cookie"); idiosyncratic use of words or phrases (e.g., Go on green riding" to mean "I want to go on the swing"); or frequent irrelevant remarks (e.g., starts talking about train schedules during a conversation about sports)
  - (6) marked impairment in the ability to initiate or sustain a conversation with others, despite adequate speech (e.g., indulging in lengthy monologues on one subject regardless of interjections from others)
- C. Markedly restricted repertoire of activities and interests, as manifested by the following:
- (1) stereotyped body movements, e.g., hand-flicking or -twisting, spinning, head-banging, complex whole-body movements
  - (2) persistent preoccupation with parts of objects (e.g., sniffing or smelling objects, repetitive feeling of texture of materials, spinning wheels of toy cars) or attachment to unusual objects (e.g., insists on carrying around a piece of string)
  - (3) marked distress over changes in trivial aspects of environment, e.g., when a vase is moved from usual position
  - (4) unreasonable insistence on following routines in precise detail, e.g., insisting that exactly the same route always be followed when shopping
  - (5) markedly restricted range of interests and a preoccupation with one narrow interest, e.g., interested only in lining up objects, in amassing facts about meteorology, or in pretending to be a fantasy character
- D. Onset during infancy or childhood.  
**Specify** if childhood onset (after 36 months of age).

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has five categories: Autistic Disorder (AD), Rett's Disorder, Childhood Disintegrative Disorder (CDD), Asperger's Disorder, and PDD Not Otherwise Specified (PDD-NOS). Age of onset before 3 years was reinstated in AD. AD and CDD differ in that CDD specifies a developmental regression following at least two years of apparently normal development. Asperger's Disorder is distinguished from AD by the lack of delay in language development. Rett's Disorder differs from AD by its sex ratio (only females) and characteristic pattern of deficits (i.e., deceleration of head growth, loss of previous hand skills, and acquired poor coordination in gait and/or trunk movements). PDD-NOS is used for children who have a Pervasive Developmental Disorder, but do not meet the criteria for one of the above disorders. The *DSM-IV* diagnostic criteria for Autistic Disorder are listed in Table 2.

Autism is a syndrome that is defined by behaviors and a natural history, rather than by etiology or pathology (Rutter & Schopler, 1986). Although in many cases the etiology is unknown, the results of numerous biological and epidemiological studies have resulted in two etiological principles of autism. First, as expected in a syndrome that is defined only by its clinical features, there are many etiologies. Second, the etiologies of autism are organic and not psychosocial (Folstein & Rutter, 1988).

### **Childhood Disintegrative Disorder**

The inclusion of age of onset in the *DSM* system has been debated over the years, and is reflected by its insertion, removal, and reinsertion in the progression of the *DSM* editions. The *DSM-IV* (APA, 1994) has tried to solve the problem by including age of onset before 3 years in AD and adding a separate diagnostic category, Childhood Disintegrative Disorder (CDD), which requires a developmental regression following at least two years of apparently normal development.

There is variation in age of onset, or, at least, of "recognition" of symptoms, in the autism spectrum disorders (Gillberg, 1989b). Although the vast majority of parents identify symptoms before 36 months (e.g., Lotter, 1966, 1967; Short & Schopler, 1988; Wing, 1980b), epidemiological surveys have consistently observed cases with an age of onset later than 3 years (Gillberg, 1984b, 1986; Hoshino, Kumashiro, Yashima, Tachibana, & Watanabe, 1982; Lotter, 1966, 1967; Steffenburg & Gillberg, 1986; Wing & Gould, 1979). The proportion of cases detected after the age of 36 months has ranged from 9% (Hoshino et al., 1982) to 19% (Lotter, 1966, 1967). In the Aarhouse study (cited in Wing, Yeates, Brierly, & Gould, 1976), 25% of the cases reported an age of onset after 3 years. However, all studies used parental recall of age of onset, which is subject to bias and measurement error, particularly when some of the cases examined were as old as 18 years.

Table 2

*DSM-IV (1994) Diagnostic Criteria for Autistic Disorder*

- 
- A. A total of six (or more) items from (1), (2), and (3), with at least two from (1), and one each from (2) and (3):
- (1) qualitative impairment in social interaction, as manifested by at least two of the following:
    - (a) marked impairment in the use of multiple nonverbal behaviors such as eye-to-eye gaze, facial expression, body postures, and gestures to regulate social interaction
    - (b) failure to develop peer relationships appropriate to developmental level
    - (c) lack of spontaneous seeking to share enjoyment, interests, or achievements with other people (e.g., by a lack of showing, bringing, or pointing out objects of interest)
    - (d) lack of social or emotional reciprocity
  - (2) qualitative impairments in communication as manifested by at least one of the following:
    - (a) delay in, or total lack of, the development of spoken language (not accompanied by an attempt to compensate through alternative modes of communication such as gesture or mime)
    - (b) in individuals with adequate speech, marked impairment in the ability to initiate or sustain a conversation with others
    - (c) stereotyped and repetitive use of language or idiosyncratic language
    - (d) lack of varied, spontaneous make-believe play or social imitative play appropriate to developmental level
  - (3) restricted repetitive and stereotyped patterns of behavior, interests, and activities, as manifested by at least one of the following:
    - (a) encompassing preoccupation with one or more stereotyped and restricted patterns of interest that is abnormal either in intensity or focus
    - (b) apparently inflexible adherence to specific, nonfunctional routines or rituals
    - (c) stereotyped and repetitive motor mannerisms (e.g., hand or finger flapping or twisting, or complex whole-body movements)
    - (d) persistent preoccupation with parts of objects
- B. Delays or abnormal functioning in at least one of the following areas, with onset prior to age 3 years: (1) social interaction, (2) language as used in social communication, or (3) symbolic or imaginative play.
- C. The disturbance is not better accounted for by Rett's Disorder or Childhood Disintegrative Disorder.

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This situation is made further complicated by two factors. First, many diseases leading to autistic symptoms (e.g., encephalitis) may occur before or after 30 months of age. Second, age of onset is often difficult to determine as different kinds of behavior are found at different ages in autism (Ricks, 1975, 1979; Wing, 1971, 1980a). For example, problems in infancy, such as in nonverbal communication, may not be seen by parents if they do not have experience or knowledge in early child development. The more obvious symptoms, such as lack of language or repetitive rituals, do not appear until the child is two years of age or older (Wing & Attwood, 1987). Therefore, many have argued that it is artificial to give a different diagnosis according to age of onset (e.g., Cohen, Paul, & Volkmar, 1987; Wing & Attwood, 1987).

Results from studies that have compared individuals with different ages of onset have varied. Several studies were unable to find any differences in the clinical picture of children with autism and autism-like conditions with early or late onset (Hill & Rosenbloom, 1986; Ornitz & Ritvo, 1976; Volkmar, Stier, et al., 1985; Wing & Gould, 1979; Wolf & Goldberg, 1986), other studies have found that early onset children are more impaired than late onset children (Dahl, Cohen, & Provenca, 1986; Gunnarson, 1949; Harper & Williams, 1975; Kolvin, Humphrey, & McNay, 1971; Kurita, 1988; Prior, Boulton, Gajzago, & Perry, 1975; Short & Schopler, 1988; Volkmar, Cohen, & Paul, 1986), and others have found late onset children to be more handicapped (Burd, Fisher, & Kerbeshian, 1988; Evans-Jones & Rosenbloom, 1978; Heller, 1930; Hill & Rosenbloom, 1986; Rutter & Lockyer, 1967; Volkmar & Cohen, 1989).

There does, however, appear to be a difference in children with a “later onset” or “age of recognition” and those with Childhood Disintegrative Disorder (CDD), who have an apparent period of normal development before the onset of a severe regression. Volkmar and Cohen (1989) identified 10 cases (6%) of CDD from a larger sample of 165 individuals with autism. These CDD cases were compared to the cases with autism whose disorder had been recognized by age 2 (N = 136; “early onset”) and to those whose disorder had been recognized between ages 2 and 3 years (N = 19; “later onset”), on features of clinical presentation and course. The authors found that the onset of severe regression occurred between ages 24 to 42 months in the children with CDD. All of the CDD children had communicative speech and were reportedly able to speak in sentences prior to developmental regression. These children made, at best, only a limited recovery. Four children remained mute and only one child regained the ability to speak in sentences. Seven of the children were severely to profoundly mentally retarded and three were moderately mentally retarded. The three groups differed significantly in regard to IQ. The CDD children had the lowest IQ and the “later onset” children the highest. In regard to clinical picture and outcome, the cases with CDD were significantly more likely to be mute than the “later onset” cases and in residential placement than either the “early” or “late” onset cases. Once CDD was established, it was behaviorally indistinguishable from severe autism. The delayed recognition of the “later” onset individuals appeared to be due to several factors. These children tended to be higher functioning and

often a combination of parental denial or special circumstance (e.g., bilingual family) appeared to cause the delay in recognition. The authors found that both the clinical picture at the time of regression and the results of the various outcome measures supported the independence of Childhood Disintegrative Disorder as a diagnostic category, in particular when it was compared to cases with “later onset” autism.

Short and Schopler (1988) studied age of onset in 889 children with autism seen by Division TEACCH since 1970. The authors found two groups: an “early onset” group, whose parent-reported age of onset was before 24 months (76% of the children) and a “later onset” group that consisted of 18% that were identified by 36 months and 6 % after 36 months (2% between 37-42 months, 3% between 43-48 months, and 1% after 48 months). The medical records of all 38 children with onset at 36 months or later were reviewed. Evidence of developmental regression was found in 8 cases. The mean IQ of the regression group was 45, the “early onset” group was 42, and the “later onset” group was 59. The authors proposed two distinct “late onset” groups: those who regressed after 30 months of age and those who were probably delayed from an early age, but whose symptoms were relatively mild and therefore not recognized earlier. The group of children who regressed were similar to the “early onset” group and were located at the more severe end of the impairment continuum. Short and Schopler pointed out that parent-reported ages of onset probably result in high estimates of actual age of onset. The “late onset” cases without evidence of regression in their study may well have had an earlier onset, perhaps from birth, but were not recognized until later. Parents may be better able to pinpoint an onset that occurs after a regression because it is so striking.

To further complicate diagnostic perplexity, it is not uncommon for children with autism to begin to speak and then suddenly lose their acquired speech (most often between age 18-30 months), and thereafter remain mute (Schreibman, 1988). Reported estimates of speech loss in autism range from 20% (Rutter & Lord, 1987) to 34-37% (Kurita, 1985; Wolf & Goldberg, 1986).

In order to clarify the clinical picture of Childhood Disintegrative Disorder (CDD) and its relationship to autism with and without speech loss, Kurita, Kita, and Miyake (1992) performed a comparative study of 18 cases of CDD (according to ICD-10 definition with onset after age 2 years) and a group of 196 cases of autism, of whom, 51 had lost their speech (26%) and 145 were without speech loss (74%). The authors found that the cases with CDD had shown a more apparent regression after normal or nearly normal development than the cases of autism with speech loss. However, two-thirds of the CDD cases had slight developmental abnormalities before regression. By definition, the children with CDD had a significantly later age of onset ( $M = 2.8$  years) than the children with autism who lost speech ( $M = 1.4$  years). At an evaluation performed when the children were about 7 years old, approximately 4 years after regression, the children with CDD were more severely retarded than the children with autism, although both groups displayed similar autistic symptoms. Speech reemerged at

an average age of 4.4 years in 83% of the CDD cases ( $M = 1.7$  years after the regression onset) and in 90% of the autism cases with speech loss.

When comparing the results of the Kurita et al. (1992) study that dichotomized autism according to presence or absence of speech loss, and the research done by Volkmar and Cohen (1989) on early versus late “age of recognition,” it is important to note that speech loss may not necessarily be related to early recognition as many individuals with autism who lose speech usually demonstrate other abnormalities before its onset (Kurita, 1985). Additionally, the loss of speech does not indicate the start of a disease process. However, due to the fact that speech loss is a clinical symptom that may imply some type of brain function disintegration, it is quite possible that individuals with autism with speech loss develop less favorably than those without speech loss (Hoshino et al., 1987; Kurita, 1985). “Age of recognition,” on the other hand, is related to parental perception of their child’s disorder. It is apparent that the milder the disorder, the later the age of its recognition. This may explain the different results found in previous studies where the cases of autism that were recognized later were less impaired than cases noticed earlier (e.g., Harper & Williams, 1975; Short & Schopler, 1988; Volkmar et al. 1986), while the cases with speech loss after a period of normal or near normal development were more impaired than cases who showed autistic symptoms earlier (e.g., Hoshino et al., 1987, Kurita, 1985; Kurita et al., 1992).

Gillberg (1989b) outlined several of the problems involved in retrospective studies of early symptoms in autism, where one is dependent on the children’s parents for information. Several factors influence this information, such as the child’s position in the sibship (first-born and those who are many years younger than their siblings are probably more likely to be detected as abnormal later) as well as the parents’ degree of “environmental perceptiveness,” or ability to detect deviance in their child, which may vary according to parents’ age, education, intelligence, social circumstances, personality, and mental health.

The *DSM-IV* (1994) diagnostic criteria for Childhood Disintegrative Disorder are found in Table 3.

### **Asperger’s Disorder**

Asperger’s syndrome was first described by the Austrian physician Hans Asperger (1944/1991). Historically, there has been disagreement over whether Asperger’s syndrome, a diagnosis given to individuals with good language abilities but unusual social relatedness, is different than high-functioning autism. Some researchers believe the two to be separate syndromes (e.g., Ozonoff, Rogers, & Pennington, 1991; Szatmari, Bartolucci, Finlayson, & Krames, 1986), while others believe that there is insufficient evidence to date, to consider the two as separate disorders (e.g., Ghaziuddin, Tsai, & Ghaziuddin, 1991; Gillberg, 1985; Schopler, 1985; Volkmar, Paul, & Cohen, 1985; Wing, 1981a).

Table 3

*DSM-IV (1994) Diagnostic Criteria for Childhood Disintegrative Disorder*

- 
- A. Apparently normal development for at least the first 2 years after birth as manifested by the presence of age-appropriate verbal and nonverbal communication, social relationships, play, and adaptive behavior.
  - B. Clinically significant loss of previously acquired skills (before age 10 years) in at least two of the following areas:
    - (1) expressive or receptive language
    - (2) social skills or adaptive behavior
    - (3) bowel or bladder control
    - (4) play
    - (5) motor skills
  - C. Abnormalities of functioning in at least two of the following areas:
    - (1) qualitative impairment in social interaction (e.g., impairment in nonverbal behaviors, failure to develop peer relationships, lack of social or emotional reciprocity)
    - (2) qualitative impairments in communication (e.g., delay or lack of spoken language, inability to initiate or sustain a conversation, stereotyped and repetitive use of language, lack of varied make-believe play)
    - (3) restricted, repetitive, and stereotyped patterns of behavior, interests, and activities, including motor stereotypies and mannerisms
  - D. The disturbance is not better accounted for by another specific Pervasive Developmental Disorder or Schizophrenia.
- 

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Although Asperger did note the many similarities between his syndrome and Kanner's autism, he believed them to be distinct syndromes, as did Van Krevelen (1971) and Wolff and Barlow (1979). However, as Wing (1981a) points out, regardless of some differences, which could be explained by variation in the severity of the impairments, the syndromes are more alike than unlike. For example, the child with autism may be aloof and indifferent to others, while the child with Asperger's syndrome may be passive or make inappropriate one-sided approaches (for a review, see Wing, 1981a). Although there is still some discussion as to whether or not Asperger's syndrome and high-functioning autism are separate diagnostic entities, it is now generally agreed that both lie at the milder end of the autism spectrum continuum, and that Asperger's Disorder differs from Autistic Disorder in regard to better verbal abilities and, possibly, poor motor development (Ghaziuddin et al., 1991).

Wing's (1981a) clinical description of Asperger's syndrome included odd and pedantic speech, abnormal nonverbal communication (expressive and receptive), impairment of two-way social interaction, repetitive activities, resistance to change, awkward gross motor coordination, excellent rote memory, intense interest in one or two idiosyncratic subjects, special abilities (e.g., musical), learning problems, eccentricity, and egocentrism. Approximately 20% of the cases described by Wing did not have normal or high intelligence, although they had all of the features characteristic of Asperger's syndrome. In addition, Wing found that more than 40% of her adult cases had affective illness or possible depression and 11% had attempted suicide. Concurrent psychiatric

illnesses are not uncommon. In particular, anxiety and depression may be found in late adolescence and early adulthood when individuals become aware that they are handicapped and different from other people (Tantam, 1988; Wing, 1981a).

Gillberg and Gillberg (1989) estimate the prevalence of Asperger's syndrome in Swedish children with a normal IQ to lie between 10 to 26 per 10,000 and in those with mild mental retardation at 0.4 per 10,000. The sex ratio is estimated to be between 10 to 20 males to 1 female (Rickarby, Carruthers, & Mitchell, 1991).

Individuals with Asperger's syndrome are not usually detected until the preschool or early school period, and are thus less likely to show symptoms that cause concern during their early years (Gillberg, 1989a). The *DSM-IV* (1994) diagnostic criteria for Asperger's Disorder are found in Table 4.

In summary, compared to the period when only "classic autism," as defined by Kanner and Eisenberg (1956), was the only accepted form, the past few decades have shown advances in the understanding and conceptualization of autism (Aarons & Gittens, 1992). It is now agreed that autism is not an all-or-nothing syndrome, but rather can be viewed on a continuum of pervasiveness and severity of disability (Cohen et al. 1986). Wing and colleagues (Wing, 1988; Wing & Attwood, 1987) have suggested using the term "autistic spectrum disorders" for individuals who display symptoms in three areas: impaired communication and reciprocal social skills and a limited repertoire of interests

Table 4  
*DSM-IV (1994) Diagnostic Criteria for Asperger's Disorder*

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A.	Qualitative impairment in social interaction, as manifested by at least two of the following: <ol style="list-style-type: none"> <li>(1) marked impairment in the use of multiple nonverbal behaviors such as eye-to-eye gaze, facial expression, body postures, and gestures to regulate social interaction</li> <li>(2) failure to develop peer relationships appropriate to developmental level</li> <li>(3) lack of spontaneous seeking to share enjoyment, interests, or achievements with other people (e.g., by a lack of showing, bringing, or pointing out objects of interest)</li> <li>(4) lack of social or emotional reciprocity</li> </ol>
B.	Restricted repetitive and stereotyped patterns of behavior, interests, and activities, as manifested by at least one of the following: <ol style="list-style-type: none"> <li>(1) encompassing preoccupation with one or more stereotyped and restricted patterns of interest that is abnormal either in intensity or focus</li> <li>(2) apparently inflexible adherence to specific, nonfunctional routines or rituals</li> <li>(3) stereotyped and repetitive motor mannerisms (e.g., hand or finger flapping or twisting, or complex whole-body movements)</li> <li>(4) persistent preoccupation with parts of objects</li> </ol>
C.	The disturbance causes clinically significant impairment in social, occupational, or other important areas of functioning.
D.	There is no clinically significant general delay in language (e.g., single words used by age 2 years, communicative phrases used by age 3 years).
E.	There is no clinically significant delay in cognitive development or in the development of age-appropriate self-help skills, adaptive behavior (other than in social interaction), and curiosity about the environment in childhood.
F.	Criteria are not met for another specific Pervasive Developmental Disorder or Schizophrenia.

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and behavior. The most seriously handicapped are the profoundly retarded, multihandicapped individuals, who exhibit a fairly regular pattern of profound impairments across the areas of intellectual, adaptive, social, language, and motor functioning. At the least pervasive end of the continuum lie individuals characterized by relatively mild impairments in only one domain. Individuals classified as having a specific Pervasive Developmental Disorder fall between these two extremes, showing an uneven pattern of impairments across several domains (Gillberg & Gillberg, 1989; Newson, 1999). The highest functioning are the people with deficits in attention, motor control, and perception (DAMP; Gillberg, 1983), who often have normal or above normal intelligence.

## SEX DIFFERENCES

The male:female ratio has varied in different studies from 1.4-4.8 to 1 (Bohman, Bohman, Björck, & Sjöholm, 1983; Gillberg, 1984b; Lotter, 1966; Steinhausen & Breulinger, 1986; Torrey, Hersh, & McCabe, 1975; Wing, 1981b). Gillberg and colleagues (Gillberg, 1984b; Gillberg, Steffenburg, & Schaumann, 1991) have performed two epidemiological population-based studies in Western Sweden, and found similar boy:girl ratios in the autistic disorder group (3.3:1 in 1984 and 3.8:1 in 1991) and identical ratios of 1.1:1 in the autistic-like conditions group.

Several investigators have noted that the boy:girl ratio increases with IQ (Gillberg et al., 1991; Lotter, 1966; Wing, 1981b; Steffenburg & Gillberg, 1986). There are significantly more males than females with autism with an IQ greater than 50, and the ratio becomes nearly equal at lower IQ levels. For example, the sex ratio for the children with an IQ below 50 is estimated to be 2.5:1 (Konstantareas, Homatidis, & Busch, 1989), while the ratio for children with IQs above 70 has been found to range from 5:1 (Lord, Schopler, & Revicki, 1982; Tsai, Stewart, & August, 1981) to 7:1 (Konstantareas et al., 1989). Steffenburg (1990) suggested that these trends indicate that genetic factors may be somewhat more important in boys, while severe brain damage affects both sexes about equally.

Previous research has found that females with autism spectrum disorders tend to be more severely affected than males (Coleman, 1978; DeMyer et al., 1973; Gillberg & Steffenburg, 1987; Gillberg et al., 1991; Gittelman & Birch, 1967; Konstantareas et al., 1989; Lord & Schopler, 1985; Lord et al., 1982; Lotter, 1974; Rutter, Greenfeld, & Lockyer, 1967; Short & Schopler, 1988; Tsai & Beisler, 1983; Tsai et al., 1981; Walker, 1976; Wing, 1981b; Wolf & Goldberg, 1986).

Wing (1981b) compared high- and low-functioning individuals with autism. She found that there were more males than females in the high-functioning group. Tsai and colleagues (Tsai & Beisler, 1983; Tsai et al., 1981) and Lord and Schopler and colleagues (Lord & Schopler, 1985; Lord et al., 1982) found that females showed greater autism severity than males in a variety of areas and on a

number of different instruments. Coleman (1978) observed that females had lower developmental levels and were more unresponsive than males. Short and Schopler (1988) studied age of onset and symptom severity in 889 children with autism. They found that mean IQ was significantly lower for females with autism than males. In addition, females were identified significantly earlier than were males. The authors hypothesized that females are identified earlier because they show greater symptom severity.

Tsai and colleagues (August, Stewart, & Tsai, 1981; Tsai & Beisler, 1983; Tsai et al., 1981) have suggested a multifactorial model of inheritance in autism, with different thresholds for females and males. Multifactorial inheritance requires that a disorder be caused by numerous factors (e.g., genetic, environmental, or a combination of the two), each resulting in a vulnerability. Only when individuals reach a certain threshold do they demonstrate the complete syndrome (Konstantareas et al., 1989). The genetic contribution in the etiology of autism can be seen in the greater morbidity found in females than in males (Konstantareas et al., 1989). Spence (1976), in discussing the multifactorial inheritance model, has argued that individuals of the sex that is less often affected (females, in this case) are expected to (a) be more severely afflicted, (b) have more relatives that are affected, and (c) have a greater proportion of relatives that are more severely afflicted. That is, the threshold of the less-affected sex is higher (i.e., more factors are required), resulting in fewer individuals being afflicted, but those who are, show a more severe form of the disorder.

In an attempt to examine the multifactorial model in regard to females being more severely affected than males, Konstantareas et al. (1989) performed a comparative study of 22 females and 67 males with autism. The authors found that nonverbal IQ and mental age were higher in boys. The sex ratio for the children with an IQ below 50 was 2.5:1 and for those with an IQ over 50, it was 4:1. For children with IQs above 70, the sex ratio was 7:1. In addition, boys showed higher developmental skills in the physical, self-help, and social domains. The authors found that females tended to have poorer receptive language abilities and more boys than girls were rated as verbal. Finally, girls showed more autistic symptomatology than boys. The authors interpreted these findings as supportive of the multifactorial model of inheritance in autism.

Sex has also been found to be a prognostic factor. Lotter (1974) found that no females in his study attained either good or fair outcomes and that males in general had better prognoses. Other studies have found similar results (DeMyer et al., 1973; Rutter et al., 1967; Wolf & Goldberg, 1986).

Gillberg and Steffenburg (1987) performed a population-based follow-up study of children with autism (N = 23) and autistic-like conditions (N = 23). These children were followed to age 16-23 years. Thirty percent of the cases showed a temporary aggravation of autistic symptoms (e.g., aggressiveness, self-injurious behavior, hyperactivity, insistence on sameness) around the time of puberty onset. An additional 22% of the cases showed a permanent deterioration (i.e., the above-mentioned symptoms, followed by hypoactivity, loss of language

skills, and deterioration of mental development) that began during adolescence. There was a strong tendency for females to be more affected by deterioration than males.

In summary, Research has consistently found that females, who are less often affected with autism spectrum disorders, tend to be more severely affected and have a poorer prognosis, than males (Lord et al., 1982).

Although individuals with autistic spectrum disorders typically display symptoms in the three areas specified by Wing (1988): impaired communication and reciprocal social skills and a limited repertoire of interests and behavior, the primary emphasis in this dissertation has been on language.

## LANGUAGE

Due to the fact that virtually all children with autism show severe language impairments, many researchers have studied language disorders in autism (Rutter, 1978d). When Kanner (1943) first wrote about the 11 children with autism seen at his clinic, he described the various language abnormalities he had observed. Later, in 1946, when he had seen 23 children with autism, he wrote “the peculiarities of language present an important and promising basis for investigation.” Later research has confirmed that all children with autism show a retarded development of spoken language (either delayed or by regression); about half do not acquire speech; and of those who do acquire speech, over 75% show abnormal speech features, such as echolalia or pronominal reversal (Baltaxe & Simmons, 1981; DeMyer et al., 1974; DeMyer, Hingtgen, & Jackson, 1981; Kanner, 1943; Ornitz, 1973; Rutter, 1965, 1970, 1977; Rutter & Lockyer, 1967; Wing, 1971). Only about 30% of those who are able to speak develop somewhat useful language (DeMyer et al., 1981).

Learning how to communicate with others is a process that begins during infancy. Communicative behaviors are learned from the social environment and become increasingly efficient, sophisticated, and conventional over time (Alpert & Rogers-Warren, 1985). Communicative competence is built upon the acquisition of several prerequisite skills, including being able to: (1) attend to and interact with the physical environment; (2) actively participate in social interactions with other individuals; and (3) understand and use expression forms (Fay & Schuler, 1980; McLean & Snyder-McLean, 1978). Different types of prerequisite skills may be involved in the development of the various components of the communication system. The components that deal with form (i.e., syntax, phonology, and morphology) are believed to involve the prerequisite skills of auditory discrimination and imitative ability. In comparison, the semantic and pragmatic components are believed to involve the prerequisite skills of being able to attend to the physical environment and to participate in social interactions (Blank, Gessner, & Esposito, 1979; Curtiss, 1981). The components of semantics and pragmatics are particularly impoverished in

individuals with autism compared to the syntax and phonology components (Tager-Fulsberg, 1981).

Language skills may be divided according to whether they measure expressive (language use) or receptive (language understanding) abilities. Although individuals with autism spectrum disorders often have impairments and delays in both, expressive language skills have been the most studied (e.g., DeMyer et al., 1974; Freeman, Ritvo, Needleman, & Yokota, 1985; Rutter et al., 1967). For example, DeMyer et al. (1973), in a follow-up study, found that at initial evaluation (mean age 65.6 months), no children had normal speech, 35% had some useful communicative speech (2% could express ideas and converse, but below age level; 4% could converse at a level above immediate needs, but communication was often bizarre or repetitious; 1% could only communicate immediate needs; 20% had both echolalia and only a few words to communicate immediate needs; and 8% had only a few communicative words), 20% had only echolalia and no communicative speech, and 45% had no speech. At follow-up approximately six years later (mean age was 12 years), most of the children in this study had improved language skills. Four percent had normal speech, 50% had some useful communicative speech (13% could express ideas and converse, but below age level; 13% could converse at a level above immediate needs, but communication was often bizarre or repetitious; 4% could only communicate immediate needs; 12% had both echolalia and only a few words to communicate immediate needs; and 8% had only a few communicative words), 7% had only echolalia and no communicative speech, and 39% had no speech. Eleven percent of the children developed useful speech after age 5 years and an additional 4%, who were mute at initial evaluation, developed echolalia or a few communicative words after age 5. Presence of communicative words at initial evaluation was a more favorable prognostic sign for the later development of useful speech than were only echolalia without communicative speech or muteness. Children with noncommunicative echolalia were more likely to later gain conversational speech than were mute children. Indeed, 65% of the mute children remained mute at follow-up. Eleven percent of the children in this study showed a worsening of speech. The figures in this study are similar to those found in other studies (e.g., DeMyer et al., 1974; Freeman et al., 1985; Rutter et al., 1967). The proportion of children without functional speech at age 5 who later develop speech has been estimated between 17% (DeMyer et al., 1973) and 22% (Rutter et al., 1967). Among the children with autism who do learn to speak, most children, both with and without mental retardation, show severe speech delays. Bartak and Rutter (1976) compared children with autism with IQs above and below 70. The mean age of the first use of single words was 4 years and 7 months in the group with mental retardation and 2 years and 6 months in the normal IQ group. Ornitz, Guthrie, and Farley (1977) found that language comprehension is somewhat less delayed. Parents of children with autism recalled that their child's understanding of simple nouns occurred at a median age of 24 months. This is 12 months later than the age reported by parents of normal children. Rutter et al. (1967) and DeMyer et al. (1973) found that even in those children whose speech had

improved considerably, there still remained difficulties with abstract concepts, repetitive questioning, odd conversations with an obsessiveness over details or one subject, and/or disorders in speech intonation, rhythm, and inflection.

Language skills also predict outcome. Those individuals who are mute after age 5 years have a poor prognosis, both for speech acquisition and for general functioning level (Baltaxe & Simmons, 1983). Eisenberg (1956) found poor outcome for all but 1 of 30 children without speech at age 5 years. Rutter et al. (1967) found that higher IQ, lack of response to sounds during the preschool years, and acquisition of useful speech by 5 years were powerful predictors of later good social adjustment. Lotter (1974) found similar results; IQ and speech were the strongest predictors of later outcome.

The existence of some functional, communicative speech is indicative of a better prognosis than is noncommunicative echolalia alone (Paul, 1987a). Although echolalia is viewed as an intermediate stage towards more functional language, it continues into adulthood in many individuals with autism (Paul, 1987a). Paul, Cohen, and Caparulo (1983) performed a longitudinal study of children with autism and children with aphasia. They found that language comprehension ability at early ages was associated to the degree of improvement in social relations in late adolescence and adulthood.

Although children with autism who fail to gain useful speech tend to have a poor social prognosis (Lotter, 1974; Rutter, 1978a; Rutter et al., 1967), the lack of speech in itself is not a sufficient explanation for this poor prognosis. Many aphasic and deaf mutes become well-functioning adults, even though they are unable to speak. Nonspeaking adults with autism lack more than speech. These adults manifest a global problem in communication and cognitive processes, as well as a variety of social and behavioral problems (Rutter, 1978a).

## **Mutism**

The incidence of mutism in individuals with autism has been found to range from 28% (Wolff & Chess, 1965) to 61% (Fish, Shapiro, & Campbell, 1966). Other studies have found incidences between these two figures (Eisenberg, 1956; Kanner, Rodriguez, & Ashenden, 1972; Lotter, 1967; Mittler, Gillies, & Jukes, 1966; Ritvo et al., 1989; Rutter et al., 1967; Volkmar & Cohen (1989). Occasional bursts of speech in stressful situations, never to be repeated again, have been reported in this group (Paul, 1987a).

When first diagnosed during childhood, about 80% of children with autism are mute (Ornitz, Guthrie, & Farley, 1977). About 50% remain mute for life without intensive treatment (Newsom et al., 1988; Rutter et al., 1967). Most of these individuals are functionally mute rather than totally silent. That is, they are able to produce some sounds and perhaps even word-approximations, but are not able to articulate words or phrases (Newsom et al., 1988).

Schuler (1976; cited in Alpert & Rogers-Warren, 1985; Fay, 1980c) has specified three levels of muteness and applied the term to individuals who: 1)

produce no vocalizations, neither communicative nor noncommunicative (“totally mute”); 2) produce only meaningless vocalizations that are used for self-stimulation (“functionally mute”); and 3) use a limited number of words or word-approximations in a functional manner to express immediate desires (“semi-mute”). The condition “semi-mute” is more common in other childhood language disorders than in autism (Fay, 1980c). In this dissertation, the term “mute” is used for individuals who are “totally mute” and “functionally mute.” In addition, Schuler suggests a parallel ordering of deficient receptive skills, ranging from “probably minimal” in regard to total muteness, to “probably poor” in functional muteness, to “somewhat better developed” in regard to semi-muteness.

It is not uncommon for children with autism to begin to speak and then suddenly lose their acquired speech (often between 18-30 months of age), and thereafter fail to progress linguistically (Schreibman, 1988). Reported estimates range from 20% (Rutter & Lord, 1987) to 34-37% (Kurita, 1985; Wolf & Goldberg, 1986).

Rutter et al. (1967) performed a follow-up study of 62 patients with “childhood psychosis” seen at Maudsley Hospital between 1950 and 1958. Fifty percent of these children were mute at first examination (average age 6 years) and 40% were still without speech at follow-up (average age 15½ years). An additional 11% lost all speech in adolescence (4 after they developed epilepsy). Thus, half the children were without speech at follow-up.

Ricks and Wing (1976) found that even after an initially mute child acquires some communicative speech, problems still persist with abstract concepts, spontaneity, humor, feelings, idiomatic expressions, pronouns, and prepositions.

The introduction of early intensive behavioral intervention (e.g., Anderson, Avery, DiPietro, Edwards, & Christian, 1987; Birnbrauer & Leach, 1993; Lovaas, 1987; Maurice, 1993; Smith, Eikeseth, Klevstrand, & Lovaas, 1997) has changed the proportion of individuals who remain mute as adults. For example, in a 12-year prospective follow-up study of 53 children with autism, Freeman et al. (1991) found that only 17% remained completely nonverbal. This was a much lower percentage than the 50% rate usually reported (Eisenberg, 1956; Kanner et al., 1972; Lotter, 1967; Mittler et al., 1966; Ritvo et al., 1989; Rutter et al., 1967; Volkmar & Cohen, 1989). The authors noted that this low figure may be due to the fact that all of these children received early intensive intervention.

## **Echolalia**

Language, when and if it develops, is abnormal in many ways. Echolalia and pronominal reversal are very common, as are deficits in understanding spoken language, and neologisms or metaphorical use of language (Cunningham, 1968; Cunningham & Dixon, 1961; DeMyer et al., 1981; Kanner, 1946; Rutter, 1966a; Shapiro, Fish, & Ginsberg, 1972; Shapiro, Roberts, & Fish, 1970; Tubbs, 1966; Wing, 1971; Wolff & Chess, 1965).

The prevalence of echolalia among verbal children with autism has been estimated to be about 75% (Baltaxe & Simmons, 1981; Rutter, 1965; Rutter & Lockyer, 1967). Two types of echolalia have been described. *Immediate echolalia* is the most common language abnormality in autism (Hingtgen & Bryson, 1972; Prizant & Duchan, 1981). It was previously viewed as nonfunctional and to occur when the child did not understand the speech of others, but attempted to maintain social contact (Carr, Schreibman, & Lovaas, 1975; Coleman & Stedman, 1974; Fay, 1969, 1971, 1980a, 1983; Paccia & Curcio, 1982; Shapiro & Lucy, 1978). Little research has been performed on *delayed echolalia* (the repetition of speech after a time lapse), due to the difficulty of identifying the original occurrence of the modeled utterance, which is needed if one is to separate delayed echolalia from the child's spontaneous utterances (Prizant, 1983). Prizant (1982), citing clinical observation, has suggested that delayed echolalia may be a repetition of conversations with the child alternating conversational turns, and that contextual factors (e.g., situation, setting, objects, persons) that are associated with the original utterance may be discriminative stimuli for its occurrence.

Although echolalia was previously viewed as nonfunctional, later research has investigated the functional uses of immediate and delayed echolalia and the possible role of echolalia in language acquisition in children with autism. Rutter (1966b) suggested that children with autism who later acquire more adequate language functioning appear to go through a prerequisite echolalia stage. Similarly, Baltaxe and Simmons (1977) and Prizant (1982) concluded that echolalia is probably necessary for continued language growth. These authors proposed that, unlike normal language development, in which grammar and the functional use of language are viewed as a "build-up" process, language development in children with autism may be viewed as a "breakdown" process, in which language is learned by analyzing larger chunks of repeated language. Prizant and Duchan (1981) found that many echolalic responses were interactive, produced with evidence of comprehension, and served six communicative functions: assertions, turn-taking, requests, affirmative answers, self-regulation, and rehearsal to aid processing.

Even though echolalia is seen as one of the most typical autistic symptoms, not all individuals with autism echo, nor is it unique to autism. It also occurs in blind children, in some forms of dementia, and is seen in the development of normal children as well (Paul, 1987a). Echolalia is found in normal children, beginning at about age 9 months and continuing until age 2 or 3 years. As children's language skills gain complexity, echolalia frequency decreases (Menyuk, 1977; Prutting & Connolly, 1976). If echolalia is found past a certain point in development, it is associated with language impairment (e.g., autism, mental retardation, aphasia, dysphasia; Baltaxe & Simmons, 1975; Fay, 1980a; Schuler, 1979). Howlin (1982) found that echolalia in children with autism also decreases in frequency as their language skills become more complex.

Rutter (1965) reported the incidence of pronominal reversal (e.g., use of "you" instead of "I" when referring to self) to be 25% in speaking individuals

with autism. Disorders in pronominal reversal are likely due to echolalia. That is, the pronouns are inverted in the echolalic utterances the individual produces (Fay, 1971).

## **Spontaneous Communication**

The lack of spontaneity of speech in autism is a well-known phenomenon. Studies have found that speaking individuals with autism show a sparse use of verbal expression and a lack of spontaneity and clear communicative intent as compared to groups with other language disorders (Bartak, Rutter, & Cox, 1975; Prior, 1977).

Prior (1977) compared the language abilities of 20 children with autism and 20 with mental retardation. The author found that expressive verbal and gestural performance was particularly impoverished in the autism group, indicating a severe deficit in spontaneous communicative ability. In addition, the author noted an absence of spontaneous protodeclarative gestures in the 12 mute children with autism, which are a preverbal form of intentional communication that normally occurs around the first year of life. This result suggested a qualitatively distinct pattern of prelinguistic development (Curcio, 1978). The absence or severe deficiency in gestural usage by children with autism has also been observed by others (Bartak et al., 1975; Wing, 1971).

In summary, a considerable number of studies have been performed over the past 35 years to examine the nature of language impairment in autism, and several reviews summarize this work (e.g., Fay & Mermelstein, 1982; Paul, 1987a; Swisher & Demetras, 1985; Tager-Flusberg, 1989). Early descriptive studies (e.g., Pronovost, Wakstein, & Wakstein, 1966; Wolff & Chess, 1965) described the main clinical features of language in autism. These features included immediate and delayed echolalia, abnormal use of prosody, pronominal reversals, noncommunicative speech, a lack of spontaneous speech, and mutism. Later empirical studies, performed within a psycholinguistic framework, have focused on identifying which aspects of language impairment are central to the deficit in autism (e.g., Tager-Flusberg et al., 1990). Based on these studies, it is now agreed that individuals with autism have major deficits in the pragmatic aspects of language use, both in the range of functions that these individuals express (e.g., Wetherby & Prutting, 1984) and in their ability to communicate in a discourse setting (e.g., Curcio & Paccia, 1987). Degree of language impairment is an important prognostic factor (Eisenberg, 1956; Rutter et al., 1967; Wing, 1971).

Language abnormalities have been extensively studied in autism spectrum disorders and were considered by Kanner (1943) to be of primary importance in defining the disorder. Because approximately 50 % of individuals with autism never acquire functional speech (Rutter, 1978b, 1978c), one manner to subgroup persons with autism is according to whether they are able to speak or are mute.

Speech development appears to be associated to IQ, and few children with IQs less than 50 develop speech after age 5 years (Paul, 1987b; Rutter, 1970, 1978a; Rutter et al., 1967), unless they receive early, intensive behavioral intervention (e.g., Lovaas, 1987; Smith et al., 1997). However, the issue may be more complicated. Clinical experience and research have shown many instances of individuals with the same low IQ, and some acquire speech, while others remain mute. Conversely, some intellectually able individuals with nonverbal IQs in the normal range never learn to speak (Rutter, 1978a). As Rutter points out, it is important to study what differentiates the “failure to develop spoken language” subgroup, and how we can identify such children at an early age. Systematic research findings are lacking, but greatly needed. The qualities of a child’s play, imitation abilities, language comprehension, and babble are factors that have been suggested as possible prognostic indicators of the child’s chances of acquiring useful language skills (Rutter, 1978a).

To my knowledge, no studies have been performed comparing large groups of verbal and nonverbal individuals with autism spectrum disorders on symptoms and behavior. Study I is an attempt to compare these two groups on type and degree of symptoms and behavior as measured by the Autism Behavior Checklist, a commonly used diagnostic and screening instrument.

## SCREENING

### **Diagnostic Instruments**

There are several observational scales available to aid in the diagnosis of autism (see Parks, 1983, for a review). At the time the studies in this dissertation were performed, the scales included: Rimland’s Diagnostic Checklist for Behavior-Disturbed Children (Rimland’s Form E-1 and Form E-2; Rimland, 1964, 1971), the Childhood Autism Rating Scale (CARS; Schopler, Reichler, & Renner, 1986), the Behavior Observation Scale for Autism (BOS; Freeman, Ritvo, Guthrie, Schroth, & Ball, 1978; Freeman, Ritvo, & Schroth, 1984), the Behavior Rating Instrument for Autistic and Atypical Children (BRIAAC; Rutter, Kalish, Wenar, & Wolf, 1977), the Autism Observation Scale (Siegel, Anders, Ciaranello, Bienenstock, & Kraemer, 1986), and the Autism Behavior Checklist (ABC; Krug, Arick, & Almond, 1980b). Interrater reliability has been demonstrated to be adequate for each of these instruments, with the exception of Rimland’s Diagnostic Checklist (Parks, 1983). However, their validity in discriminating among different diagnostic groups has varied, depending on the selection of the subjects in both the autism and comparison groups (Cohen et al., 1978; Krug et al., 1980b; Parks, 1983; Sevin, Matson, Coe, Fee, & Sevin, 1991; Teal & Wiebe, 1986; Volkmar, Cicchetti, et al., 1988; Wenar, Rutter, Kalish-Weiss, & Wolf, 1986). Generally, discrimination has been best when children with autism and severe mental retardation have been

compared to normal children (Wenar et al., 1986) or to other nonautistic mentally retarded children without matching for intellectual level (Teal & Wiebe, 1986; Volkmar, Cicchetti, et al., 1988). Due to the fact that items associated with both autism and low developmental ages (less than 1 or 2 years) are included in most of these scales (Wenar et al., 1986), they may be less effective in identifying higher-functioning children, adolescents, and adults with autism than low-functioning and severely handicapped children (Krug et al., 1980b).

Volkmar, Cicchetti, et al. (1988) outlined a number of problems in the development of diagnostic scales and checklists. First, autism is a heterogeneous disorder. For example, high- and low-functioning individuals differ in many aspects. Second, the symptoms of autism change over time as individuals develop and grow older. Third, these instruments are often constructed after a deviance model, where abnormal behaviors are rated, which results in problems when appropriate comparison groups are selected. Fourth, most of these scales are based on parent-report, which may be unreliable, especially if a long period of time has elapsed between completion of the scale and the events or behaviors in question.

Most of the research on the psychometric properties of diagnostic instruments has focused on the lower-functioning (i.e., mentally retarded) individuals with autism (Sevin et al., 1991; Teal & Wiebe, 1986; Volkmar, Cicchetti, et al., 1988). However, about 5-30% of individuals with autism have IQs within the normal range (DeMyer, 1979; Freeman & Ritvo, 1984; Rutter & Schopler, 1987; Yirmiya & Sigman, 1991). Rutter and Schopler (1987) have questioned whether these diagnostic instruments are applicable for use with high-functioning individuals with autism. Yirmiya, Sigman, and Freeman (1994) compared the Autism Behavior Checklist (ABC) and the Autism Diagnostic Interview (ADI) on their ability to identify 18 high-functioning school-age children and adolescents who had been diagnosed as having autism based on DSM-III criteria. The authors found that only 4 of the children had scores above the suggested (Krug, Arick, & Almond, 1980a) cutoff scores for autism (scores of 67 and above) or borderline autism (scores between 54 and 67) on the ABC based on the children's current behavior, but all were correctly identified as autistic (N = 15) or borderline autistic (N = 3) on the ABC based on parental recall of the children's behavior at age 3-5 years. The ADI showed greater specificity. The authors suggest that the ABC may not be appropriate for use with high-functioning school-age children with autism, a concern that has also been expressed by the authors of the ABC (Krug et al., 1980a) and others (Miranda-Linné & Melin, 1997; Sevin, Matson, Coe, Fee, & Sevin, 1991; Volkmar, Cicchetti, et al., 1988; Wadden, Bryson, & Rodger, 1991).

Rimland (1971), recognizing the need for an objective method to diagnose autism and to differentiate syndromes in the group of "psychotic" children, developed a checklist called the Diagnostic Form E-2. A "behavior score" on the E-2 is to be derived from such symptoms as "insistence on sameness" and "avoidance of people," and a "speech score" is derived from such symptoms as pronominal reversal and delayed echolalia. Because symptoms that counter

indicate autism are included, which are to be subtracted, “behavior scores” may range from –33 to +37 and “speech scores” may range from –9 to +13. To meet criterion for autism, a score of +20 is needed on the “behavior score” and a score of +7 is needed on the “speech score.” However, the mute children’s results on the “speech score” were problematic. Although Rimland was aware that about 50% of the children with autism are mute, the mute children scored between 0 and +6 on the speech section of the E-2, thus failing to meet the speech criterion.

Fay (1980c) and Prior and Bence (1975) have criticized the weight given to the speech items in Rimland’s (1971) diagnostic checklist. Mute children are unable to obtain a +7 criterion level because they have no speech to be deviant. Verbal children have speech patterns that considerably add to their scores, thus giving them higher scores than the nonverbal children, so that the two groups are not strictly comparable in terms of handicap severity.

The Autism Behavior Checklist was studied in this dissertation, because it was suspected as having similar problems as Rimland’s (1971) Form E-2. Specifically, the expressive language items on the Language subscale provide speaking individuals with higher scores (thus indicating greater language pathology), while mute individuals, who have no language to be evaluated and are more language impaired, receive lower scores (see Study I).

### **Autism Behavior Checklist**

The Autism Behavior Checklist (ABC) is a widely used screening device for autism, both in the U.S.A. and Sweden. The ABC is one of five components of the Autism Screening Instrument for Educational Planning (ASIEP; Krug, Arick, & Almond, 1980a). The other four components of the ASIEP measure vocalizations, interaction, learning, and educational performance. Because symptoms, and their severity, change as a person with autism grows older, the ABC provides different profiles for a broad range of ages, from 18 months to 35 years.

The ABC has 57 items grouped into the following five subscales: Sensory, Relating, Body and Object Use, Language, and Social and Self-Help skills. Subscale placement of the items was based mostly on face validity or visual inspection (Sturmey, Matson, & Sevin, 1992). Krug et al. (1980b) selected the behaviors described in the 57 items from nine sources: the criteria outlined by Kanner (1943), Lovaas (Lovaas, Freitag, Gold, & Kassorla, 1965; Lovaas, Koegel, Simmons, & Long, 1973), the British Working Party’s Checklist or Creak’s Nine Points (Creak, 1964), Rimland’s Form E-2 (Rimland, 1971), the BRIAAC (Ruttenberg, Dratmann, Fraknoi, & Wemar, 1966; Ruttenberg, Kalish, Wenar, & Wolf, 1977), Rendle-Short and Clancy’s Checklist (1968), and Lotter’s Checklist (1974). The items for the ABC were then submitted to experts in the field for critical review. Using the phi and gamma coefficients from the chi-square analyses of 1,049 checklists, Krug et al. assigned a weight from 1 to 4 to each item, based on its ability to differentiate children with autism from

mentally retarded, severely emotionally disturbed, deaf and blind, and normal children.

Subscale scores are derived by adding the weights of all items endorsed for each of the five scales, and adding the five scale scores to make a total score. Higher ABC scores indicate an individual with many autistic behavior symptoms. The authors recommend that individuals with total scores of 68 or above have a high probability of being autistic, those in the 53-67 range are questionably autistic, and those with scores less than 53 are unlikely to have autism (Krug et al., 1980a). Some researchers, however, have questioned the accuracy of the recommended cutoff scores (Miranda-Linné & Melin, 1997; Sevin, Matson, Coe, Fee, & Sevin, 1991; Volkmar, Cicchetti, et al., 1988; Wadden, Bryson, & Rodger, 1991; Yirmiya, et al., 1994).

The ABC was developed using sophisticated analytic techniques at each step, and, at the time of the present studies, was the most commonly used and expedient scale available to aid in diagnosing autism (Newsom et al., 1988). It is well known and often utilized by researchers and clinicians in the field; it is quick to use; it may be answered by parents, teachers, or others who know the individual well; its employment does not require special training; and it has adequate reliability and validity.

### *Reliability and Validity*

Krug et al. (1980b) reported a split-half reliability of .87. Volkmar, Cicchetti, et al. (1988) reported split-half reliability for the total scale as .74, and split-half reliabilities for the subscales as ranging from .30 to .70.

Interrater reliability for the ABC was assessed by having 14 groups of three independent raters complete checklists for each of 14 children (Krug et al., 1980b). Agreement averaged 95% (not corrected for chance) across the 42 raters. However, no descriptions were provided of the raters or of the children. Volkmar, Cicchetti, et al. (1988) found interrater reliability on the ABC to be 70% (corrected for chance).

Although the content validity of the ABC is assumed to be adequate because various diagnostic criteria were used in the selection of items, an external validation of the content validity of the ABC has not been performed (Parks, 1983).

Criterion-related validity was examined by completing the ABC on a new sample of 62 children who were previously diagnosed as autistic (Krug et al., 1980b). The authors found that 86% of this sample received scores within one standard deviation of the mean and the remaining 14% had scores within 1.5 standard deviations. However, Lerea (1987) notes that this statistic is not very impressive given that plus or minus one standard deviation in a normal curve encompasses 68% of a population containing any Gaussian variable. Parks (1983) notes that a better test of validity would have been independent evaluations of children with a wide range of ABC scores.

Discriminant validity was assessed by comparing the mean scores of each of the subscales and the mean total scores for the autistic group with those for each of the other groups studied (i.e., mentally retarded, severely emotionally disturbed, deaf and blind, and normal children). All subscale scores and the total scores were significantly higher for the autistic group than for other four groups (Krug et al., 1980b). Significant differences remained between the autistic group and the other groups even when each group was subdivided according to sex, age, residential placement, language level, and student-teacher ratio (Krug et al., 1980b). The findings from other studies of the discriminant validity of the ABC, however, have varied widely. Teal and Wiebe (1986) used the ABC in conjunction with two of the ASIEP subtests assessing interaction and educational skills and were able to accurately discriminate 100% of the children with autism and 95% of the nonautistic trainable mentally retarded children. Other studies have reported poorer discriminative accuracy for the cutoff scores recommended by Krug et al. Volkmar, Cicchetti, et al. (1988), using the recommended cutoff scores by Krug et al., found that only 57% of children with autism were classified as probably autistic and 23% were classified as questionably autistic. The test was only 62% accurate in discriminating nonautistic children. Wadden et al. (1991) found that only 49% of the children with an autism diagnosis were rated as having a high probability of autism when they used the Krug et al. recommended cutoff scores, 27% fell within the questionable range, and 24% in the unlikely range. The nonautistic group was predicted with 100% accuracy. However, when they used a cutoff score of 44, they found the ABC correctly classified 87% of the children with autism and 96% of the nonautistic group. Sevin et al. (1991) also utilized the suggested cutoff score and 50% of their subjects who fulfilled the *DSM-III-R* (APA, 1987) criteria were misclassified as not autistic.

The studies by Sevin et al. (1991), Volkmar, Cicchetti, et al. (1988), Wadden et al. (1991) and Yirmiya, et al. (1994) suggest that the cutoff scores recommended by Krug et al. (1980b) are too high and may thus not identify a large proportion of individuals with autism. Results obtained from Swedish school-age children found that total scores  $\geq 70$  indicated moderate-to-severe autism, 45-69 range indicated mild autism, 20-44 range indicated borderline autism, and scores  $< 20$  were normal (Gillberg, Wahlström, Johansson, Törnblom, & Albertsson-Wikland, 1986).

Although most researchers and clinicians only use a single cutoff score from the ABC, the screening instrument was originally devised to also show a symptom area profile derived from the five subscales (Krug et al., 1980a, 1980b).

Oswald and Volkmar (1991), using a signal detection procedure, evaluated the ability of individual items on the ABC to discriminate 52 individuals with autism from 62 individuals with other developmental disabilities. The authors attempted to identify the smallest number of items that were significantly able to contribute to the discrimination. They found that only two items (Item 47 “‘Looks through’ people” and Item 17 “‘Not responsive to other people’s facial expressions/feelings’”) were able to discriminate the autistic from the nonautistic

individuals as well as any of the three total scoring procedures tested (including the Krug et al. [1980a, 1980b] suggested scoring using weighted items and scores of  $\geq 67$  indicating “probable” autism) and that further combinations did not significantly improve the power of discrimination. These items are weighted 4 and 3, respectively, in the standard ABC scoring procedure.

As noted earlier, Krug et al. (1980b) categorized the 57 items into five subscales on a subjective basis (Sturmey et al., 1992). Accordingly, research has been performed to examine the internal structure of the ABC. Sturmey et al. evaluated the internal consistency of three scales, including the ABC, and found satisfactory results for the ABC total, which had a Cronbach’s alpha of .87. However, the results for the ABC subscales were more problematic. Only the Body and Object Use subscale was satisfactory (Cronbach’s alpha = .79). The Relating subscale was adequate (Cronbach’s alpha = .69). The remaining 3 subscales, Sensory (Cronbach’s alpha = .47), Language (Cronbach’s alpha = .38), and Social and Self-Help (Cronbach’s alpha = .42) were all unacceptable. The authors recommended a factor-analytic study of the ABC, comparing the present five subscales with subscales derived by factor analysis.

### *Factor Analyses*

As part of an appraisal of the ABC, Volkmar, Cicchetti, et al. (1988) conducted a principal component factor analysis on the five ABC subscale scores, chronological age, and mental age in a group of 94 individuals with autism and 63 nonautistic individuals. The authors found three factors with eigenvalues greater than 1.00. Factor 1 accounted for 38% of the variance and loaded positively with the five ABC subscales and negatively on chronological and mental age. The second factor, accounting for 17% of the variance, loaded negatively on language and chronological age. Factor 3 (16% of the variance) loaded positively and heavily on mental age. Volkmar, Cicchetti, et al., referring to these results, and to correlational analyses of the five subscales, chronological age, and mental age, proposed that although the five subscales appeared to measure a single common factor, they did differ sufficiently to be used as separate subscales. The authors stressed the significance of both chronological age and mental age on the ABC, as some behaviors change over time.

Wadden et al. (1991) studied the discriminant validity and factor structure of the ABC on 67 children with autism and 56 children with other learning disorders. Attempting to replicate the findings reported in Volkmar, Cicchetti, et al. (1988), the authors also performed a factor analysis on the five subscales, mental age, and chronological age of their subjects. Wadden et al., however, found a 2-factor solution to be the most suitable. All five subscales loaded on Factor 1, which accounted for 46% of the total variance. Factor 2 (13% of the total variance) loaded on chronological and mental age. This outcome did not agree with that reported by Volkmar, Cicchetti, et al., who found that mental and chronological age loaded on separate factors. The results of the Wadden et al.

factor analysis of the five subscales also hinted that the ABC might measure a single common factor; however, a maximum likelihood factor analysis performed on all 57 items disconfirmed this hypothesis. Wadden et al. then factor analyzed all 57 items to investigate their factor structure using principal axis factor analyses and varimax rotations. The authors examined 3-, 4-, and 5-factor solutions and found the 3-factor model to be most stable and interpretable. Thirty-six of the 57 items had factor loadings of at least .4. Factor 1, labeled Nonresponsive, contained 15 items; Factor 2, labeled Aloof/Repetitive, 12 items; and Factor 3, labeled Infantile/Aggressive, 9 items. Wadden et al. stated that their 3-factor solution accounted for 31% of the total variance in the ABC, with Factor 1 accounting for 12%, Factor 2 for 10%, and Factor 3 for 9% (their 4-factor solution accounted for 34% of the total variance and the 5-factor solution for 37%). The authors found that 23 of the 36 items that loaded .4 or more in the 3-factor solution were also given a weight of 3 or 4 by Krug et al. (1980a, 1980b).

To summarize, research has shown that there are three main problems with the ABC. First, Krug et al.(1980b) subjectively placed the 57 items into the five subscales primarily on the basis of face validity or visual inspection (Sturmey et al., 1992). Wadden et al. (1991) attempted to empirically investigate the factor structure of the ABC and found a 3-factor model, containing 36 of the 57 items, to be most stable and interpretable. Second, several studies have suggested that the Krug et al. recommended cutoff scores may be too high and may misdiagnose higher functioning individuals with autism (Sevin et al., 1991; Volkmar, Cicchetti, et al., 1988; Wadden et al., 1991). Finally, although Krug et al. recommended the use of symptom profiles based on the five subscales and have reported different age profiles (as symptoms, and their severity change as an individual with autism grows older), research has focused on a single total cutoff score, without taking age into account. This dissertation has attempted to provide solutions to the first two problems (see Studies I and II) and makes recommendations regarding the third.

## **Parent-Report**

Almost all studies of autism and pervasive developmental disorders have relied on parental report or clinician observation (Szatmari, 1992). Parents provide invaluable information on their child's behavior. They have observed their child in many different situations and over a long period of time. Parental report is therefore important in regard to obtaining information on low frequency and situation-specific behaviors (Stone & Hogan, 1993).

However, low correlations between clinical observations and parental reports have been reported. A meta-analytic study of agreement between parent and observer reports of children's emotional and behavioral problems found low correlations, ranging between -.06 to .47, with a mean of .27 (Achenbach, McConaughy, & Howell, 1987). More relevant was a study by Sevin et al.

(1991), who were unable to find statistically significant correlations between the parental reported ABC questionnaire and direct behavioral observation ratings on the Childhood Autism Rating Scale (CARS; Schopler et al., 1986) and the Real Life Rating Scale (Freeman, Ritvo, Yokota, & Ritvo, 1986), all well-established diagnostic instruments in autism.

Conversely, Stone and Hogan (1993) were able to find significant correlations between parental reports (on the Parent Interview for Autism) and clinical observation (on the CARS and the total number of DSM-III-R criteria met), adding credence to the view (e.g., Campbell, Szumowski, Ewing, Gluck, & Breaux, 1982; Dulcan et al., 1990; Glascoe, MacLean, & Stone, 1991) that parents are able to provide accurate information about their child's behavior.

Szatmari, Archer, Fisman, and Streiner (1994) evaluated parent and teacher agreement for 83 higher functioning preschool children with pervasive developmental disorders on the ABC. They found that girls had lower total parent-reported ABC scores than boys (66 vs. 51), although the difference was not significant, possibly due to the small number of girls ( $N = 8$ ) in the study. The authors found virtually no agreement on the ABC and a wide variation in scores was observed between parents and teachers. Across all subscales and for the total score, all correlations, except for the Language subscale ( $r = .33, p < .001$ ), were very low (less than .20) and nonsignificant. No tendency was found for one group (the parents or the teachers) to rate children higher or lower than the other group. High levels of parental stress seemed to be associated with parents reporting more autistic behaviors. The authors suggest that the reliability and validity of the ABC may be poor, as have other authors (Teal & Wiebe, 1986). That is, many of the items on the ABC require the respondent to make inferences about the child (e.g., "has no social smile"), which may lead to measurement error and poor agreement. Another possibility is that there is a true difference across settings for these children. That is, the differences in structure and expectations between school and home may result in more autistic behaviors at home. They suggest caution when combining information from several informants. Volkmar, Cicchetti, et al. (1988) found that parents rated significantly more pathology than teachers.

Although the use of parent-reported data has its problems, it is a necessary and widely applied method of data collection in autism research and was used in Studies I and II in this dissertation.

## TEACHING METHODS

Approximately 50 percent of children with autism never acquire a verbal language (Rutter, 1966b). Early intensive behavioral intervention has produced impressive gains in a large number of nonverbal children who would otherwise have a poor prognosis for acquiring language (e.g., Anderson et al., 1987; Birnbrauer & Leach, 1993; Lovaas, 1987; Lovaas et al., 1973; Maurice, 1993; Smith et al., 1997). Although behavioral techniques have changed and expanded

over the last 40 years, as clinical experience and research have added to the knowledge base, one of the main techniques is the discrete-trial method. In short, a discrete-trial consists of four steps: (a) the trainer's instructions, (b) the child's response, (c) the consequence (reinforcement or correction), and (d) a short pause (3-5 seconds) between the consequence and the next instruction (between-trials interval; Anderson, Taras, & Cannon, 1996).

Eighteen years ago, in a review of the behavioral approaches to language instruction of children with autism, Carr (1983) outlined a number of the problems that had become apparent in many operant language programs. Among them was the problem of stimulus generalization, that is, the treatment gains that were observed in the clinic seldom generalized to other situations (i.e., across adults, across settings, and across instructional tasks). Difficulties with stimulus generalization are most likely to occur when training is performed by one adult, in one setting, and by the use of a limited set of instructional tasks (Carr, 1983). Multiple exemplar training has been one of the most common methods employed for enhancing generalization effects in the autism research literature (e.g., Carr & Kologinsky, 1983; Handleman, 1979; Stevens-Long & Rasmussen, 1974).

In addition, the mere teaching of specific language forms did not guarantee that the children would use the acquired forms in their daily environments of home and school (Carr, 1983). One of the largest problems facing those who worked clinically with language training of children with autism was that many of these children did not use the language they had learned in school or the clinic to communicate spontaneously. That is, unless questioned or otherwise prompted, these children did not spontaneously use language to communicate (Carr, 1982; Lovaas et al., 1973). Although there is a large body of research on an underlying cognitive impairment that may help to clarify this lack of spontaneity (e.g., Ornitz, 1987), Carr (1981) suggested that part of the problem might be due to the use of training procedures that inhibited spontaneity by bringing the child's language under the control of a few highly specific stimuli.

However, research has subsequently developed improved instructional techniques for children with autism for a variety of behaviors, in particular, the teaching of verbal language. These methods facilitate generalization and spontaneity, and include techniques for increasing motivation (Dunlap, 1984), using direct reinforcers (Koegel, O'Dell, & Koegel, 1987), frequently varying tasks and stimulus materials (Dunlap, 1984), reinforcing verbal attempts to communicate (Koegel et al., 1987), and using incidental teaching (Carr & Kologinsky, 1983; Hart & Risley, 1980).

Hart and Risley (1968, 1974, 1975, 1980, 1982) modified traditional operant methods into a procedure called incidental teaching, which facilitated generalization and the spontaneous use of language in disadvantaged preschoolers. However, incidental teaching had been generally employed on children who already had acquired, and spontaneously used, the language skills necessary for them to initiate verbal interactions. When these procedures were applied to persons with autism, who are often unable to initiate verbal interactions, the methods were modified and other similar techniques were

developed. All of these procedures involve arranging the environment to give children opportunities to talk, an adult that prompts a specific language form, and the provision of natural consequences for correct responses by presenting the item or event that has been requested (Neef, Walters, & Egel, 1984). The “mand-model” technique was developed by Rogers-Warren and Warren (1980) and is more teacher-directed than the original incidental teaching procedures. It has been used to teach expressive language skills to disadvantaged children (Rogers-Warren & Warren, 1980), receptive language skills to adults with autism (McGee, Krantz, Mason, & McClannahan, 1983), and preposition use to children with autism (McGee, Krantz, & McClannahan, 1985). A “natural language teaching paradigm,” which is similar to the “mand-model” technique, has been used to improve verbal language acquisition in nonverbal children with autism (Koegel et al., 1987) and has been taught to parents for increasing the speech of their children with autism (Laski, Charlop, & Schreibman, 1988).

The “delay procedure” (Halle, Marshall, & Spradlin, 1979) requires the teacher to wait up to 15 s before providing a prompt in an attempt to increase children’s initiation responses. It has been used to teach verbal language use in retarded children (Halle, Baer, & Spradlin, 1981; Halle et al., 1979), sign language use in children with autism (Carr & Kologinsky, 1983), verbal responding in children with autism (Charlop, Schreibman, & Thibodeau, 1985), and verbalizations of affection in children with autism (Charlop & Walsh, 1986). A related procedure relies on “interrupting an established behavior chain” (Goetz, Gee, & Sailor, 1985), in which the teacher stops the child from completing a behavior chain and asks “What do you want?”. This procedure has been used to teach pictorial communication skills to severely retarded adolescents (Goetz et al., 1985) and item and event requests to severely retarded children (Hunt, Goetz, Alwell, & Sailor, 1986). It has also been used as one of four modified incidental teaching procedures presented to teachers as a self-instruction manual in an effort to promote communication in students with “severe emotional disturbance and autism” (Haring, Neetz, Lovinger, Peck, & Semmel, 1987). A “loose training” strategy has been utilized to teach the use of “is/are” to moderately retarded students (Campbell & Stremel-Campbell, 1982). The “embedded instruction” procedure has been used to teach appropriate yes/no responding to developmentally disabled children (Neef et al., 1984).

It is generally assumed that incidental teaching and its various modifications are more powerful in promoting the generalization and spontaneous use of communication in persons with autism than traditional discrete-trial procedures. Neef et al. (1984) and Koegel et al. (1987) showed that modified incidental teaching procedures resulted in the acquisition and generalization of expressive verbal language in children with autism who had made minimal progress with traditional discrete-trial training. At the time this dissertation was begun, however, there existed only one previous study in the literature that had performed a direct, controlled comparison of incidental teaching and traditional discrete-trial training for children with autism. McGee et al. (1985) compared the two strategies for teaching the expressive use of prepositions. They found that

incidental teaching promoted greater generalization and more spontaneous use of prepositions. There were no significant differences in acquisition, retention, or time efficiency. However, in a special probe at the end of the study that measured the ability of the children to use the acquired prepositions correctly to describe the positions of novel stimuli, the subjects showed no, or limited, but equal, generalization.

Based on the literature, it is not yet possible to answer the question: “What is the best way to teach individuals with autism?”. (Gresham, Beebe-Frankenberger, & MacMillan, 1999; Newsom, 1999). Study III in this dissertation was, however, a further contribution to the empirical literature that is attempting to answer this question.

## AIMS OF THE PRESENT DISSERTATION

The aims of the present dissertation on autism are several. Although all of the studies were begun at approximately the same time, Study III was completed first. Therefore, the first aim was to compare two behavioral approaches (discrete-trial and incidental teaching) to language instruction on two boys with autism. One of the participants was mute until he was 11 years old, when intensive behavioral instruction was initiated. The study began one year later, at which point he had about a 100-word vocabulary. The second child had developed speech early, but was gravely language disordered (e.g., echolalia, limited expressive and receptive language abilities). Although several similarities were found in these children’s results, the two participants also showed different rates and styles of learning in the two teaching methods, despite the fact that they had identical DQs on recent assessments. In addition, they demonstrated strikingly large behavioral differences in general (which were not systematically assessed).

Given that it is impossible to make generalizations from just two individuals, these findings led to more global questions regarding differences in behavior and symptoms in speaking and mute individuals with autism spectrum disorders, which was the second aim of this dissertation. Two questionnaires were sent to all members of the Swedish National Autism Society, and were answered by the parents of 497 children, adolescents, and adults with a broad spectrum of autistic disorders. The first questionnaire elicited demographic information, as well as questions about the individual’s age at diagnosis; which diagnoses were received; age of onset and types of early symptoms; pre-, peri-, and neonatal hazards; family history of neuropsychiatric and cognitive disorders; and verbal communication abilities. The second questionnaire was a modified version of the ABC. Study I compared the behavior and symptoms of 155 mute and 335 speaking individuals on the ABC. In addition, questions about test construction, in particular, the expressive items on the Language subscale, were investigated. Mute individuals do not have any language to be rated as impaired and thus

receive lower scores on these items and the Language subscale, although they are more language impaired than speaking individuals.

The final aim of this dissertation assessed an additional issue in the construction of the ABC. Krug et al. (1980a, 1980b) had categorized the 57 items into five subscales on a subjective basis. Therefore, an empirical investigation of the factor structure of the ABC was performed, using a large sample of 383 individuals with autism and autism-like conditions.

Specifically, the aims of this dissertation are:

- (1) to compare the behavior and symptoms of speaking and mute individuals with autism spectrum disorders on the Autism Behavior Checklist (Study I)
- (2) to evaluate the effects of the expressive language items on the Autism Behavior Checklist Language subscale scores and the total scores in speaking and mute individuals with autism and autistic-like conditions (Study I)
- (3) to evaluate the factor structure of the Autism Behavior Checklist (Study II)
- (4) to compare the results of two behavioral techniques on expressive language use, in regard to acquisition, teaching efficiency, generalization, and spontaneous usage in two children with autism (Study III).

## EMPIRICAL STUDIES

### STUDY I

#### **Aims**

The language aspects of the ABC have not been analyzed. As was seen in Rimland's (1971) E-2 Form (see Introduction), mute individuals do not receive points on several expressive language items on the ABC (e.g., "Has pronoun reversal [you for I, etc.]", "Speech is atonal and arrhythmic"; "Seldom uses 'yes' or 'I'"; "Repeats phrases over and over"; "Repeats sounds or words over and over"; "Echoes questions or statements made by others"; and "Uses at least 15 but less than 30 spontaneous phrases daily to communicate"). As a result, mute individuals with autism may obtain lower Language subscale scores and total scores on the ABC than do speaking individuals (lower scores imply less

impairment). Given that most mute individuals with autism reasonably should have the same degree, or perhaps, a more severe degree of autism than do speaking individuals, this is not reflected in their lower scores. Mute individuals have greater language or communication difficulties than do speaking, and should therefore have higher scores on the Language subscale. However, the opposite result is found on the ABC. The purpose of the first study was to compare speaking and mute individuals with autism spectrum disorders to see whether: (a) the two groups' results on the behavioral items and scores (total and subscale scores) differ on the ABC; (b) the mute individuals receive lower total ABC scores, due to the inclusion of expressive speech items on the Language subscale; and (c) the speaking and mute individuals would differ in regard to symptoms and degree of autism if the expressive language items were disregarded in the ABC.

## Method

In order to secure a fairly representative sample of the autism spectrum disorder population in Sweden, a letter and two questionnaires were sent to all members of the Swedish National Autism Society (NAS), requesting volunteers for a study on language in autism. Because the NAS did not know which members were parents of individuals with autism, the materials were mailed to all 2,052 members. The questionnaires were returned by 1,596 members (a response rate of 78%). Of these responders, 497 were parents of children, adolescents, and adults with pervasive developmental disorders who had answered the questionnaires. The mean age of the entire sample was 14 years and 11 months ( $SD = 7.94$ ; range = 2-44). There were 341 males and 154 females (sex was omitted on two questionnaires), equal to a sex ratio of 2.2:1. The sample represented the full spectrum of autism and autistic-like disorders.

The first questionnaire elicited information about the individual's age; sex; hand preference; age at diagnosis and diagnoses received; age of onset and types of early symptoms; pre-, peri-, and neonatal hazards; family history of neuropsychiatric and cognitive disorders; and verbal communication abilities. The second questionnaire was a modified version of the ABC. The wording (translated into Swedish) and order of the items was the same as in the U.S. version, however the weights and subscale grouping of each item were excluded. In addition, each question could be answered on a 4-point Likert-like scale (see below).

The present study classified language abilities of the participants into two groups: a mute group (completely mute and has never spoken or spoke a little when younger, but now completely mute) and a speaking group (able to use at least one word to spontaneously express needs). There were 155 individuals (66% male and 34% female) in the mute group and 335 individuals (70% male and 30% female) in the speaking group. Seven parents did not answer the verbal

Table 5  
*ABC Total and Subscale Scores for 155 Mute and 335 Speaking Individuals*

ABC	Language level				<i>t</i>	<i>df</i>	<i>p</i>
	Mute		Speaking				
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>			
Total score	59.90	25.46	54.86	28.71	1.87	488	.062
Language	7.51	3.37	10.07	6.82	-5.55	486	.0001
Sensory	7.99	6.25	5.76	5.15	3.88	254	.0001
Relating	15.17	9.34	12.74	8.50	2.86	488	.004
Body and Object Use	16.59	8.54	12.76	9.28	4.35	488	.0001
Social/Self Help	10.19	4.82	9.28	4.96	1.91	488	.057

<sup>a</sup>Separate variance estimates used for *t* tests, two-tailed *p* values for ABC scores.

communication abilities question on the questionnaire and were not included in later analyses.

No significant differences were found between the two groups when they were compared on age, sex, and diagnosis. The parents reported that 50% of the total sample had the diagnosis Autistic Disorder, 12% reported “Autistic-Like Condition,” 9% “Childhood Psychosis,” 19% did not specify whether Autistic Disorder or “Childhood Psychosis,” and the rest gave other diagnoses (e.g., Asperger’s Disorder, Rett’s Disorder, Childhood Disintegrative Disorder, Symbiotic Psychosis, Childhood Schizophrenia). However, the mute group was significantly more often reported as having epilepsy than the speaking group (43% versus 21%, respectively). In addition, the mute group was significantly younger when given a first diagnosis than the speaking group (80% versus 64%, respectively, by age 5 years).

When the results from the ABC were examined, the original weights (ranging from 1 to 4) were included and a dichotomous scoring was employed. Specifically, the 4-point scale was divided into two parts and answers from *applies completely* to *applies fairly well* were given a value of “1” and answers from *applies somewhat* to *does not apply* were given a value of “0”. Higher scores on the total score, a subscale score, or an item indicate greater pathology. Means and standard deviations for all items, subscale scores, and total score were calculated on a group basis (speaking and mute), and compared using *t*-tests. Because a large number of comparisons were made in this study, a *p* value of .01 was selected to indicate significance. However, results with a  $p \leq .05$  are also reported as trends. With the exception of the Language subscale, only items that were found to be significant ( $p \leq .01$ ) or trends ( $p \leq .05$ ) are reported.

## Results

As seen in Table 5, the two groups did not significantly differ on the ABC total score (possible range of total scores = 0-158;  $p = .062$ ). The speaking group received significantly higher scores on the Language subscale, while the mute group showed significantly more pathology on three of five subscales (Sensory, Relating, and Body and Object Use).

As speculated, the speaking group showed highly significantly greater scores on the Language subscale than the mute group (see Table 5; possible range of Language scores = 0-31). As seen in Table 6, the Language subscale contains a

Table 6

*ABC Scores on Language Items for 155 Mute and 335 Speaking Individuals with Autism Spectrum Disorders<sup>a</sup>*

Language items:	Language level				<i>t</i>	<i>df</i>	<i>p</i>
	Mute		Speaking				
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>			
<b>Expressive items</b>							
8. Has pronoun reversal (you for I, etc.)	0.08	0.48	0.97	1.40	-10.37	460	.0001
11. Speech is atonal and arrhythmic	0.18	0.83	1.09	1.78	-7.67	488	.0001
18. Seldom uses "yes" or "I"	0.62	0.93	0.93	1.00	-3.29	488	.0011
29. Gets desired objects by gesturing	1.41	0.92	0.70	0.95	7.73	488	.0001
32. Repeats phrases over and over	0.29	0.89	1.69	1.49	-12.94	458	.0001
42. Uses 0-5 spontaneous words per day to communicate wants and needs	1.64	0.77	0.83	0.99	9.84	376	.0001
46. Repeats sounds or words over and over	0.93	1.39	1.46	1.50	-3.72	488	.0002
48. Echos questions or statements made by others	0.08	0.55	1.15	1.81	-9.85	443	.0001
56. Uses at least 15 but less than 30 spontaneous phrases daily to communicate	0.06	0.41	0.70	1.27	-8.32	454	.0001
<b>Receptive items</b>							
4. Does not follow simple commands which are given once (sit down, come here, stand up)	0.35	0.48	0.28	0.45	1.66	488	.097
15. Does not respond to own name when called out among two others (Joe, Bill, Mary)	0.93	1.00	0.48	0.85	4.86	262	.0001
20. Does not follow simple commands involving prepositions ("put the ball on the box" or "put the ball in the box")	0.52	0.50	0.27	0.44	5.58	488	.0001
37. Cannot point to more than five named objects.	0.49	0.50	0.23	0.42	5.61	258	.0001

<sup>a</sup>Separate variance estimates used for *t* tests, two-tailed *p* values for ABC scores.

total of 13 items, which were divided according to whether the items measure expressive (i.e., items that require speech) or receptive (i.e., items that measure speech understanding) language skills. The speaking group obtained significantly greater scores (and therefore more pathology) on all expressive items, with the exception of Items 42 (as all mute individuals used 0 spontaneous words per day) and 29 (which dealt with the use of gestures to obtain desired objects). The mute group had significantly higher scores on 3 of the 4 items that measured receptive language skills. There was no significant difference between the groups on 1 receptive language item (Item. 4). In summary, the mute individuals had greater difficulties understanding speech and used gestures to communicate their desires. Many of the speaking individuals had odd, repetitive speech and echolalia.

The Sensory subscale has 9 items totally. The mute group obtained a highly significant difference in degree of pathology on this subscale than the speaking group (see Table 5; possible range of Sensory scores = 0-26). Table 7 shows that the mute group received significantly higher points (and therefore demonstrated more autistic symptomatology) on 2 items on the Sensory subscale and trends toward more pathology on 3 items. These results suggested that mute individuals with autism and autistic-like conditions were more likely to show abnormal responses to some sensory stimuli (i.e., auditory and visual stimuli) than did speaking individuals. Interestingly, the results for abnormal pain reaction (Item 26, "Sometimes painful stimuli such as bruises, cuts and injections evoke no reaction") did not differ between the two groups.

The mute group demonstrated significantly more autistic symptoms on the Relating subscale than the speaking group (see Table 5; possible range of

Table 7  
*ABC Scores on Sensory Items for 155 Mute and 335 Speaking Individuals with Autism Spectrum Disorders<sup>a</sup>*

Sensory items:	Language level				<i>t</i>	<i>df</i>	<i>p</i>
	Mute		Speaking				
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>			
21. Sometimes shows no "startle response" to a loud noise (may have thought child was deaf)	1.06	1.44	0.63	1.22	3.28	260	.0012
34. Often will not blink when a bright light is directed toward eyes	0.27	0.45	0.17	0.38	2.36	261	.019
44. Squints, frowns or covers eyes when in the presence of natural light	0.77	1.32	0.51	1.13	2.15	263	.032
52. Frequently has no visual reaction to a "new" person	1.28	1.49	0.67	1.25	4.40	259	.0001
57. Stares into space for long periods of time	1.68	1.98	1.25	1.86	2.30	488	.022

<sup>a</sup>Separate variance estimates used for *t* tests, two-tailed *p* values for ABC scores.

Table 8

*ABC Scores on Relating Items for 155 Mute and 335 Speaking Individuals with Autism Spectrum Disorders<sup>a</sup>*

Relating items:	Language level				<i>t</i>	<i>df</i>	<i>p</i>
	Mute		Speaking				
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>			
3. Child frequently does not attend to social/environmental stimuli	1.37	1.90	0.93	1.69	2.55	488	.011
13. Does not (or did not as a baby) reach out when reached for	1.25	0.97	1.00	1.00	2.58	488	.01
17. Not responsive to other people's facial expressions/feelings	1.35	1.50	0.90	1.38	3.27	488	.0011
33. Does not imitate other children at play	2.25	1.31	1.78	1.48	3.35	488	.0009
43. Often frightened or very anxious	0.74	1.29	1.02	1.42	-2.12	488	.034
47. "Looks through" people	1.50	1.94	1.12	1.80	2.09	488	.037

<sup>a</sup>Separate variance estimates used for *t* tests, two-tailed *p* values for ABC scores.

Relating scores = 0-38). This subscale contains a total of 12 items. As seen in Table 8, the mute group showed significantly more pathology on 4 items and a tendency on 1 item. The speaking group displayed a tendency toward higher points on 1 item. This suggested that mute individuals had greater problems in social interaction (i.e., were more socially nonresponsive and withdrawn and unable to imitate other children at play) than speaking individuals. The latter group, however, tended to be more anxious or frightened.

There are a total of 12 items on the Body and Object Use subscale. The mute group obtained a highly significant difference in degree of pathology on this subscale than the speaking group (see Table 5; possible range of Body and Object Use scores = 0-38). Table 9 shows that the mute group demonstrated significantly more abnormal behavior on 5 items, and a tendency on 1 item. These results indicated that mute individuals were more likely to exhibit stereotypic behavior (e.g., hand flapping, whirling self, twirling/spinning objects, and rocking), greater deficits in play skills, and tended to engage in more primitive sensory activity (i.e., smelling and mouthing) than speaking individuals.

No difference between the two groups was observed on the Social and Self-Help Skills subscale (see Table 5; possible range of Social and Self-Help Skills scores = 0-25), which contains 11 items totally. As shown in Table 10, mute individuals received significantly higher scores on 5 items. The speaking group showed a significantly higher score on 1 item and trends toward higher scores were found on 2 items. These outcomes suggested that mute individuals had

Table 9  
*ABC Scores on Body and Object Use Items for 155 Mute and 335 Speaking  
 Individuals with Autism Spectrum Disorders<sup>a</sup>*

Body and Object Use items:	Language level				<i>t</i>	<i>df</i>	<i>p</i>
	Mute		Speaking				
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>			
1. Whirls self for long periods of time	0.65	1.48	0.29	1.03	2.73	226	.007
5. Does not use toys appropriately (spins tires, etc.)	1.63	0.78	1.12	0.99	6.06	374	.0001
12. Rocks self for long periods of time	1.45	1.93	0.82	1.62	3.48	258	.0006
22. Flaps hands	2.63	1.90	1.87	2.00	3.96	488	.0001
40. Twirls, spins and bangs objects a lot	2.45	1.95	1.64	1.97	4.27	488	.0001
51. Will feel, smell and/or taste objects in the environment	1.63	1.50	1.30	1.49	2.26	488	.024

<sup>a</sup>Separate variance estimates used for *t* tests, two-tailed *p* values for ABC scores.

Table 10

Social and Self Help items:	Language level				<i>t</i>	<i>df</i>	<i>p</i>
	Mute		Speaking				
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>			
14. Strong reactions to changes in routine/environment	1.59	1.50	1.92	1.44	-2.32	488	.02
19. Has "special abilities" in one area of development, which seems to rule out mental retardation	0.72	1.54	1.96	2.00	-7.47	381	.0001
23. Severe temper tantrums and/or frequent minor tantrums	1.39	1.50	1.69	1.49	-2.06	488	.039
41. Difficulties with toilet training	0.63	0.49	0.40	0.49	4.75	488	.0001
45. Does not dress self without frequent help	0.68	0.47	0.41	0.49	5.84	488	.0001
49. Frequently unaware of surroundings, and may be oblivious to dangerous situations	1.32	0.95	0.91	1.00	4.28	488	.0001
50. Prefers to manipulate and be occupied with inanimate things	2.32	1.98	1.83	2.00	2.56	488	.0107
55. A developmental delay was identified at or before 30 months of age	0.74	0.44	0.51	0.50	4.94	488	.0001

Note. <sup>a</sup>Separate variance estimates used for *t* tests, two-tailed *p* values for ABC scores.

greater problems with some self-help skills (e.g., toilet training and dressing self), poorer understanding of risks in dangerous situations, preferred inanimate objects over other people and animals, and were more likely to be identified early as having a developmental delay than speaking individuals. Indeed, the results from the first questionnaire showed that mute individuals were significantly younger when their parents first suspected that something was wrong with their child (age of onset or “recognition” [Volkmar, Stier, et al., 1985]) and were diagnosed at a younger age than were speaking individuals. Speaking individuals more often had “special abilities,” tended to show stronger reactions to changes in the environment or in routines, and tended to have more temper tantrums than mute individuals. The finding that speaking individuals tended to demonstrate a greater number of temper tantrums is somewhat surprising. One might expect mute individuals, who ought to be frustrated by their lack of ability to express desires, to show more temper tantrums.

## **Conclusions and Discussions**

Contrary to expectations, no significant difference was observed between the speaking and mute groups with autism spectrum disorders on the ABC total score ( $M = 60$  vs.  $55$  for the mute and speaking groups, respectively;  $p = .062$ ). However, as was hypothesized, the two groups obtained significantly different scores on many ABC items and on four of the five subscales. Specifically, the mute group demonstrated more pathology on a majority of the items that were found to differ between the two groups (significant differences on 21 items and trends on 5 items) and significant differences on three of the five subscales (Sensory, Relating, and Body and Object Use). In general, the speaking group showed much less pathology, obtaining significantly higher scores on a mere 8 items and trends on 3 items, and a significant difference on only one of the five subscales (Language).

When the items on the Language subscale were divided into expressive (i.e., items that require speech or gestures) or receptive (i.e., items that measure speech understanding) language skills, it was found that speaking individuals received higher scores on 7 of the 9 expressive language items and that mute individuals obtained higher scores on 3 of the 4 receptive language items and 2 of the 9 expressive language items (1 item that assessed the use of gestural communication and 1 item measuring the use of 0-5 spontaneous words per day to communicate, as all mute individuals used 0 words). It was not surprising that mute individuals did not obtain points on items that require speech, since the groups were divided a priori according to whether or not an individual could speak. However, questions regarding test construction were raised. All of the expressive speech communication items carry greater weights (mean weight of the 8 items = 3.0) than the receptive and gestural communication items (mean weight of the 5 items = 1.4). The disparity in number and weighting of the speech items resulted in the speaking individuals obtaining highly significantly greater

scores on the Language subscale of the ABC, which in turn appeared to equalize their significantly lower scores on the three other subscales. This resulted in approximately equal ABC total scores.

A related question concerned the appropriateness of a test that grants greater pathology scores on expressive language skills to speaking rather than to mute individuals. Obviously, mute individuals are more language-handicapped than speaking, regardless of how few words or how odd the latter individuals speak. Further support for the notion of a greater language handicap in the mute group was their higher scores on 3 of the 4 receptive language items.

The results of the present study demonstrated that if the expressive language items on the ABC were disregarded, most mute individuals would display significantly greater autistic symptoms and behaviors on many items and subscales, resulting in significantly higher ABC total scores and therefore show a more severe degree of autism. Given this finding, one may question whether the Language subscale is weighted too strongly in the ABC total score. On the other hand, if the expressive language items were not so many in number and greater in weight, there is a risk that many speaking individuals would not meet the recommended cutoff scores for autism and be misdiagnosed as nonautistic.

One possibility to remedy the situation is to increase the number and/or weights of the receptive language items to reflect the greater communication difficulties experienced by mute individuals. Alternatively, to give mute individuals greater points on the expressive language items. At the very least, clinicians and others in the field ought to be aware of the problems found on the Language subscale, and its effects on total ABC scores.

The mean total score across both groups ( $M = 57$ ) found in this study supported the proposal by other researchers (Sevin et al., 1991; Volkmar, Cicchetti, et al., 1988; Wadden et al., 1991) that Krug et al.'s (1980b) recommended cutoff scores (68 or above = high probability of autism, 53-67 = questionably autistic, and less than 53 = unlikely autism) are too high and misclassify a large proportion of individuals with autism.

The incidence of mutism in individuals with autism has been found to range from 28% (Wolff & Chess, 1965) to 61% (Fish, Shapiro, & Campbell, 1966). In the present study, 32% of the entire group was classified as mute, a proportion which is low, but within the boundaries of the above range. The low proportion was probably due to the conservative criteria used to define muteness in this study. Schuler (1976; cited in Alpert & Rogers-Warren, 1985; Fay, 1980c) defined three degrees of muteness and employed the term to individuals who: (1) produce no sounds ("totally mute"); (2) emit only meaningless sounds that are used for self-stimulation ("functionally mute"); and (3) use a limited number of words or word-approximations in a functional manner to express immediate desires ("semi-mute"). In the present study, the term "mute" was used for individuals who were "totally mute" and "functionally mute." Specifically, if an individual was able to spontaneously use only one word to express desires, or had only echolalia and did not have any other communicative speech, he or she was placed in the speaking group. The definitions of speaking and mute in the

present study were thus more strict than in most other studies (e.g., Konstantareas et al., 1989; Wing, 1969), which often include “semi-mute” and “only echolalia” individuals in their nonspeaking groups.

It is not uncommon for children with autism to begin to speak and then suddenly and permanently lose their acquired speech, most often between age 18-30 months (Schreibman, 1988). In the present study, the proportion of mute individuals who spoke a little when younger, but later lost their speech, and did not speak at all now, was 41%, which was somewhat higher than the previously reported estimates of 20% (Rutter & Lord, 1987) to 34-37% (Kurita, 1985; Wolf & Goldberg, 1986).

There was one divergent finding in the present study. No significant difference in the proportions of muteness were found between the two sexes. Thirty percent of the males and 34% of the females were mute. Given that previous research has found that females with autism tend to be more severely affected (Coleman, 1978; DeMyer et al., 1973; Gillberg & Steffenburg, 1987; Gillberg et al., 1991; Gittelman & Birch, 1967; Konstantareas et al., 1989; Lord & Schopler, 1985; Lord et al., 1982; Lotter, 1974; Rutter et al., 1967; Short & Schopler, 1988; Tsai & Beisler, 1983; Tsai et al., 1981; Walker, 1976; Wing, 1981b; Wolf & Goldberg, 1986), the females in this study may be higher-functioning than what is normally found in the general population of autism spectrum disorders.

A relative strength of Studies I and II was the large sample size that included a wide range of autism spectrum disorders. Although autism prevalence has long been estimated at 4-5 per 10,000 (Wing et al., 1976), Wing (1996) has subsequently suggested that the prevalence of autism spectrum disorders may be as high as 1% of school-aged children. A recent total population study performed in a middle-sized town in Sweden found autism spectrum disorders (i.e., autistic disorder, Asperger’s syndrome, and other autistic-like conditions) at a rate corresponding to 1.2% of the general population of children (Kadesjö, Gillberg, & Hagberg, 1999). Given the population of Sweden at the time of the studies, there were between 3,280-98,400 children, adolescents, and adults with autism spectrum disorders in the country, depending on which general population incidence rate one applies. The present study, therefore, includes between 0.5 - 15% of the people with autism and autistic-like conditions in Sweden and is similar to the populations that are rated on the ABC in clinical settings.

Studies I and II had at least two limitations. First, it is possible that this sample may not be representative of all parents of individuals with autism in Sweden. Research has shown that membership in the National Association for Autistic Children was related to higher SES (Wing, 1980b). Families who are members of autism societies are a self-selected group, and may differ from the parents who are not members of that society (Smith, Chung, & Vostanis, 1994). Whether or not such a bias exists in Sweden, and to what extent it may affect the present studies, is unknown. Smith et al. found that members of the West Midlands Autistic Society accounted for 73% of all families with a child with autism in the Birmingham area. The Swedish National Autism Society has an

extensive network and is well-known by all professionals who work with autism (who, in turn recommend parents to join the group). Therefore, one may surmise that membership proportions are, at the very least, equal to or higher than those found in the Birmingham area.

Second, Studies I and II contain all of the problems associated with parent-report questionnaires; specifically, problems with parents' memories and the risk that the parents depicted their children in a favorable or unfavorable manner. Almost all studies of autism rely on parental report (Szatmari, 1992), as parents provide invaluable information on their child's behavior, particularly low frequency and situation-specific behaviors (Stone & Hogan, 1993). Although, low correlations between clinical observations and parental report have been observed (e.g., Sevin et al., 1991), several other studies have found parent-reported information to be accurate (e.g., Schopler & Reichler, 1972; Stone & Hogan, 1993; Wing & Gould, 1978). Regardless of any eventual problems associated with parent-reported data, it is a widely utilized and necessary method of data collection in autism research.

In summary, the results of this comparative study of the ABC-rated behavior of speaking and mute individuals with autism spectrum disorders showed that mute individuals demonstrated greater pathology in almost all areas. There were, however, a few exceptions, in particular the items that measured expressive language skills. Although the mute individuals had higher scores on a majority of items and subscales, both speaking and mute individuals received approximately equal ABC total scores, due to the inclusion of the heavily weighted speech items. If the expressive language items were disregarded, mute individuals would show significantly greater symptoms and degree of autism.

## STUDY II

### **Aims**

The purpose of the second study was to investigate the factor structure of the ABC using a large sample of individuals with autism spectrum disorders. Wadden et al. (1991) factor analyzed all 57 ABC items on a sample of 67 children and adolescents with autism and 56 with other learning disorders and found a 3-factor model to be the most appropriate. First, we attempted to replicate the Wadden et al. 3-factor solution on a larger and more homogeneous (i.e., all participants had autism spectrum disorders) sample of 383 individuals. Second, if our 3-factor solution was not sufficiently similar to the Wadden et al. model, we were to assess other factor solutions to see which emerged as the most interpretable and stable. Third, we examined how well our ensuing factor solution agreed with Krug et al.'s (1980a, 1980b) five subscales, which were subjectively derived on the basis of apparent item content. Fourth, given that the

sample in the present study contained a broader spectrum of disorders along the autistic continuum than in previous studies, we compared our mean total ABC scores to those recommended by Krug et al.

## **Method**

As part of a larger study concerning language in autism, the ABC was answered by the parents of 497 children, adolescents, and adults with autism spectrum disorders (i.e., autistic disorder, Asperger's syndrome, and other autistic-like conditions). A more detailed description of the method of sample selection, participants, and questionnaires is presented in Study I. In order to obtain a more homogeneous and comparable group, only the individuals aged 5-22 years were included in Study II, resulting in 383 children, adolescents, and young adults. There were 268 males and 115 females, equal to a sex ratio of 2.3:1. The mean age of the sample was 12.7 years ( $SD = 5$ , range = 5-22 years). The sample included the full spectrum of autism and autistic-like disorders and is most likely more representative of the individuals that are rated on the ABC in clinical settings.

In order to examine the internal structure of the ABC, factor analyses were conducted using all 383 participants. The factor analyses performed in previous studies were judged to be insufficiently stable to be used as a basis for a confirmatory factor analysis, due to the relatively low number of subjects in these studies and their heterogeneous diagnoses (i.e., nearly half of the participants did not have autism spectrum disorders). Therefore, the 57 items were factor analyzed by a principal factor analysis with squared multiple correlations used as communality estimates with a varimax rotation. The factor analyses were carried out on nonweighted items using the 4-point Likert-like scales. Only items loading .4 or more were included in the assessment of our factor solutions.

## **Results**

Three-, 4- and 5-factor solutions were examined. The 3-factor model obtained in this study accounted for 67.5% of the total variance (as compared to 31% in Wadden et al. [1991]), our 4-factor model accounted for 75% and 5-factor model for 80%.

The 3-factor solution was first compared to 3-factor model proposed by Wadden et al. (1991). The present study's 3-factor solution contained 37 items, and the Wadden et al. 3-factor model had 36 items. When the two models were contrasted in detail, however, large differences were found. Although 30 of the items in the 3-factor solution found by Wadden et al. were also found in our 3-factor model, the location of the items in the factors was quite divergent. Specifically, our Factor 1 contained 14 items. Seven of these items were also in

Wadden et al.'s Factor 1, 2 items were from Wadden et al.'s Factor 2, 3 items were located in Wadden et al.'s Factor 3, and 2 items were not included in Wadden et al.'s 3-factor solution. Our Factor 2 was composed of 13 items. Four of these items were also located in Wadden et al.'s Factor 2, 6 items were from Wadden et al.'s Factor 1, and 3 items were not found in the Wadden et al. 3-factor solution. Our Factor 3 consisted of 10 items. Five of these items were also in Wadden et al.'s Factor 3, 3 items were located in Wadden et al.'s Factor 2, and 2 items were not included in Wadden et al.'s 3-factor solution. Six items found in the Wadden et al. 3-factor solution were not included in our 3-factor model. In addition, the items that clustered in our 3-factor solution were diverse and did not neatly merge together, thus making it difficult to find a unifying and interpretable name for each factor.

Therefore, the 4- and 5-factor solutions were evaluated and the 5-factor model was selected on the basis of three criteria. First, the 5-factor solution produced five factors with eigenvalues of at least 1.00 (Factor 1 = 10.26, Factor 2 = 3.12, Factor 3 = 2.10, Factor 4 = 1.66, and Factor 5 = 1.12). Second, the Cronbach's alpha values for the items in four of the five factors were satisfactory and one factor was adequate (Nunnally, 1978). Specifically, the alpha values of the items in Factors 1 through 5 were .86, .82, .75, .64, and .73, respectively. Finally, the item grouping in the 5-factor model was the most interpretable, thus making the factors more amenable to naming.

In the 5-factor solution, 39 of the 57 items had factor loadings of .4 or more on at least one factor (see Table 11), with 13 items loading on Factor 1, 11 items on Factor 2, 6 items on Factor 3, 5 items on Factor 4 and 4 items on Factor 5. The 5-factor solution accounted for 80% of the total variance in the 57 item ABC, with 45% accounted for by Factor 1, 14% by Factor 2, 9% by Factor 3, 7% by Factor 4 and 5% by Factor 5.

As seen in Table 11, 21 (out of a total of 34 possible on the ABC) of the 39 items that loaded .4 or more had a weight of 3 or 4 (Krug et al., 1980a, 1980b). Factor 1 had 9 items with a weight of at least 3, Factor 2 had 1 item, Factor 3 had 2 items, Factor 4 had 5 items, and Factor 5 had 4 items.

The 4-factor solution contained a total of 38 items with factor loadings of .4 or more, with 13 items loading on Factor 1, 13 items on Factor 2, 8 items on Factor 3, and 4 items on Factor 4. The 4-factor solution accounted for 75% of the total variance. The Cronbach's alpha values for the items in the Factors 1 through 4 were .84, .86, .78, and .73, respectively.

The item groupings for four factors in the 4- and the 5-factor solutions were very similar. Factors 1 and 5 (Factor 4 in the 4-factor model) were identical. Nine of the items in Factor 2 were identical, 2 items found in the 4-factor solution ("Twirls, spins and bangs objects a lot" and "Flaps hands") were placed in Factor 4 in the 5-factor model, and 1 item ("Does not imitate other children at play") was not included in the 5-factor solution. Six of the items in Factor 3 were identical, 1 item found in the 4-factor model ("Does a lot of lunging and darting about, interrupting with spinning, etc.") moved to Factor 4 in the 5-factor solution, and 1 item ("Will feel, smell, taste objects in the environment") was not

Table 11  
*Factor Loadings of .4 or More in a 5-Factor Model of the ABC*

Behavioral item	Factor <sup>a</sup>					W <sup>b</sup>	K <sup>c</sup>
	1	2	3	4	5		
Has no social smile	<b>61</b>	7	7	-9	-4	2	R
Does not reach out when reached for	<b>59</b>	14	16	5	0	2	R
Actively avoids eye contact	<b>58</b>	7	23	11	-5	4	R
Child doesn't attend to social/environmental stimuli	<b>58</b>	15	1	12	14	4	R
Not responsive to other's facial expressions/feelings	<b>54</b>	28	0	20	5	3	R
"Looks through" people	<b>52</b>	23	17	15	13	4	R
Frequently has no visual reaction to a "new" person	<b>50</b>	32	-14	18	8	3	S
Often doesn't blink when a bright light is directed toward eyes	<b>48</b>	16	6	32	5	1	S
Does not respond to own name when called out among others	<b>45</b>	40	0	20	3	2	L
Resists being touched or held	<b>45</b>	-6	32	1	13	4	R
Sometimes shows no "startle response" to loud noise	<b>44</b>	20	-11	38	1	3	S
Stares into space for long periods of time	<b>40</b>	19	9	35	7	4	S
Prefers to manipulate/occupied by inanimate objects	<b>40</b>	20	18	36	17	4	H
Does not dress self without frequent help	9	<b>67</b>	-4	0	5	1	H
Does not use toys appropriately	25	<b>58</b>	4	33	13	2	B
Cannot point to more than five named objects	8	<b>54</b>	-2	16	-9	1	L
Difficulties with toilet training	11	<b>53</b>	13	10	-8	1	H
Has "special abilities" in one area of development	13	<b>-53</b>	16	12	14	4	H
Seldom uses "yes" or "I"	18	<b>51</b>	13	9	22	2	L
Uses 0-5 spontaneous words per day to communicate	15	<b>51</b>	8	14	-5	2	L
Does not follow simple commands involving prepositions	26	<b>50</b>	-10	23	-6	1	L
Frequently unaware of surroundings/oblivious to danger	30	<b>47</b>	10	33	16	2	H
Gets desired objects by gesturing	1	<b>44</b>	27	20	-7	2	L
Does not follow simple commands given once	33	<b>40</b>	3	4	13	1	L
Severe temper tantrums and/or frequent minor tantrums	8	0	<b>63</b>	13	13	3	H
Hurts others by biting, hitting, kicking, etc.	8	11	<b>61</b>	-6	13	2	H
Hurts self by banging head, biting hand, etc.	8	14	<b>52</b>	21	2	2	B
Does not wait for needs to be met	6	26	<b>50</b>	5	10	2	H
Strong reactions to changes in routine/environment	31	-8	<b>44</b>	14	22	3	H
Is very destructive	11	33	<b>42</b>	19	3	2	B
Flaps hands	5	29	9	<b>46</b>	12	4	B
Twirls, spins and bangs objects a lot	10	37	23	<b>45</b>	4	4	B
Whirls self for long periods of time	5	14	9	<b>43</b>	2	4	B
Seems not to hear, so that a hearing loss is suspected	33	3	4	<b>42</b>	4	3	S
Does a lot of lunging and darting, interrupting	11	24	37	<b>41</b>	16	4	B
Repeats phrases over and over	2	-4	18	3	<b>73</b>	3	L
Echoes questions or statements made by others	5	-6	7	13	<b>63</b>	4	L
Repeats sounds or words over and over	12	16	18	17	<b>60</b>	3	L
Has pronoun reversal	2	-1	-4	-2	<b>55</b>	3	L

<sup>a</sup> Decimal points omitted

<sup>b</sup> Weights assigned by Krug et al.

<sup>c</sup> ABC subscales (Krug et al.). R = Relating, S = Sensory, H = Social/Self Help, B = Body Concept, L = Language

included in the 5-factor solution. Two items not found in the 4-factor model (“Seems not to hear, so that a hearing loss is suspected” and “Whirls self for long periods of time”) were located in Factor 4 in the 5-factor solution.

## **Conclusions and Discussions**

Using a larger sample of 383 children, adolescents, and young adults with a broad range of autism spectrum disorders, Study II was unable to replicate the 3-factor solution found by Wadden et al. (1991). Although 30 of the items found in the present study’s 3-factor solution were also included in Wadden et al.’s 3-factor model, about half of these items loaded under different factors. In addition, the items that loaded in each of our three factors were not easily associated, making the factors problematical to describe and name. Therefore, the 4- and 5-factor solutions were evaluated. The 5-factor model emerged as the most stable and meaningful.

Factor 1, which was labeled Nonresponsive Behavior, contained items that reflected a lack of response to both physical (e.g., “Often will not blink when a bright light is directed toward eyes”; “Sometimes shows no ‘startle response’ to a loud noise [may have thought child was deaf]”) and social stimuli (e.g., “Does not [or did not as a baby] reach out when reached for”; “Not responsive to other people’s facial expressions/feelings”). The items loading on Factor 2, which was designated as Infant-Like Behavior, included behaviors commonly found in all very young children in a variety of domains, such as self-help activities (e.g., “Does not dress self without frequent help”; “Difficulties with toilet training”) and language abilities (e.g., “Cannot point to more than five named objects”; “Uses 0-5 spontaneous words per day to communicate wants and needs”). Factor 3, which was named Aggressive Behavior, contained items dealing with aggression to others (e.g., “Hurts others by biting, hitting, kicking, etc”), objects (e.g., “Is very destructive [toys and household items are soon broken]”), and self (e.g., “Hurts self by banging head, biting hand, etc”). Also included were items relating to temper tantrums due to changes in routines, the environment, or delays in needs being met. The items that loaded on Factor 4, which was labeled Stereotypical Behavior, included items relating to the stereotypic behaviors that are common in Pervasive Developmental Disorders and mental retardation (e.g., “Flaps hands”; “Twirls, spins and bangs objects a lot”). Factor 5, which was called Echolalic Speech, contained reference to repetitive speech and sounds and echolalia (e.g., “Echoes questions or statements made by others”; “Has pronoun reversal [you for I, etc]”).

Twenty-one (62%) of the 34 items given a higher weighting of 3 or 4 by Krug et al. (1980a, 1980b) were included in the present study’s 5-factor model. Wadden et al.’s (1991) 3-factor solution contained 23 (68%) of the more highly weighted items. A comparison of the items that loaded in both Study II and the Wadden et al. study resulted in 18 common items with weights of 3 or 4.

In addition, this study did not confirm the present classification of the 57 ABC items into the five subscales proposed by Krug et al. (1980a, 1980b) on the basis of the apparent face validity of item content (Sturmey et al., 1992). The present factor analyses of the 57 items using 383 participants also found that a 5-factor model was the most stable and interpretable. However, with the exception of Factor 5, which consisted solely of 4 items from the Krug et al. Language subscale, the factors in the present study were composed of items from two or more of Krug et al.'s subscales (see Table 11). Specifically, Factor 1 contained 7 items from the Relating subscale, 4 items from the Sensory subscale, 1 item from the Social and Self-Help subscale, and 1 item from the Language subscale. Factor 2 was constructed of 4 items from the Social and Self-Help subscale, 1 item from the Body Concept subscale, and 6 items from the Language subscale. Factor 3 was made of 4 items from the Social and Self-Help subscale and 2 items from the Body Concept subscale. Factor 4 had 4 items from the Body Concept subscale and 1 item from the Sensory subscale.

The results of Study II illustrate the problems that may arise when item placement is made on a subjective basis rather than empirical categorization. However, the sample in the present study contained a broader range of autism spectrum disorders than in the original standardization (Krug et al., 1980a, 1980b), which may partially explain the divergent results.

Finally, the mean total score of 68 ( $SD = 25$ ) in the present study is in agreement with the cutoff scores recommended by Krug et al. (1980b). This result does not support previous studies, including Study I in this dissertation, that have suggested that the recommended cutoff scores may be too high (Gillberg et al., 1986; Miranda-Linné & Melin, 1997; Sevin et al., 1991; Volkmar, Cicchetti, et al., 1988; Wadden et al., 1991). The divergent findings in Studies I and II are surprising, given that the present study's sample of 383 individuals, aged 5-22 years, was a subsample of the 490 individuals in Study I, which had an age range of 2-44 years, and much lower mean total scores ( $M = 57$ ,  $SD = 28$ ). These contradictory findings may be due to the changes in behavior and symptoms that are common in the lifespan of most individuals with autism spectrum conditions (and, indeed, all humans). The preschool period is often very difficult for parents, which is followed by a relatively calm phase during the early school-age period. Puberty is a turbulent time for most adolescents and approximately a third of adolescents with autism to show a deterioration in abilities and a worsening of behavior problems, followed by a continuing improvement in these symptoms in adulthood (Gillberg & Steffenburg, 1987; Mesibov, 1983; Rutter, 1970; Rutter et al., 1967). Because Study II contained a higher proportion of adolescents and young adults than in Study I (most of the 107 individuals that were not included in Study II were those who were older than 22 years), the greater behavior problems found in adolescence were reflected in higher ABC mean scores.

Although Nonresponsive, Infantile, Aggressive, Stereotypic, and Repetitive Speech Behaviors are common in autism spectrum disorders, the current *DSM-IV* (APA, 1994) does not specifically mention some of the aspects included in these

factors. For example, a lack of response to physical stimuli; difficulties in self-help activities; and aggression to others, objects, and self are not included in the *DSM-IV* diagnostic criteria and are relegated to the status of associated features (Newsom, 1999).

It should be once again emphasized that Krug et al. (1980b) did not devise the ABC to merely measure a single autism dimension. Rather, in order to relate symptom area scores to diagnosis, they also intended to show a symptom area profile on the five subscales. Instead of focusing on a single cutoff score on the ABC, it is recommended that further research be performed on whether the different autism spectrum disorders differ in regard to the five factors found in this study.

There were two comparative advantages to the present study. First, as was discussed in Study I, the large size of this sample, that contained individuals with a broad range of autism spectrum disorders.

The second advantage to this study was that it was more homogeneous than previous studies, which included individuals without autistic-like disorders in the factor analyses of the ABC.

In the present study, a large amount of the total variance was accounted for by the factors (80% in the 5-factor solution). Wadden et al. (1991) performed factor analyses using 123 participants (67 with autism and 56 with other learning disabilities) and were able to account for only 31% in their 3-factor model (Study II's 3-factor model accounted for 68%). The effects of including another non-related diagnostic group in a factor analysis are unknown and are very difficult to predetermine, but the use of two diagnostic groups in the Wadden et al. study may account for some of the differences between the two studies. Wadden et al. hypothesized that their small variance may be a reflection of the unreliability of single items, compared to the sums of the larger number of item scores used in a subscale score. They further speculated that the use of only 2.3 subjects per variable might have caused some instability. Tabachnick and Fidell (1989) recommend at least five subjects for each variable. The present study had a relatively large number of subjects for each variable (6.7). The Cronbach's alpha coefficients for the items in the factors found in this study were satisfactory (range = .73-.86), with the exception of Factor 4, which was adequate (.64). This relatively low alpha level was most likely due to two reasons. First, there were only 5 items in this factor. Second, the factor addressed stereotypic behaviors. It is unlikely that many individuals with an autism spectrum disorder would demonstrate all 5 stereotypical behaviors. It seems reasonable to assume that most may have only one or a few, or different combinations and degrees of this sort of behavior. The results from Study II suggest that the items in the ABC have a good reliability and that the small amount of explained variance found by Wadden et al. was a result of the relatively few subjects per variable.

In summary, no support was found for classifying the 57 items into the current five subscales proposed by Krug et al. (1980a, 1980b). In addition, this study was unable to replicate the 3-factor solution recommended by Wadden et al. (1991). Rather, the ABC appears to measure five components of autism

spectrum disorders, specifically, Nonresponsive Behavior, Infant-Like Behavior, Aggressive Behavior, Stereotypical Behavior, and Echolalic Speech. Finally, the mean total score found in the present study is in agreement with the cutoff scores recommended by Krug et al.

## STUDY III

### **Aims**

The first purpose of Study III was a direct, controlled comparison of incidental teaching and traditional discrete-trial teaching methods on the expressive use of color adjectives, with reference to acquisition, teaching efficiency, and generalization in two children with autism. In addition, the results from the single previous study existing in the literature at the time Study III was performed were expanded to include a comparison of the effects of the two procedures on spontaneous use of color adjectives in home and parents generalization sessions. Finally, five special probes were performed to assess the ability of the children to generalize the color adjectives to describe the stimulus items when the colors were reversed.

### **Method**

Two boys with autism participated in this study. Both of them had been diagnosed by an agency not affiliated with this study and fulfilled the diagnostic criteria for Autistic Disorder described in the *DSM-III-R* (APA, 1987). At the time of the study, both of the children were receiving intensive behavioral training in verbal receptive and expressive language skills.

Child 1 was 12 years of age at the time of the study. His developmental quotient (DQ) on Griffith's Developmental Scales (Alin-Åkerman & Nordberg, 1980) was 37 in a recent evaluation. He was initially nonverbal, but as a result of 1 year of intensive operant speech training, had a vocabulary of approximately 100 words at the time of the study. When requested to speak, this child generally answered in one- or two-word phrases. His expressive speech consisted primarily of brief requests (e.g., "apple"), prompted statements, and echolalic responses. He had severe articulation problems.

Child 2 was 10 years of age. In a recent assessment his DQ on Griffith's Developmental Scales was 38. When questioned, this child generally answered in one- or two-word phrases. He exhibited immediate as well as delayed echolalia. Child 2 was able to request desired items and activities using one or two words (e.g., "Swimming") and had minor articulation problems.

Eight highly preferred items (four red and four green) consisting of food (e.g., raspberries, apples) and toys (e.g., a musical card) were selected as stimulus

materials for each child. Two pairs of red and green stimulus items were randomly selected for traditional discrete-trial training and the remaining two pairs were used for incidental instruction. All items that the children were not able to label on a pretest were taught using standard operant procedures.

The acquisition probes were performed in a hallway, and a classroom was subdivided into two separate activity areas for traditional discrete-trial instruction and incidental teaching. During the daily acquisition probes and the traditional training procedures, the children and teachers were seated across from each other at desks. Incidental teaching was carried out in front of a 1.5 m<sup>2</sup> shelf that displayed the training items. The children and teachers sat next to each other, approximately 0.3 m from the shelf. The five special probes that were performed to measure the generalization of color adjective use to describe the novel colors of the stimulus items occurred in a second classroom. The children and teachers were seated across from each other at desks, and the stimulus items were individually presented on the desk top.

An observer, with a full view of the participants and stimulus items, but not the teachers' data sheets, also collected data during the acquisition probes, teaching sessions, and generalization to novel stimulus colors probes.

Generalization probes were also held in the children's homes and were conducted by the children's parents. The children were seated approximately 1 m away from shelves that displayed the stimulus materials. One of the child's parents sat on the side between the child and the shelves so that the child had a clear view of the items, but not direct access. All generalization to home and parents probes were videotaped.

### *Experimental Design*

The traditional discrete-trial and incidental teaching of color adjectives were evaluated according to their effects on acquisition, teaching efficiency, generalization to home and parents, and spontaneous usage. A multiple schedule design introduced sequentially across two subjects in a multiple-baseline fashion was used (Kazdin, 1982). Two standard probe procedures measuring acquisition and generalization to home and parents were employed across experimental conditions. In addition, the differential effects of the two procedures on spontaneous use of color adjectives were studied. Finally, in order to assess generalization of color adjective use to describe novel colors of the stimulus items, five special generalization probes were performed at the end of the study.

### *Teaching Procedures*

Each child received daily 1:1 instruction from a teacher. All teaching sessions began with an acquisition probe, which served as a daily evaluation of acquisition of correct color adjective use, followed by traditional discrete-trial

and incidental teaching procedures. The order of the presentation of the teaching procedures was randomly determined for Child 1 on the first day of the study and was alternated thereafter. The other child followed a reverse order.

*Traditional discrete-trial teaching.* Each training stimulus was individually placed on a table, and the teacher asked “What color is it?” Twenty trials were performed daily and each stimulus was presented for 5 consecutive trials (i.e., massed trials).

Incorrect responses were followed by prompts (e.g., “Say red strawberry”). Correct responses, both prompted and unprompted, were reinforced by descriptive praise (e.g., “Great, you said red strawberry!”) and an edible reinforcer that was not one of the training stimuli.

*Incidental teaching.* Twenty trials were performed daily. When the child initiated an incidental teaching episode by showing interest in an item by looking at it, reaching for it, or naming it, the teacher asked “What color is it?” Items that had been trained in five trials were removed from the shelves so that all items could be taught.

Incorrect responses were followed by prompts, the level of which depended upon the child’s response. In the beginning of training, it may have been necessary for the teacher to prompt the entire response (e.g., “Say red strawberry”). Eventually, the prompts were faded (e.g., “Say r...”). Correct responses, prompted and unprompted, were reinforced by descriptive praise and 5 s access to the requested item, or if food, a small piece.

### *Acquisition Probes*

A minimum of five acquisition probes were conducted during baseline for each child. Once the teaching procedures were instituted, acquisition probes were administered at the beginning of each teaching session. The acquisition probes consisted of five randomly ordered presentations of each of the four stimuli from the two teaching procedures (for a total of 40 trials). The teachers presented each stimulus and asked, “What color is it?” The teachers provided praise and an edible preferred reinforcer (which was not one of the training stimuli) for attending behavior on a variable ratio 3 schedule. No prompts, reinforcers, praise, or feedback were delivered for use of color adjectives. The teaching sessions were discontinued when both children reached a criterion level of 80% or better correct responding to the stimuli from both teaching procedures during five consecutive acquisition probes. Four follow-up acquisition probes were performed a week after the children reached criteria.

## *Generalization Assessment Procedures*

*Generalization to home and parents.* In order to assess generalization to home and parents, as well as the spontaneous use of color adjectives, 1:1, 10-minute, free-play sessions were conducted by the children's parents at home. At least five generalization probes were performed for each child during baseline. During the teaching conditions, generalization sessions were held once a week, and five additional follow-up probes were conducted a week after both subjects reached criteria on the two teaching procedures. All generalization probes were videotaped and two independent observers later watched the films and collected data.

The children's parents were uninformed about the experimental conditions of the study. The instructions the parents were given for the free-play sessions were that the child was always to receive the desired item, either by correctly asking for it using a color adjective (either spontaneously or after the prompt "What color is the \_\_\_?") or by following the parent's instruction to point to and request the item without using a color adjective. The parents were asked to not model color adjective use (e.g., "Say I want the red strawberry"), provide feedback, teaching, or practice for the child's incorrect or correct color adjective use. The items were replaced on the shelves after each use.

*Generalization to novel stimulus colors.* In order to assess generalization to novel colors of the stimulus items, five separate probes were performed after the two children reached the 80% criterion level. Two stimulus items (one red and one green) from each of the two teaching procedures were selected for each child. These four items, which had previously been taught and acquired as one color, were altered to the other color (e.g., green soda pop was changed to red-colored soda) and were randomly presented five times (for a total of 20 trials). The teachers presented each stimulus and asked, "What color is it?" The teachers provided praise and an edible preferred reinforcer (which was not one of the training stimuli) for attending behavior on a variable ratio 3 schedule. No prompts, reinforcers, praise, or feedback were delivered for use of color adjectives.

## *Measurement Procedures*

*Acquisition probes.* A data sheet for acquisition probes indicated the order for the presentation of the stimuli. Four different versions of the data sheet were used in order to assure a random presentation of the stimulus materials. The teachers, who were uninformed about the purposes of the study, and the first author independently scored each trial for presence or absence of color adjective use and for correct or incorrect color adjective use.

*Teaching sessions.* The same observers also collected data on the duration of the two teaching procedures (using a stopwatch) and the number of teaching trials (to measure teacher accuracy in providing the correct number of trials per item). A data sheet for traditional discrete-trial teaching sessions indicated the order for the presentation of the stimuli. In order to assure a varied presentation order of the stimulus materials, four different versions of the data sheet were used. The trials were scored for spontaneous or prompted color adjective use. During the incidental teaching sessions, the observers scored the trials for object requested, and whether color adjective use was spontaneous or prompted.

*Generalization probes.* The frequency of color adjective use during generalization to home and parents probes was later scored by a time-sampling data collection procedure using 10-s intervals. Each color adjective use was scored in the interval in which it ended and a cassette player was used to synchronize the timing of observation intervals. One psychology undergraduate and the first author collected data from the video films of the generalization probes. The psychology undergraduate observer was trained in data collection procedures prior to the study and was kept uninformed as to the objective of the investigation.

A coded data sheet provided up to two occurrences/nonoccurrences of color adjective use per 10-s interval (the maximal number possible given that the child was given access to the requested items). Each color adjective use was scored in the following categories: (a) use of one of the eight target stimulus items, (b) correct or incorrect color adjective use, and (c) spontaneous or prompted color adjective use. The data were summarized separately for use of color adjectives for objects trained by the traditional discrete-trial procedures and those trained by incidental teaching in the following manner: (a) the frequency of occurrence of correct color adjective use and (b) the percentage of color adjective use scored as correct and spontaneous.

Generalization to novel stimulus colors was assessed in a manner similar to the acquisition probes. Four different versions of a data sheet indicated the order for the presentation of the stimuli. The teachers and the first author independently scored each trial for presence or absence of color adjective use and for correct or incorrect color adjective use.

### *Interobserver Agreement*

*Acquisition probes.* Interobserver agreement was assessed in 69% of the acquisition probes for both children. Agreement was conducted on a trial-by-trial basis and was calculated by the formula: the total number of agreements divided by total number of agreements plus disagreements. Mean interobserver agreement was 99% for Child 1 (range 90-100%) and 99% for Child 2 (range 90-100%).

*Teaching sessions.* Interobserver agreement was assessed in 67% of the teaching episodes for Child 1 and 57% of the teaching episodes for Child 2. Agreement for duration of teaching sessions was computed by dividing the smaller duration by the larger duration and agreement for number of teaching trials was calculated by dividing the smaller frequency by the larger frequency. Mean interobserver agreement for the duration of Child 1's incidental teaching episodes was 100% (range 88-100%) and 100% for traditional discrete-trial teaching sessions. Mean interobserver agreement for the duration of Child 2's incidental teaching episodes was 98% (range 75-100%) and 100% for traditional discrete-trial teaching sessions. The interobserver agreement for number of teaching trials was 100% for both children and both procedures.

*Generalization probes.* Interobserver agreement was assessed in 100% of the generalization to home and parents probes for both children and was computed for occurrences as well as for occurrences and nonoccurrences. The formula used was the number of agreements divided by total number of agreements plus disagreements, with an agreement counted only for those observations scored the same across categories (i.e., the same stimulus item circled, correct vs. incorrect, and spontaneous vs. prompted). Mean occurrence agreement for Child 1 was 83% (range 73-100%), and mean agreement for occurrence/nonoccurrence was 91% (range 83-100%). For Child 2, mean occurrence agreement was 87% (range 71-100%), and mean agreement for occurrence/nonoccurrence was 92% (range 82-100%).

Interobserver agreement was assessed in 100% of the generalization to novel stimulus colors probe for both children. Agreement was conducted on a trial-by-trial basis and was calculated by the formula: the total number of agreements divided by total number of agreements plus disagreements. Mean interobserver agreement was 98% for Child 1 (range 95-100%) and 99% for Child 2 (range 95-100%).

## **Results**

The comparative acquisition probe data are shown in Figure 1. The mean baseline results for both children were 0% correct color adjective use for the items assigned to both procedures. The color adjectives taught by traditional discrete-trial procedures were learned more quickly by both children. The means of the last five data points prior to when both children reached criteria for Child 1 were 82% correct for incidental teaching methods and 96% correct for traditional discrete-trial teaching procedures. For Child 2, the means of the last five teaching sessions prior to both reaching criteria were 100% correct for both incidental and traditional discrete-trial procedures. The means of the four follow-up acquisition probes performed a week later for Child 1 were 86% correct for incidental procedures and 98% correct for traditional discrete-trial methods. Child 2's mean percent correct in the four follow-up data points were 98% for incidental

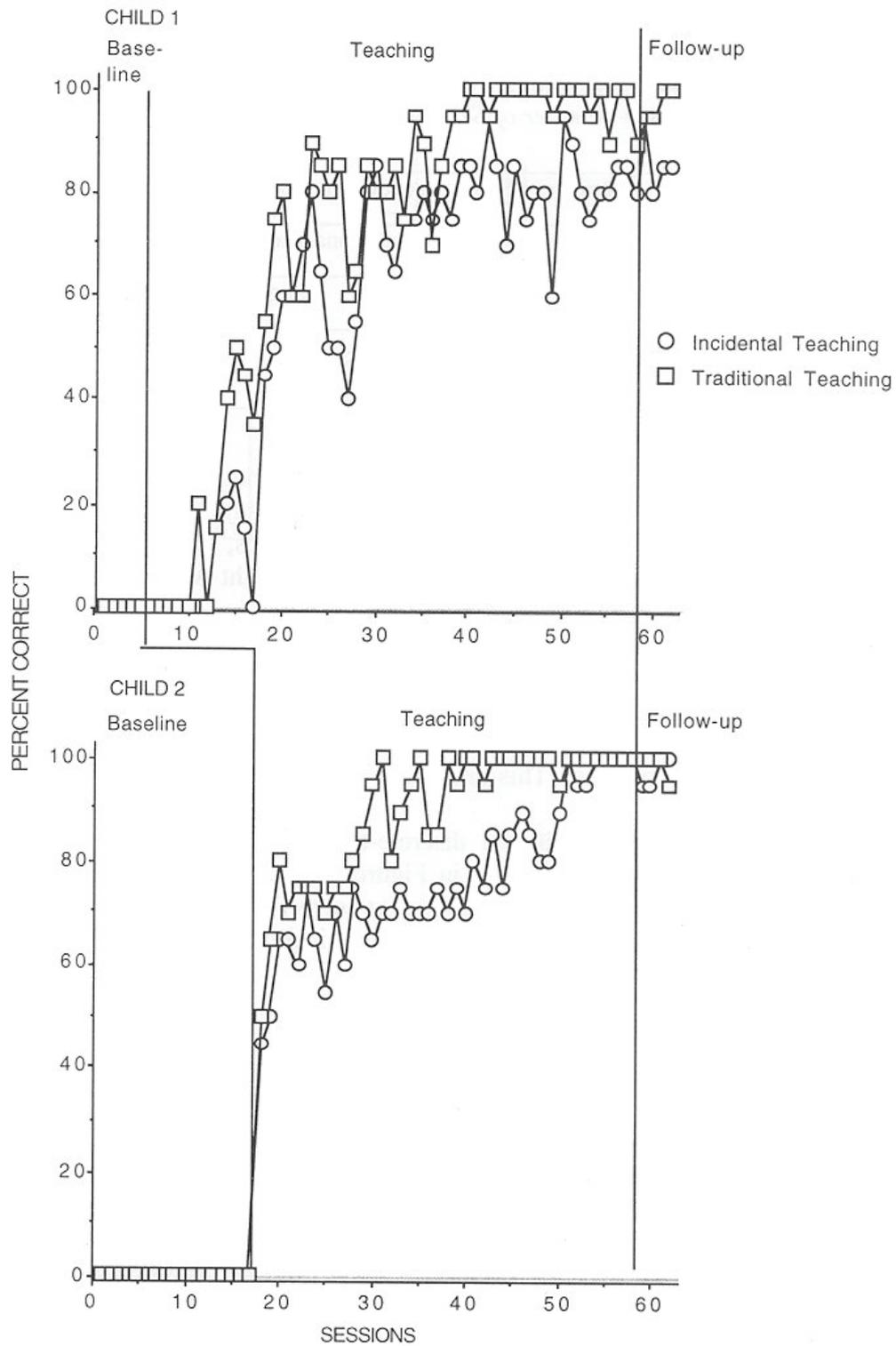


Figure 1  
*Percent correct responses on acquisition probes during incidental and traditional discrete-trial teaching.*

Table 12

*Duration of Incidental and Traditional Discrete-Trial Teaching Episodes with Equal Numbers of Trials (N = Number of Sessions)*

Means and ranges of each procedure in minutes					
Child	Incidental teaching		Traditional teaching		N
	Mean	Range	Mean	Range	
1	7	3-12	5	3-9*	58
2	5	3-8	2	1-5*	46

\* $p < .0001$ .

teaching methods and 99% for traditional discrete-trial teaching procedures. To summarize, although both children acquired correct color adjective use more quickly by the traditional discrete-trial teaching methods, there was no substantial difference in the retention of color adjectives taught with traditional or incidental teaching procedures at follow-up.

The relative durations of the traditional and incidental teaching procedures are displayed in Table 12. To summarize the results across both children, the mean duration of the incidental teaching sessions was 6 minutes (range 3-12 minutes) and the mean duration of the traditional discrete-trial teaching sessions was 3 minutes (range 1-9 minutes). This difference was highly significant,  $t(103) = 15.99, p < .0001$ .

The generalization of the traditional discrete-trial and incidental teaching procedures to home and parents is shown in Figure 2. Summarizing across the children, the mean percentage of incidentally taught correct color adjectives used during home generalization probes was 0 at baseline, increasing to 10% during the teaching period until both children reached criteria, followed by a further increase to 19% during the follow-up probes conducted a week later. The ability to correctly use the color adjectives acquired by the traditional discrete-trial teaching procedures followed a different pattern. In both children, the mean percentage of traditionally acquired correct color adjectives used during home generalization probes was 0 at baseline, increasing to 19% during the teaching period until both children reached criteria, followed by a decrease to a mean of 13% during the follow-up probes. In summary, although traditional discrete-trial teaching methods initially produced higher mean frequencies in correct responding during home generalization probes, this ability rapidly dissipated 1 week after the study's completion. In this study it appeared that gains acquired by incidental methods occurred more slowly, but were more permanent, and perhaps, continued to increase even after teaching had been discontinued. However, given the short follow-up period and the few subjects in this study, any conclusion pertaining to the durability of the acquired skills obtained by the two teaching methods must be very tentative.

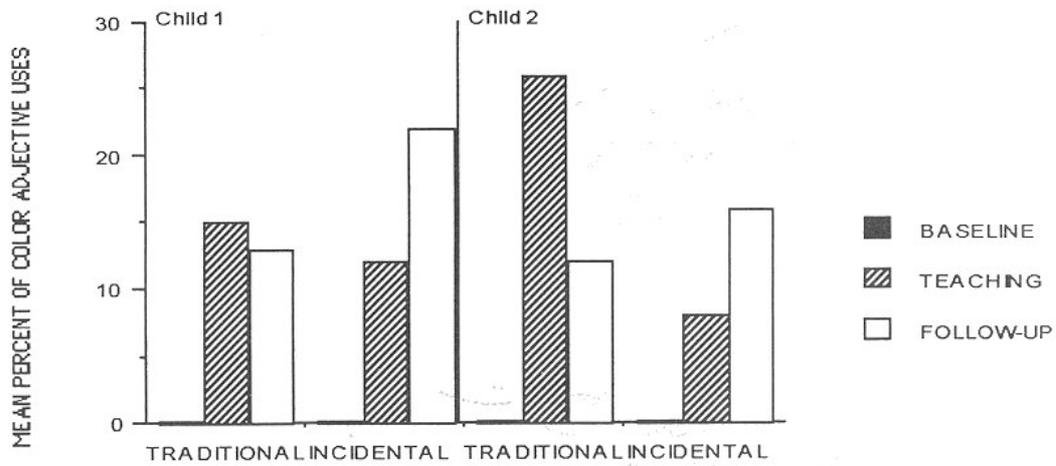


Figure 2  
*Mean percentage of correct color adjectives used during home generalization probes.*

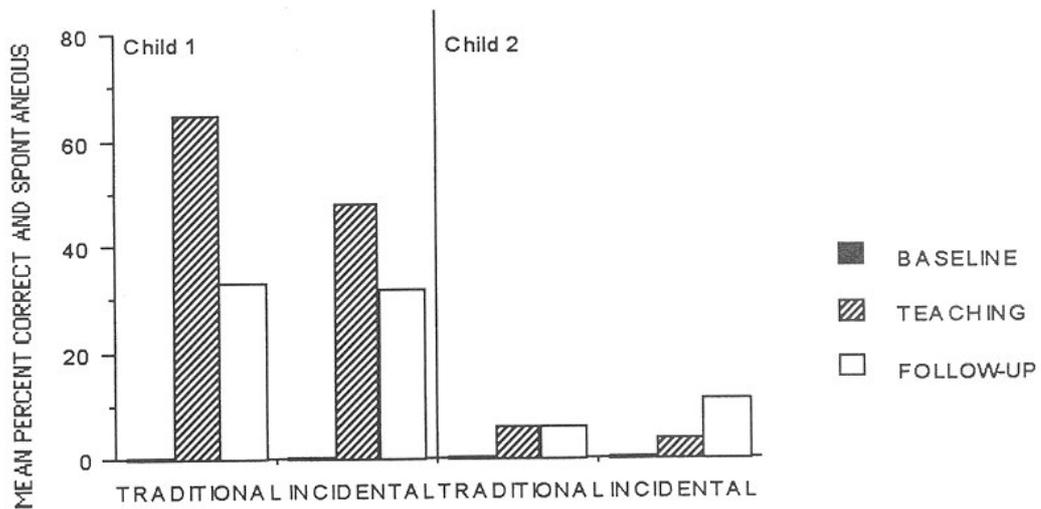


Figure 3  
*Mean percentage of color adjectives used during home generalization probes that were scored as correct and spontaneous responses.*

Table 13  
*Mean Percentage of Correct Color Adjectives Used During Novel Stimuli Color Generalization Probes*

ABC	Language level				<i>t</i>	<i>df</i>	<i>p</i>
	Mute		Speaking				
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>			
Total score	59.90	25.46	54.86	28.71	1.87	488	.062
Language	7.51	3.37	10.07	6.82	-5.55	486	.0001
Sensory	7.99	6.25	5.76	5.15	3.88	254	.0001
Relating	15.17	9.34	12.74	8.50	2.86	488	.004
Body and Object Use	16.59	8.54	12.76	9.28	4.35	488	.0001
Social/Self Help	10.19	4.82	9.28	4.96	1.91	488	.057

<sup>a</sup>Separate variance estimates used for *t* tests, two-tailed *p* values for ABC scores.

The spontaneous and correct usage of color adjectives during home and parent generalization probes is depicted in Figure 3. There was no spontaneous use of color adjectives by either of the children during baseline. To summarize, the children were able to spontaneously use color adjectives acquired by both teaching procedures. For Child 1, spontaneity occurred more often with the traditionally acquired items during the teaching period. During the follow-up period, however, spontaneity to the items taught by both procedures dropped to a lower, but equal level. For Child 2, the traditionally and incidentally acquired color adjectives were used spontaneously at a low, but essentially equal level during the teaching period. During follow-up, however, Child 2's ability to use incidentally acquired color adjectives spontaneously nearly tripled, while his spontaneity for the traditionally acquired adjectives remained at the same level.

Generalization of color adjective use to describe novel colors of the stimulus items is shown in Table 13. Across children, incidental teaching procedures resulted in significantly higher levels of correct responding to previously acquired stimuli that had switched colors,  $t(9) = 3.77, p < .01$ .

## Conclusions and Discussions

Incidental and traditional discrete-trial teaching procedures were used to teach two children with autism color adjectives and were compared in terms of acquisition, teaching efficiency, generalization, and spontaneous usage. The results demonstrated that although traditional discrete-trial teaching resulted in a faster acquisition of color adjectives, there was no difference in retention between the two teaching methods during the four follow-up acquisition probes a week later. The traditional discrete-trial teaching sessions were performed, on the average, twice as fast as the incidental teaching sessions (3 minutes vs. 6 minutes). This difference was highly statistically significant and may be clinically significant as well. If one considers the enormous number of language

skills that many children with autism must acquire, and the large number of training sessions that were necessary for the children in this study to reach criteria, the time difference could be substantial when added up during the course of a school year. The results from the home and parents generalization probes showed that although traditional discrete-trial teaching initially resulted in higher mean frequencies in correct responding while the teaching conditions were in effect, this ability rapidly decreased 1 week later during the five follow-up probes. The results for incidental teaching methods were the opposite, that is, they resulted in slower gains in generalization to home and parents during the teaching period; however, the frequencies continued to increase and at follow-up reached higher levels than those found for traditional discrete-trial teaching. Both children were able to use the color adjectives acquired by the two procedures spontaneously. During the teaching period, the children demonstrated greater spontaneity for the items that were taught by traditional discrete-trial methods. At the follow-up period 1 week later, however, spontaneity dropped for Child 1 to lower, but equal levels for the two procedures, while Child 2's spontaneity for the incidentally acquired items increased almost threefold and the traditionally taught items' spontaneity remained at the same level as during the teaching period. Incidental teaching resulted in significantly higher percentages of correct responding during the generalization to novel stimulus colors probes. To summarize, during the teaching period, the color adjectives taught by traditional discrete-trial methods were acquired more quickly, had higher correct response frequencies during the acquisition probes, were taught more efficiently, and generalized more rapidly and at higher levels to home and parents. When both children reached criteria and teaching was discontinued, however, there was no difference between the two procedures in retention of color adjectives during the follow-up acquisition probes, and the generalization of the incidentally acquired items to home and parents continued to increase and bypassed the generalization of the traditionally acquired items during follow-up. The results from the measures of spontaneous use of color adjectives showed that incidental teaching procedures, though learned more slowly and produced less frequently during acquisition, yielded equal or better results than the traditional procedures at follow-up. The results demonstrated that although it takes a longer time for children with autism to learn with incidental teaching procedures, once they have acquired an ability, it may be more permanent knowledge. However, the short follow-up period and the few subjects in this study do not allow for any definite conclusions regarding the durability of the acquired skills obtained by the two teaching methods until more research into this area is performed. Throughout the study, we had a clinical impression that the children merely memorized the expected responses during traditional discrete-trial teaching and did not really seem to have a concept of color for the traditionally acquired items. This may explain the initially higher spontaneous use of color adjectives for the items taught by traditional procedures during the home and parents generalization probes. A further confirmation of this suspicion was found during the five special generalization to novel stimulus colors probes at the end of the study. Incidental

teaching resulted in higher percentages of correct responding to the previously acquired stimuli that had switched colors. This implies that the children did indeed develop a greater concept of color, rather than pure memorization, for the incidentally acquired stimulus items.

The results from the generalization to home and parents probes during the teaching period, before the children reached criteria and teaching was discontinued, showed higher frequencies of requests for items from the traditional discrete-trial teaching procedures than from the incidental. At follow-up, the situation was reversed in both children. There is a possibility that the children's desire for the incidentally taught items was satiated during the daily teaching sessions, where the items that were requested were also used as reinforcers (during traditional discrete-trial teaching the children were given a reinforcer that was not one of the training stimuli). At follow-up, when the teaching sessions had been terminated, the children's desire for the incidentally taught items may have increased and resulted in the higher frequencies recorded at that period. Of course, this potential problem is found in all generalization assessments of incidental teaching methods, where one of the essential elements is response-produced reinforcement. Interestingly, as in the McGee et al. (1985) study, both children chose items in a ritualistic pattern during the incidental teaching sessions and the home generalization probes.

Although incidental teaching resulted in greater generalization to home and parents during follow-up and to novel colors of stimulus items, the problem of generalization is far from solved for children with autism. The mean percentages of correct color adjective use during the follow-up home generalization probes for the items that were taught by incidental teaching were greater than those found for traditional discrete trial teaching, but were still low (22% for Child 1 and 16% for Child 2). The five generalization to novel colors of stimulus items probes performed at the end of the study showed better results for incidental teaching (and both percentages were higher than those found in McGee et al. [1985]), but were still somewhat low. Child 1 and Child 2 gave correct color adjective responses in 72% and 62%, respectively, of the trials. Greater generalization may have been achieved if more exemplars of the training stimuli had been used (Stokes & Baer, 1977).

Traditional discrete-trial and incidental teaching are the two major language instruction strategies used today, and perhaps, may be best regarded as complementary methods for facilitating language development (Carr & Kologinsky, 1983). Briefly, the discrete-trial strategy is adult-initiated and is carried out in drill form (Koegel, Russo, & Rincover, 1977) and may be most effective in teaching language forms, for example label nouns (Carr, Binkoff, Kologinsky, & Eddy, 1978). The incidental teaching strategy is child-initiated, and is dependent on the moment for moment changing interests displayed by the child, and may be more effective in developing the spontaneous use of language forms (Hart & Risley, 1968, 1974, 1975, 1980, 1982). One advantage of incidental teaching is the use of natural reinforcers (e.g., letting the child play with a ball after he or she says "ball," rather than reinforcing the child with a

raisin), which strengthen the functionality of language use (i.e., the development of a language that regularly and predictably produces a variety of desired reinforcers). This functionality may facilitate the generalization and spontaneous use of language. As children learn the association between words and desired reinforcers (e.g., that one receives juice when one is thirsty and says “juice”), the children will use language in the outside community, where they will be reinforced by others, at least part of the time. If, on the other hand, children are taught to expect a raisin whenever they say “shoe,” there will be few occasions for reinforcement from others, who are unaware that the word “shoe” is actually a request for a raisin (Carr, 1983).

One limitation of incidental teaching, however, is that it may be impossible or impractical to use natural reinforcers for some language behaviors (e.g., to teach a child to say “April” in response to the question “What month is it?”). In addition, one cannot expect a nonverbal child with autism to say the word “raisin,” before we have taught the child to produce the necessary sounds that make up the word, which may be most efficiently taught with discrete-trial procedures. Carr (1983) proposes that nonverbal children with autism must first acquire language forms through discrete-trial instruction before they can be used in incidental teaching. The results from the present study supplied support for this suggestion when it was demonstrated that the items taught by traditional discrete-trial procedures were taught more rapidly, showed faster acquisition and, initially, greater generalization, while the incidental teaching methods resulted in greater generalization, and in more spontaneous usage (in one child) at follow-up.

In conclusion, although the incidental teaching procedure used in this study was less natural than the “standard” Hart and Risley (1982) method (i.e., specific responses were required from the children during consecutive teaching episodes), our procedure did include the other essential elements, such as being child-initiated, in natural settings that required adult assistance to obtain access to natural reinforcers, and using varying levels of prompts. The results of the present study demonstrated that severely language-delayed children with autism can acquire, generalize, and spontaneously use new language forms taught by incidental teaching procedures. There is a growing amount of evidence that demonstrates the successful application of incidental teaching procedures for children with autism. Future language training programs and teacher training for children with autism ought to include incidental teaching procedures in their curricula. This does not mean that the traditional discrete-trial methods do not have a valid, well-deserved place in behavioral language intervention. The results of this study indicate that the most expedient manner for children with autism to acquire, generalize, and spontaneously use language may well be, as Carr (1983) proposes, to rapidly provide the children with the necessary language forms through traditional discrete-trial methods and then later utilize modified incidental teaching to facilitate spontaneous usage.

When this study was published, it was proposed that research be conducted to provide direct, controlled comparisons of incidental teaching, traditional

discrete-trial methods, and a combination of the two in the above-proposed order as the next step in the elucidation of the question of how to best teach children with autism. Unfortunately, with the exception of a study published at approximately the same time, the proposed controlled comparison studies have not been performed. Elliott, Hall, and Soper (1991) compared the effects of discrete-trial language instruction versus natural language teaching in 23 adults with autism and severe to profound mental retardation, using a matched group, multiple-baseline, crossover design. Both techniques increased initial and long-term generalization. A significant interaction was observed between prior functioning level and sequence of instruction. Specifically, the participants that functioned in the *severe* range of mental retardation showed greater generalization when given discrete-trial teaching first, followed by natural language teaching. The participants that functioned in the *profound* range of mental retardation, however, tended to perform better when natural language teaching was followed by discrete-trial teaching. Although the results suggested no relative superiority for either teaching method, the authors strongly supported the use of natural language teaching for persons with autism and mental retardation, as they believe that it has many strengths, few drawbacks, and produces equal generalization and retention.

Because there already exists such strong empirical support for operant procedures for speech and language acquisition in autism (for a review, see Maurice, Green, & Luce, 1996; Newsom, 1999; Schreibman, 1988), and an awareness of the potential limitations of these methods (e.g., Carr, 1988), research has subsequently focused on demonstrating the efficacy and effectiveness of modified incidental teaching procedures. Leung and Chan (1993) used a time delay procedure to teach spontaneous verbal requests to three children with autism. The children were able to generalize the spontaneous requests across settings, persons, stimuli, and presentation format. Wall and Gast (1997) taught adult caregivers to use a 4-sec constant time delay procedure to teach leisure skills to 2 adolescents with autism and 2 adults with moderate or severe mental retardation. A multiple probe design across behaviors and across the 4 participants showed that the instructors succeeded in delivering systematic instruction. Kohler, Strain, Hoyson, and Jamieson (1997) combined naturalistic teaching and peer-mediated tactics (i.e., peer modeling, cooperation, and verbal exchanges) on social interactions in 10 preschoolers with autism. The authors found that teacher-child and child-peer interactions increased in length and improved later learning during the maintenance phase that only included naturalistic teaching performed by a teacher. Koegel, Camarata, Valdez-Menchaca, and Koegel (1998) examined the generalization of motivational procedures to teach question-asking in 3 children with autism, who lacked verbal initiations. The children were able to generalize spontaneous question-asking across stimuli, settings, and people, without additional teaching, prompting, or reinforcement. Buffington, Krantz, McClannahan, and Poulson (1998) used systematic modeling, prompting, and reinforcement to teach gestures in combination with verbal communication to 4 children with autism. A multiple-

baseline across-responses design was used. All children were able to acquire and generalized the responses to novel stimuli and a novel setting. McGee, Morrier, and Daly (1999) used an incidental teaching approach for early intervention for 28 toddlers with autism. The authors reported that 82% verbalized meaningful words and 96% showed increased or acceptable levels of “peer proximity” at program exit. However, there were no control or other treatment groups used for comparison in this study. Kaiser, Hancock, and Nietfeld (2000) taught parents naturalistic language intervention strategies during 24 individual training sessions in the clinic. The parents were able to generalize the use of the strategies to home at the end of the training sessions. At follow-up, performed 6 months later, the parents maintained their use of the procedures, but at lower levels. Intervention effects on communication were maintained and generalized for 4 of 6 children.

Only two studies have performed direct, controlled comparisons of alternative incidental teaching techniques. Heckaman, Alber, Hooper, and Heward (1998) compared least-to-most prompts and progressive time delay on the frequency of errors and disruptive behavior in 4 children with autism. The authors found that progressive time delay produced fewer errors and lower rates of disruptive behavior for all 4 children. Shook (2000) used an alternating treatments design to compare constant and progressive time delay procedures to teach question-asking to preschoolers with autism. The results indicated that although both prompting procedures were effective, the constant time delay procedure was slightly more efficient.

Although there is ample support for both traditional discrete-trial and incidental teaching procedures, research that provides direct, controlled comparisons of the two methods and, particularly, the optimal teaching order of these procedures, is still lacking. Based on the literature, the question of how to best teach children with autism is yet unanswered (Gresham, Beebe-Frankenberger, & MacMillan, 1999; Newsom, 1999).

## GENERAL DISCUSSION

### THEORETICAL DISCUSSIONS

#### **Do mute and speaking individuals with autism spectrum disorders demonstrate differences in type and degree of behaviors and symptoms?**

Although all individuals with autism spectrum disorders display symptoms in the three areas that are typical of autism: impaired communication and reciprocal social skills and a limited repertoire of interests and behavior (Wing, 1988), it was shown in Study I that speaking and mute individuals with these disorders demonstrate many differences in type and degree of behaviors and symptoms.

Mute individuals demonstrated more pathology than the speaking group on nearly half of the ABC items and on a majority of the subscales. Specifically, they had greater difficulties understanding speech and used gestures to communicate their desires, were more likely to show abnormal responses to auditory and visual stimuli, had greater problems in social interaction (i.e., were more socially nonresponsive and withdrawn and unable to imitate other children at play), were more likely to exhibit stereotypic behavior (e.g., hand flapping, whirling self, twirling/spinning objects, and rocking), showed greater deficits in play skills, tended to engage in more primitive sensory activity (i.e., smelling and mouthing), had greater problems with some self-help skills (e.g., toilet training and dressing self), demonstrated poorer understanding of risks in dangerous situations, preferred inanimate objects over other people and animals, and were more likely to be identified early as having a developmental delay.

Speaking individuals had odd, repetitive speech and echolalia; tended to be more anxious or frightened; more often had “special abilities;” tended to show stronger reactions to changes in the environment or in routines; and tended to have more temper tantrums.

As was seen in Study I, despite the greater number of behavior problems observed in the mute group, there was no significant difference between the two groups on the ABC total score. This finding leads to questions regarding test construction. The disparity in number and weighting of the expressive speech items in the Language subscale resulted in the mute and speaking groups obtaining equal total scores on the ABC, although the latter group showed significantly less pathology on most of the ABC items and three of five subscales. A question as to whether the Language subscale is weighted too strongly in the ABC total score may be raised. In addition, reservations may be made about the appropriateness of a test that bestows greater pathology scores on expressive language skills to speaking rather than to mute individuals.

### **The 5-factor solution of the ABC as compared to the DSM criteria**

A 5-factor solution that included 39 of the 57 ABC items was found to be the most appropriate in Study II. Although the five factors found in this study: Nonresponsive, Infant-Like, Aggressive, Stereotypic, and Repetitive Speech Behaviors are common in autism spectrum disorders, the current *DSM-IV* (APA, 1994) does not specifically mention some of the aspects included in these factors. Specifically, receptive language impairments; a lack of response to physical stimuli; a lack of awareness of surroundings and social stimuli; difficulties in self-help activities; and aggression to others, objects, and self are not included in the *DSM-IV* diagnostic criteria. Many of these behaviors are seen more often in lower functioning persons with autism. The previous version, the *DSM-III-R* (APA, 1987), did include more of the behaviors found in the factors, such as abnormal response to physical stimuli and aggression. The *DSM-III-R* criteria were criticized for being overly broad, therefore large changes were made in the

*DSM-IV*. Perhaps the *DSM-IV* criteria may be criticized for being too narrow. The main deficiency of the *DSM-IV* is that it relegates sensory and perceptual abnormalities (e.g., hyper- or hypo-sensitivity to lights, sounds, odors, or textures, high pain threshold, overselective attention, impaired attention shifting) to the rank of associated features. This is in divergence with the beliefs of many experts in the field that such abnormalities are principal symptoms (e.g., Burke, 1991; Courchesne et al., 1994; Dawson & Lewy, 1989; Lovaas, Koegel, & Schreibman, 1979; Ornitz, 1989; Waterhouse, 1988). Although failure to develop peer relationships, a lack of social imitative play behaviors, and ritualistic behavior are included in both the ABC and the *DSM-IV*, these items did not load on the 5-factor model. Whether or not the *DSM-IV* is an improvement over the *DSM-III-R* and whether, and/or to what extent, the next *DSM* version will be changed, will remain to be seen.

On the other hand, the *DSM-IV* contains symptoms that are not included in the present 5-factor model of the ABC. Specifically, items that deal with impairments in the use of nonverbal behaviors, such as facial expression, body postures, and gestures to regulate social interaction; lack of ability to share enjoyment, interests, or achievements with other people; impairments in the ability to initiate or sustain a conversation with others; lack of varied, spontaneous make-believe play; and preoccupation with restricted and stereotyped interests are not included in the ABC. Although autism diagnoses cannot be made on the basis of just ABC results, if the 39 items that loaded on the 5-factor model in the present dissertation were combined with new items that measure the above *DSM-IV* symptoms areas, the discriminative validity of the ABC might be greatly improved and the ABC might become a very powerful and important diagnostic test.

It is recommended that the ABC be shortened to 39 items and that Krug et al.'s proposed five subscales be renamed to the five factors found in Study II: Nonresponsive, Infant-Like, Aggressive, Stereotypic, and Repetitive Speech Behaviors. Research that assesses the discriminative validity of the 5-factor model found in this dissertation, particularly in regard to specific Pervasive Developmental Disorders is suggested. That is, instead of focusing on a single cutoff score on the ABC, it is recommended that further research be performed to see whether the various autism spectrum disorders (i.e., Autistic Disorder, Rett's Disorder, Childhood Disintegrative Disorder, Asperger's Disorder, and PDD Not Otherwise Specified) show different symptom area profiles based on the present five factors. In addition, the discrepant total scores found in Studies I and II strongly call for the development and, above all, use of age norms for the five factors found in Study II.

### **Is there a correlation between speech abilities and degree of autism severity?**

Studies I and II may possibly tell us something about how speech abilities are related to other symptoms in the autism spectrum and suggest how different

types of speech abnormalities characterize persons with different degrees of autism severity. The findings in these studies indicate that receptive language abilities and degree of expressive speech development (i.e., muteness, number of communicative words, sentence length, grammatical abilities, etc.) are strongly related to degree of autism severity in general. Study II demonstrated that many of the above behaviors load on the “Infant-Like Behavior” factor, where high scores indicate lower degree of functioning. Echolalia and repetitive speech, which load on Factor 5 (Repetitive Speech Behaviors), may be more often encountered in persons who are higher functioning. Study I showed that mute individuals would have a greater degree of autism severity, if the expressive language items were disregarded.

The criteria for placement in the speaking and mute groups were very strict in Study I. If an individual was able to use just one word to communicate, she/he was placed in the speaking group. Therefore, the individuals in the speaking group were very heterogeneous in regard to language abilities. It would have been interesting to more finely divide the speaking sample into, perhaps, four groups: able to use 1-5 words communicatively (24% of the speaking sample were reported to lie at this level), able to use 6-30 words communicatively (20% of the speaking sample were reported to lie at this level), able to use more than 30 words communicatively (40% of the speaking sample were reported to lie at this level), and near normal use of communicative language. Although this was not done, it is possible that a “continuous” negative relationship between level of language abilities and other symptoms would have been found (i.e., that language abilities are a marker for degree of severity in general).

### **Do learning styles differ in mute and speaking individuals with autism spectrum disorders?**

This dissertation suggested that learning abilities and styles may also differ in speaking and mute individuals with autism. Although the two children in Study III had identical DQs on recent assessments, Child 1 was mute until he was 11 years old, when intensive behavioral language instruction was begun. The study began one year later, at which point he had about a 100-word vocabulary. Child 2 had developed speech early, but showed severe language problems. The similarities in the children’s results have already been summarized in the Results and Discussion sections in Study III. However, these two participants also showed very different rates and styles of learning in the two teaching methods examined: traditional discrete-trial and incidental teaching. To summarize the most important differences, Child 1, who was mute until age 11 years, took much longer to learn the language form taught by both teaching procedures and contrary to expectations, demonstrated a highly significantly greater amount of correct and spontaneous language use during home generalization probes (ranging from levels that were 13 to 3 times higher than Child 2’s) of items taught by both methods during all periods, even though both decreased

significantly, from the teaching period to the follow-up. That is, Child 1 was able to spontaneously use the language form he was being taught, even before he had reached criterion level. Child 2 reached the criterion level much more quickly, yet he showed extremely poor levels of correct and spontaneous use of the language form during home generalization probes (even though the items taught by incidental teaching nearly tripled from the teaching period to follow-up, they were still 3 times lower than Child 1's).

Although one cannot make generalizations from a study with two participants, the differences in speed and learning style cannot be attributed to dissimilarities in intelligence levels. Interestingly, previous research (Elliott, Hall, & Soper, 1991) has found a possible interactive effect of training sequence and individual functioning level, as was also suggested by Warren and Kaiser (1986). Specifically, Elliott et al. observed that the participants that functioned in the *severe* range of mental retardation showed greater generalization when given discrete-trial teaching first, followed by natural language teaching. The participants that functioned in the *profound* range of mental retardation, however, tended to perform better when natural language teaching was followed by discrete-trial teaching. Although discrete-trial and incidental teaching were performed simultaneously in the present study and both children had similar levels of functioning, they did initially differ in expressive language abilities. The findings in Study III and the Elliott et al. study are intriguing and call for further investigation.

### **What can we learn from single-case studies?**

This dissertation utilized a single-case research design in Study III. Although single-case designs have been used in many research areas, such as psychology, psychiatry, and education, there still exist many misconceptions about or oversimplifications of single-case research. For example, a widely held belief is that single-case investigations are not “true experiments” and cannot reveal “causal relations” between variables, as the term is used in scientific research. Another common view, even in those who accept that causal relations can be demonstrated in such designs, is that single-case designs cannot yield conclusions that extend beyond the few persons included in the study. Single-case designs, however, are important methodological tools that can be used to evaluate a number of research questions. They have both unique characteristics and similarities to the more commonly used between-group research design strategies (Kazdin, 1982).

Traditional between-group designs are often not well suited to the many applied situations in which treatment focuses on the individual subject. In addition, many of the demands of between-group designs (e.g., homogeneous groups of subjects, random assignment of subjects to groups, standardized treatment across subjects) are not feasible in applied settings where only one or a few subjects may be the focus of a particular intervention. Single-case studies

provide an alternative to uncontrolled studies, the traditional means of evaluating interventions applied to single cases in clinical work (Kazdin, 1982).

There are well-established guidelines and standards for determining the extent to which any given treatment has empirical support for producing beneficial treatment outcomes. Researchers often make a distinction between a treatment's *efficacy* and a treatment's *effectiveness* or clinical utility (Lonigan, Elbert, & Johnson, 1998). One way of looking at the efficacy versus effectiveness distinction is in terms of internal versus external validity (Cook & Campbell, 1979). Internal validity refers to the extent to which changes in the dependent variable can be attributed to systematic changes in the independent variable and not to other factors. Internal validity is necessary to determine the *efficacy* of a treatment. Single-case designs can provide strong support for the internal validity of a treatment. External validity refers to the extent to which findings from an investigation can be generalized to other settings, to other subjects, to other therapists, and to other families. Thus, external validity is necessary to determine the *effectiveness* of a treatment (Gresham et al., 1999). In order to determine how well a treatment can be generalized, one must replicate a study in other settings, with other subjects and therapists.

In both single-case research and in between-group research, initial investigations are mainly concerned with issues of internal validity. The study is arranged to rule out extraneous factors other than the intervention that might account for the results. External validity is primarily addressed in subsequent investigations that alter some of the conditions of the original study (i.e., replications to evaluate whether the effects of the intervention can be found across different subjects, settings, target behaviors, behavior-change agents, etc.; Kazdin, 1982).

The underlying rationale of single-case designs is similar to that of traditional between-group designs. Both designs compare the effects of different conditions (independent variables) on performance. In traditional between-group experimentations, the comparison is made between randomly placed groups of subjects who are treated differently (e.g., some subjects receive a treatment and others do not). The effect of the intervention is evaluated by comparing the performance of the different groups. In single-case research, inferences are usually made about the effects of the intervention by comparing different conditions presented to the same subject over time. To do so, it is essential that continuous assessment or repeated observations of performance occur over time. Specifically, one must examine the pattern and stability of performance before treatment is initiated (baseline data). When the intervention is implemented, the observations are continued to examine whether behavior changes coincide with the intervention. Finally, the observations are continued after the intervention has been terminated, to assess the permanence of behavior change over time (follow-up; Kazdin, 1982).

In Study III, a multiple-schedule design introduced sequentially across two subjects in a multiple-baseline fashion was used. A multiple-schedule design entails that two or more interventions are implemented (in this study, traditional

discrete-trial and incidental teaching methods) to alter a single behavior (color adjective acquisition). The major purpose of a multiple-schedule design is to show that the subjects perform differently under the two (or more) treatment conditions. The rationale behind a multiple-baseline design is that intervention effects are demonstrated by introducing the intervention at different baselines (persons, in this study) at different points in time. If each baseline changes when the intervention is introduced, the effects can be attributed to the intervention rather than to extraneous events (Kazdin, 1982).

Psychological research has placed great emphasis on between-group designs and the statistical evaluation of the results. The limitations of this type of research have previously been described (e.g., for a review, see Sidman, 1960). It is stressed that between-group research is one approach to investigate intervention effects, however, it is limited to some degree in the picture it provides of empirical phenomena. Single-case research represents another level of analysis, but it does not necessarily replace between-group research, as it too has its own collection of limitations (Kazdin, 1982).

In many cases, single-case and between-group research have similar goals (e.g., evaluating a given intervention). In other instances, single-case and between-group research address different types of questions or can address different questions with varying degrees of clarity and make unique as well as overlapping contributions. If one limits oneself to only one design methodology, it is difficult to address all of the questions that are likely to be of interest (Kazdin, 1982).

## CONCLUDING REMARKS

The present dissertation has contributed new information in several areas in the field of autism. The primary strengths of Studies I and II were the large sample sizes with a broad spectrum of autistic disorders. This allowed for unique contributions to the field regarding: (1) behavioral differences in speaking and mute individuals with autism (Study I); (2) questions about the test construction of the ABC in regard to the effect of the expressive language items on the Language subscale scores and the ABC total scores (Study I); (3) analysis of the factor structure of the ABC, which resulted in suggestions for shortening the number of items, renaming the five subscales, and adding items to increase the diagnostic power of the checklist (Study II); and (4) the proposition that there is a strong relationship between language abilities and degree of autism severity (Studies I and II). Study III was the second study in the literature to provide a direct, controlled comparison of incidental teaching and traditional discrete-trial training for children with autism, in regard to acquisition, retention, teaching efficiency, and generalization to novel stimuli. This study also contributed new knowledge to the field, by being the first study to compare the two procedures on generalization and spontaneous usage to home and parents. It also provided

support for the intriguing possibility that the differential effects of teaching methods may be related to an individual's functioning level or language abilities.

As discussed previously, early intensive behavioral intervention has produced extraordinary gains in a large number of nonverbal children who would otherwise have a poor prognosis for acquiring language and social skills (e.g., Anderson et al., 1987; Birnbrauer & Leach, 1993; Lovaas, 1987; Lovaas et al., 1973; Maurice, 1993; Smith et al., 1997). Will the increased use of these techniques radically alter what is presently known about autism spectrum disorders, specifically, prognosis, rates of mutism, language and social skills impairments, and the myriad of other behaviors and symptoms that are typically found in these individuals? Only time and continued research will tell.

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