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Interventions to Facilitate Social Interaction for Young Children with Autism: Review of Available Research and Recommendations for Educational Intervention and Future Research

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The purpose of this paper is to review the knowledge available from aggregated research (primarily through 2000) on the characteristics of social interactions and social relationships among young children with autism, with special attention to strategies and tactics that promote competence or improved performance in this area. In its commissioning letter for the initial version of this paper, the Committee on Educational Interventions for Children with Autism of the National Research Council requested "a critical, scholarly review of the empirical research on interventions to facilitate the social interactions of children with autism, considering adult–child interactions (where information is available) as well as child–child interactions, and including treatment of [one specific question]: What is the empirical evidence that social irregularities of children with autism are amenable to remediation?" To do this, the paper (a) reviews the extent and quality of empirical literature on social interaction for young children with autism; (b) reviews existing descriptive and experimental research that may inform us of relations between autism and characteristics that support social development, and efforts to promote improved social outcomes (including claims for effectiveness for several specific types of intervention); (c) highlights some possible directions for future research; and (d) summarizes recommendations for educational practices that can be drawn from this research.

KEY WORDS: Social interaction; autism; early intervention.

It is accepted as a logical truism and empirical fact that children and adults with autism demonstrate some delays, deficits, or atypical characteristics in the frequency, type, and quality of social interactions and social relationships with other individuals. This characteristic was a central feature of the original description of autism (Kanner, 1943), and has been a common feature of virtually all diagnostic classification systems since. Available research suggests that differences in social development characterize children with autism from the earliest months (perhaps even before formal diagnosis; see Dawson, Osterling, Meltzoff, & Kuhl, 2000; Wimpory, Hobson, Williams, & Nash, 2000) and that delays, deficits, or atypical characteristics in this domain may be a "core feature" of the more general syndrome (Sigman, 1994). Perhaps as a result, researchers have devoted substantial effort to describing the developmental course of social interactions and social relationships among children with autism and have similarly devoted substantial effort to the design and evaluation of interventions to facilitate development of these competencies.

The purpose of this paper is to review knowledge from available research on the characteristics of social interactions and social relationships among young children with autism, with special attention to strategies

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and tactics that promote competence or improved performance in this area. In its commissioning letter for the original version of this paper, the Committee on Educational Interventions for Children with Autism of the National Research Council requested "a critical, scholarly review of the empirical research on interventions to facilitate the social interactions of children with autism, considering adult–child interactions (where information is available) as well as child–child interactions, and including treatment of [one specific question]: What is the empirical evidence that social irregularities of children with autism are amenable to remediation?"

This paper will focus on social interactions, their role in the development of social relationships, and intervention targets and procedures that might support each. To do this, I will (a) review the extent and quality of empirical literature on social interaction for young children with autism; (b) review existing descriptive and experimental research that may inform us of relations between autism and characteristics that support social development, and efforts to promote improved social outcomes (including claims for effectiveness for several specific types of intervention); and (c) highlight some possible directions for future research.

The definitional boundaries of "social development" research reviewed here are necessarily arbitrary. Several of the other papers in this issue touch on topics and areas of related development and intervention (e.g., language, challenging behavior, overall development). While the focus of this paper—social interactions and social relationships—relates closely to the content of other papers, readers must identify points of conceptual and empirical overlap and distinction and independently draw syntheses and conclusions across these related reviews.

BASIS FOR THIS PAPER

This paper is based on a review of the empirical literature on social interaction, social relationships, and their components and correlates among young children with autism. This review is based exclusively on academic or scholarly papers in the published corpus, with an emphasis on publications from peer-reviewed journals with few additions (noted in text) from chapters in widely circulated, and generally well-regarded academic books.

This review was based on a systematic search of published research and scholarship available through May 2000; an abbreviated search was conducted in October 2001 to augment this larger review. The *PsychInfo* on-line database was searched for entries containing the terms *autistic* or *autism* and one or more of the following: *social relation(s), social relationships, social skill(s), social development, social interaction(s), friend(s),* or *friendship(s)*. The 793 resulting references were then screened using two successive criteria; first, a review of each reference was conducted, and publications were deleted from further review if they failed to demonstrate direct relevance to interventions for social interactions, social relationships, or friendships for children with autism under the age of 9. A total of 320 entries was retained, with additional entries selected from *PsychInfo* to ensure complete coverage of specific authors identified as frequent contributors to this literature. Review then proceeded in three waves. First, major reviews conducted since 1988 were considered on a selected basis, particularly to provide an overview of theoretical, conceptual, and methodological issues. Next, a review of entries that related directly to intervention, training, remediation, or related concepts was conducted. As these two reviews continued, both "ancestor" and "descendent" reviews were conducted, using references from published works and online citation indices as appropriate. Finally, studies of intervention efforts were targeted for the review provided in this paper.

A diverse array of methodologies is represented in the larger literature base, including pre-empirical anecdotal and case study reports, small- to large-sample descriptive investigations, selected basic experimental investigations in which analog or quasi-naturalistic settings are manipulated to isolate specific environmental or behavioral variables, single-case experimental investigations, and some group-comparison intervention studies. Assessment procedures vary from low-fidelity third-person report and general rating scales, to structured testing with both project-specific and published standardized tests, to a variety of observational assessment tools completed in analog, naturalistic intervention, and naturalistic generalization settings.

QUALITY OF SCIENCE AND OVERARCHING CONSIDERATIONS

In general, the quality of science in this literature base, while somewhat variable, gives evidence of developing integrity and sophistication. Since 1990, basic subject description procedures (including diagnosis, selection, and description of children with autism),

comparison samples (including children with other disabilities, and age-, language-, or intellectually matched children without disabilities), and assessment technologies have become both more sophisticated and more consistent across studies and investigators. Increasingly sophisticated designs and analyses are also evident, although to date there is little published work that explores issues of growth and change over extended periods of time. Further, there is evidence of continued interest and productivity in research from various quarters on the social interactions and relationships of young children with autism, including basic developmental researchers, researchers in psychology, psychiatry and allied medical disciplines, and investigators in special education and applied behavior analysis.

A substantial part of the intervention research in this area has been conducted either by applied behavior analysts or using tools often associated with this branch of scientific inquiry. Perhaps most noteworthy is the predominant use of experimental designs commonly described as "single-case" or "single-subject" (c.f., Hersen & Barlow, 1976). Although there is some variability in the quality and appropriateness of specific experimental designs, it also must be noted that this class of experimental investigations can, and most typically does, maintain highest standards of internal validity. Because of central features of behavior analytic designs, there is less attention to intervention effects on developmental skills (i.e., those that are expected, under both baseline and intervention conditions, to improve over time). However, these investigations also have distinctive advantage in (a) isolation of the unique and combined effects of individual intervention components, (b) focus on more powerful intervention effects, (c) tight control of experimental procedures with increased flexibility for conducting idiographic analyses, and (d) special advantage in "treatment building" phases of research, development, and dissemination of known-effective practices (McConnell, 1994).

In the current review, all single-case experimental investigations reviewed (unless otherwise noted) meet basic standards for being considered full experiments. These studies are distinguished by (a) repeated, continuous assessment of the dependent variable within and across experimental phases, typically with three or more data points per phase; (b) minimum of baseline and treatment contrast, with additional contrast (and control) phases typically included; (c) direct replication of treatment effects across three or more subjects, settings, or behaviors; and (d) evidence of experimental control of independent variable(s) and other relevant features within and across settings. Studies not meeting these standards, if included, will be described as quasi-experimental or case study investigations.

There is often strong interest in having integrative reviews like this one to evaluate the size or consistency of effects across experimental manipulations, subjects, or studies. However, the overwhelming predominance of single-case experiments in this literature makes such analyses untenable. While some efforts to estimate effect sizes and conduct meta-analyses of single-case work can be found, these approaches can be questioned methodologically and conceptually. In particular, these efforts to summarize across effects often violate the basic characteristics (and, in this sense, limitations) of single-case experimentation (Baer, Wolf, & Risley, 1987; Hersen & Barlow, 1976)

Other Challenges

There are several other, relatively smaller, challenges that must be considered in this review. First, there are variations in the diagnostic procedures (and underlying categorical or conceptual definitions) for identifying children with autism. This variation is particularly apparent across *years*, with different practices associated with different contemporary diagnostic standards (Schopler, Van Bourgondien, & Bristol, 1993). Additionally, empirical work has often followed contemporary practice issues, with study participants occasionally described as "developmentally delayed," "developmentally disabled," or "handicapped." Because of these diagnostic or grouping practices, it is sometimes difficult or impossible to discern effects for children with autism specifically. In recent years, however, researchers seem to be adopting more similar approaches, relying on diagnostic definitions from the third or fourth editions of the American Psychiatric Association's *Diagnostic and Statistical Manual* (DSM), as well as common measures (particularly the *Childhood Autism Rating Scale,* Schopler, Reichler, Vellis, & Daly, 1988) and practices, including independent diagnosis by two professionals using explicit criteria.

Second, the relative late age at which children with autism are identified and diagnosed may make more difficult researchers' ability to identify aspects of very early development, and the factors that affect it, that are critically important for the social development of young children with autism. If autism is not typically identified until 24 months or later, and if important developmental events occur *before* this time, researchers will be severely hampered in their ability to analyze and identify the contributors to observed social interaction outcomes.

Third, reading and synthesizing the research on social interaction and social relationships of young children with autism must also account for changing patterns of the social environment and the ways this environment is influenced by a variety of social and policy issues (e.g., expansion of preschool programs, inclusion). Given the well-documented effects of environmental variables on social behavior (Sainato & Carta, 1992), and given the range of ecological conditions (including things such as availability and age-of-start of intervention, access to typically developing peers, enrollment in segregated versus inclusive programs), findings from "naturalistic" descriptive and experimental research may well vary as a function of assessed and unassessed ecological conditions. Reading available research requires the reviewer to condition findings, in some approximate way, given contemporary environmental features.

REVIEW OF EMPIRICAL RESEARCH

Social Interaction Processes and Outcomes: Descriptive Research

While intervention procedures and outcomes are the major focus of this review, some preliminary attention to the large body of descriptive and basic experimental research for young children with autism is necessary. This research generally informs theoretical and general analyses of the underlying characteristics of autism and related conditions (Lord, 1993; Sigman, 1994), and it also is likely to hold special promise for informing and guiding experimental and intervention-focused research (McConnell, 1994).

Social Interaction Outcomes

Children with autism generally score below typically developing peers, and occasionally below children with other disabilities, on formal teacher-report measures or standardized tests of social competence (Lord, 1993). Social interaction deficits for young children with autism may reflect deficits in essential social skills. Lord and Magill-Evans (1995) conducted naturalistic observations in a day camp of children (ages 5 to 16) who were autistic, had behavior disorders, or were presumed to be developing typically. In general, results indicated that children with autism spent less time interacting than did children developing typically, had lower-quality interactions when they did play with peers, and spent more time engaged in purposeless or no activity and/or at greater physical distances from peers.

McGee Feldman, and Morrier (1997) found that young children with autism indeed engage in some degree of play, social participation, and social interaction. However, comparisons to typically developing children in identical situations (i.e., during free play activities soon after placement in a preschool program) indicated that children with autism spent less time in proximity to other children, received fewer social initiations from peers, were less likely to focus on other children, produced fewer verbalizations to others, focused less on adults as interactive partners, and engaged in more atypical behavior. In a more complex study, Sigman and Ruskin (1999) found an array of differences in the social behavior of children with autism, compared to children with Down's syndrome or other disabilities and children developing typically. In Sigman and Ruskin's study, children with autism spent a larger proportion of time engaged in nonsocial play (i.e., play that is solitary or near, but uncoordinated with, peers, as well as watching others play), and a smaller proportion of time in direct social play with others. Sigman and Ruskin's (1999) study also suggested a range of social development. Children with autism were more likely to produce no initiations to peers in approximately 40 minutes of observation and were less likely to respond to social initiations from peers. However, those children with autism that produced at least one social initiation did so at rates that were not different from those of children with other disabilities and those developing typically. Also, Sigman and Ruskin found no differences in the rates at which peers initiated to children with autism, nor any differences in the likelihood that peers would respond to social initiations from children with autism. In summary, Sigman and Ruskin (1999) conclude that children with autism appear to be socially isolated primarily because of their own behavior (rather than avoidance or lack of initiation from others), with rates of social initiations to others and likelihood of responses to others' initiations as especially low.

Although relative deficits or differences in performance seem to be the major thrust of these findings, two other conclusions appear warranted. First, it is *not* the case that children with autism, as a group, engage in *no* interactions with other children. Rather, available research consistently demonstrates that while children with autism make and receive fewer social initiations, respond to fewer of the initiations, and engage in shorter bursts of interaction, many of these children do participate in social interaction with peers (Kennedy & Shukla, 1995). Second, these data suggest that social interactions for many young children with autism are not preferred activities; rather, it appears that isolate

play, proximal onlooking, or other more challenging behaviors may be the more likely behaviors in "free play" activities where children developing typically are likely, and expected, to engage in social interaction.

Behaviors That May Compete with Social Participation

Compared with children of similar ages, children with autism engage in higher rates of repetitive nonfunctional movement (generally labeled stereotypic or self-stimulatory behavior), higher rates of self-injurious or otherwise challenging behavior, and lower rates of proximity to peers (sometimes described as socially avoidant behavior) (Lord, 1993). Each of these response classes decreases opportunities for social learning, and thus may affect development of social skills over extended periods of time. Although the number of studies is relatively small, there is direct evidence of an inverse functional relation between a child's rates of stereotypic or self-injurious behavior and social interaction or participation in experimental (Koegel, Koegel, Hurley, & Frea, 1992; Lee & Odom, 1996; Schleien, Heyne, & Berken, 1988) and descriptive analyses (Lord & Magill-Evans, 1995; Sigman & Ruskin, 1999). Further, while there is some evidence that "autistic-like" behaviors can be controlled through characteristics of social activities (Baker, Koegel, & Koegel, 1998; Koegel, Dyer, & Bell, 1987), it also may be the case that at least some children with autism either experience greater reinforcement from these behaviors (compared to social interaction) or engage in these behaviors specifically because of their functional effect of terminating or reducing social interaction (Warren & Reichle, 1992).

Taken together, it appears that complete understanding of the social development of young children with autism and the development of effective interventions for these children will require detailed analysis of the developmental and functional relations between social interaction and multiple classes of competing behaviors. Further research may elucidate the extent to which early social interaction competence serves as a protective factor, preventing development of these competing behaviors; conversely, future research may describe ways to replace competing behaviors with competent social skills.

EMPIRICAL EVALUATIONS OF INTERVENTION

To review the experimental literature on intervention effects, a large body of references was subsetted to identify articles focused on teaching, training, or providing intervention on social functioning. This screen identified 166 articles, which were then individually reviewed; additional studies were identified in October 2001. Additional screening excluded manuscripts in which all or a large proportion of the subjects were more than 8 years of age, reports of case studies or program descriptions (although select examples in emerging areas of research that reported at least quasi-experimental evaluations were retained), and most investigations published before 1979. A small group of manuscripts not meeting these criteria was retained, and noted as exceptional, when the methods employed and/or results obtained were essential for understanding emerging or potential areas of research among young children with autism. This final screening identified about 55 investigations for review. Table I summarizes this studies and features of their methodology and findings.

For purposes of review, these investigations can be placed into five general categories, based on existing reviews of social interaction interventions (McEvoy, Odom, & McConnell, 1992): (a) *ecological variations,* (b) *collateral skills interventions;* (c) *child-specific interventions,* (d) *peer behavior,* and (e) *comprehensive interventions.*[2]

Ecological Variations

Interventions based on ecological variations are those that promote social interaction and its development through manipulations or arrangements of general features of the physical or social environment. Ecological variations include modifications in activity structure or schedule, as well as modifications in the nature and composition of a child's peer groups. In this latter sense, social integration or inclusion can be considered an intervention when no other purposeful intervention is provided.

The current review identified a relatively modest literature base for ecological variations, with only 11 studies included here. It may be, for reasons that will be described below, that the effects of ecological variations have been subsumed into other intervention programs, reducing the attention to this class of intervention in isolation.

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[2] While most available social interaction interventions are educational or behavioral, a limited number of recent case studies describe social outcomes for drug treatments (e.g., Williams, Allard, Sears, Dalrymple, & Bloom, 2001; Wray, Yoon, Vollmer, & Mauk, 2000). The research base is small and quite preliminary in this area, and will not be reviewed further here.

Table I. Summary of Intervention Studies

Citation	Subjects	Methodology	Internal Validity	External Validity	Generalization
Ecological Variations					
Koegel, Dyer, & Bell (1987)	10 CWA, 4–13 yr	Descriptive correlational	IV	IV	III
DeKlyen & Odom (1989)	28 CWD, 3–6 yr; 8 TDC, 3–4 yr	Descriptive post-hoc analyses of treatment study	IV	III	III
Schelein, Mustonen, & Rynders (1995)	7 CWA, 4–8 yr; 8 CWA, 7–11 yr; 53 "same-age" TDC	Multiple-baseline across groups (younger, older CWA)	III	III	III
Strain (1983a)	4 CWA, 7–10 yr	Multiple-baseline across Ss with simultaneous comparison of two generalization conditions	II	III	II
Mundschenk & Sasso (1995)	3 CWA, 7–10 yr; 15 TDC, grades 2–4	Multiple-baseline across Ss	II	II	III
McEvoy, Nordquist, Twardosz, Heckaman, Wehby, & Denny (1988)	3 CWA, 4–7 yr; 6 TDC, 6 yr	Multiple-baseline across Ss	III	II	I
Brown, Ragland, & Fox (1988)	4 target children—1 CWA, 2 CWD, 1 TDC 37 TDC "peers," 44–67 mos	Multiple-baseline across two Ss, two studies	III	III	II
Collateral Skill Interventions					
Haring & Lovinger (1989)	1 CWA, 4 yr; 2 CWD Kindergarten; 5 TDC "confederates," 3–5 yr; 14 TDC, generalization sample	Two experiments; AB design replicated across three Ss	III	IV	II
Baker, Koegel, & Koegel (1998)	3 CWA, 5–7 yr	Multiple baseline across Ss	II	II	II
Krantz, MacDuff, & McClannahan (1993)	3 CWA, 6–8 yr	Multiple-baseline across Ss	III	II	III
Thorp, Stahner, & Schreibman (1995)	3 CWA, 5–9 yr	Multiple-baseline across Ss	III	III	I
Goldstein & Cisar (1992)	3 CWA, 3–5 yr; 6 TDC 3–5 yr	Multiple-baseline across Ss	III	II	II
Goldstein, Wickstrom, Hoyson, Jamieson, & Odom (1988)	8 "language-delayed" children, 44–80 mo 4 TDC	Exp 1: ABAB replicated across two Ss; Exp 2, AB across, two triads	III	III	III

Lifter, Sulzer-Azaroff, Anderson, & Cowdrey (1993)	3 CWA/PDD, 4 yr	Sequential treatment, counterbalanced across Ss	III	III	III
Koegel, Camarata, Valdez-Menchaca, & Koegel (1998)	3 CWA, 3–5 yr	Multiple-baseline across Ss	I	II	I
Kamps, Barbetta, Leonard, & Delquadri (1994)	3 CWA, 8–9 yr; classmates from grade 2, 3 classrooms	Multiple-baseline across Ss	III	II	I
Child-Specific Interventions					
Odom & Strain (1986)	3 CWA, 4 yr;	Multiple-baseline across Ss	III	II	III
Belchic & Harris (1994)	3 CWA, 4–5 yr; 5 TDC, 3–4 yr	Multiple-baseline across peers, replicated across Ss	II	II	II
Krantz & McClannahan (1998)	CWA, 4–5 yr	Multiple-baseline across Ss	III	II	I
Shearer *et al*. (1996)	3 CWA, 5 yr; 9 TDC, 3–5 yr	Alternating treatments, replicated across Ss	III	II	III
Strain, Kohler, Storey, & Danko (1994)					
Davis, Brady, Hamilton, & McEvoy (1994)	3 CWA, 5–6 yr; 24 TDC, 4–8 yr	Multiple-baseline across Ss	III	II	I
Zanolli & Daggett (1998)	1 CWA, 6 yr; 1 TDC, 2 yr	Multielement multiple-baseline across Ss	II	IV	I
Zanolli, Dagget, & Adams (1996)	2 CWA, 4 yr; 8 TDC, 4–6 yr	Multiple-baseline across activities, replicated across Ss	III	II	III
Norris & Dattilo (1999)	1 CWA, 8 yr	AB case study	IV	IV	IV
Peer-Mediated Interventions					
Odom & Strain (1986)	3 CWA, 4 yr;	Multiple-baseline across Ss	III	II	III
Strain, Kerr, & Ragland (1979)	4 CWA, 9–10 yr; 1 TDC, 11 yr	ABAC replicated across Ss	III	III	III
Goldstein & Ferrell (1987)	3 CWA, 3–6 yr; 6 TDC, 4–5 yr	Multiple-baseline across Ss; ABAB with two Ss	III	II	III
Goldstein & Wickstrom (1986)	3 CWDD/A, 3–4 yr; 2 TDC, 4 yr	Multiple-baseline across Ss	III	II	II
McGee, Almeida, Sulzer-Azaroff, & Feldman (1992)	3 CWA, 3–5 yr; 5 TDC, 4 yr	Multiple-baseline across Ss	III	II	II
Garrison-Harrell, Kamps, & Kravitz (1997)	3 CWA, 6–7 yr; 15 TDC, grade 1	Multiple-baseline across settings, replicated across Ss	III	II	III
Goldstein, Kaczmarek, Pennington, & Shafer (1992)	4 CWA, 3–6 yr; 1 CWDD;10 TDC, 3–5 yr	ABCB replicated across five Ss	III	II	III
Lee & Odom (1996)	1 CWA, 7 yr; 1 CWD, 7 yr; 4 TDC, 8 yr	ABAB replicated across Ss	III	IV	III

continued

Table I. Summary of Intervention Studies (Continued)

Citation	Subjects	Methodology	Internal Validity	External Validity	Generalization
Coe, Matson, Craigie, & Gossen (1991)	2 CWA, 7 yr; 2 TD siblings, 9–11 yr	AB Multiple-baseline across Ss	III	IV	III
Mundschenk & Sasso (1995)	3 CWA, 7–10 yr: 15 TDC, grade 2–4	Multiple-baseline across peers, Ss	III	II	III
Sasso, Mundschenk, Melloy & Casey (1998)	4 CWD, 9–10 yr; 6 TDC, 8–9 yr	Sequential alternating treatments design, counterbalanced across Ss	III	III	III
Odom, Chandler, Ostrosky, McConnell, & Reaney (1992)	6 CWD, 4–5 yr, 10 TDC, 5–6 yr	Multiple-baseline across Ss	III	II	II
Odom & Watts (1991)	3 CWA, 3–5 yr; 4 TDC, 5 yr	Multielement multiple-baseline across Ss	II	II	III
Sainato, Goldstein, & Strain (1992)	3 CWA, 3–4 yr; 3 TDC, 4–5 yr	Multiple-baseline across Ss	III	II	I
Kohler, Strain, Hoyson, & Jamieson (1997)	10 CWA, 3–5 yr; 22 TDC 3–5 yr	Multiple-baseline across classrooms (3)	III	II	II
Kamps, Barbetta, Leonard, & Delquadri (1994)	3 CWA, 8–9 yr; Classmates in 3 grade 2, 3 classrooms	Multiple-baseline across Ss	III	II	I
Comprehensive Interventions					
Rogers & DiLalla (1991)	49 CWA, 27 CWD	Chart review program evaluation	IV	III	IV
Rogers, Herbison, Lewis, Pantone, & Reis (1986)	13 CWA, 10 CWD	Descriptive program evaluation	IV	III	IV
Kohler, Strain, Maretsky, & DeCesare (1990)	2 CWA, 4 yr; 7 TDC, 3–4 yr	Alternating treatments design, replicated across Ss	III	IV	I
Gonzalez-Lopez & Kamps (1997)	4 CWA, 5–7 yr; 12 TDC 5–7 yr	ABAB replicated across Ss	III	III	III
Kamps, Leonard, Vernon, Dugan, *et al.* (1992)	3 CWA, 7 yrs; Gr 1 classmates	Multiple-baseline across Ss	III	II	II
Lefebvre & Strain (1989)	3 CWA, 4–6 yr; 6 TDC, 3–5 yr	Sequential withdrawal, replicated across Ss	IV	III	III
Odom, McConnell, McEvoy, Peterson, Ostrosky, Chandler, Spicuzza, Skellinger, Creighton, & Favazza (1999)	98 CWD, preschool	Random assignment, untreated control group design	I (not blind)	I	I

Abbreviations: CWA, Children with autism; TDC, typically developing children; CWD, children with disabilities (not differentiated); yr, years; mo, months.

Criteria for Assessing Intervention Studies

Internal validity (control for nonspecific factors such as maturation, expectancy, experimenter artifacts): I—Prospective study comparing the Tx to an alternative Tx or placebo in which evaluators of outcome are blind to treatment status; II—Multiple baseline, ABAB, reversal/withdrawal with measurement of outcome "blind" to treatment conditions or pre-post design with independent evaluation; III—Pre-post or historical designs or multiple baseline, ABAB, reversal/withdrawal (not "blind"); IV—Other

External validity/Selection biases: I—Random assignment of well-defined cohorts and adequate sample size for comparisons; II—Nonrandom assignment, but well-defined cohorts with inclusion/exclusion criteria and documentation of attrition/failures. In addition, adequate sample size for group designs or replication across 3 or more single subjects; III—Well-defined population of 3 or more subjects in single subject designs or sample of adequate size in group designs; IV—Other

Generalization: I—Documented changes (i.e., generalization) in at least one natural setting outside of treatment setting (includes social validity measures); II—Generalization to one other setting or maintenance beyond experimental intervention in natural setting in which intervention took place; III—Intervention occurred in natural setting or use of outcome measures with documented relationship to functional outcome; IV—Not addressed or other

Extant research provides modest evidence of a relation between characteristics of activities and social interaction for young children with autism. Preschool children with autism tend to engage in more social interaction when activities are ones they prefer (Koegel *et al.*, 1987) or when activities and the materials that appear in them are predictable (Ferrara & Hill, 1980). There is also some evidence that children with autism engage in higher rates of social participation and interaction following extended periods of low environmental stimulation (Harrison & Barabasz, 1991). Additionally, it appears that the relative structure of activities may affect social interaction, with more structured activities associated with higher rates of interaction without requiring increased in teacher-mediated intervention (DeKlyen & Odom, 1989).

Research on the effects of access to developmentally typical (or more socially competent) peers, while somewhat limited in scope and number, appears fairly robust. These findings suggest that simple co-location of children with autism and more competent peers *without some other intervention* is not sufficient to produce increases in social interaction (Myles, Simpson, Ormsbee, & Erickson, 1993), but may produce modest increases in rates of initiations received (Schleien, Mustonen, & Rynders, 1995). Myles *et al.* (1993) studied naturally occurring variations and found that access to typically developing peers, in and of itself, failed to produce significant social interactions. By contrast, Schleien *et al.* (1995) integrated young children with autism into monthly art classes with same-age peers and then introduced a cooperative group structure into these classes. This treatment produced an increase in social initiations to children with autism, but had little effect on responses to these initiations or independent initiations from the children with autism.

Access to integrated play groups following some period of intensive intervention targeting social interaction, either child-specific or peer-mediated, promotes maintenance and generalization of social interaction for young children with autism. In one of the earliest demonstrations of this effect, Strain (1983a) showed that access to "developmentally integrated" play groups was associated with higher rates of social interaction for children ages 7 to 10 years, but only after social interaction skill intervention. More recently, Mundschenk and Sasso (1995) demonstrated that social interaction increases as a function of the number or proportion of typically developing children in a play group who have received explicit training in social interaction skills. In this study, five peers and one child with autism (ages 7 to 10) were assigned to a play group, and peers were trained successively to interact with their classmate with autism. Only after the third peer received training in each play group were generalized interactions noted for students with autism (Mundschenk & Sasso, 1995).

Lord and Hopkins (1986) present evidence from a group design with slightly older participants (ages 8 to 12 years) that higher peer initiation rates and more social interaction occurs when children with autism are paired with same-age versus younger typically developing peers. In Lord and Hopkins's (1986) investigation, children with autism were placed in dyadic play groups for 10 days both with peers who were in kindergarten (younger, but presumed to be at similar developmental levels as children with autism) and peers who were within 6 months of their age. Results indicated that children with autism initially exhibited lower rates of social behavior in integrated, versus segregated, play groups, but that age of peers in the integrated condition also mattered. Specifically, the older peers initiated five times more often than the younger peers and responded to a higher proportion of initiations from children with autism. Children with autism made more initiations to older peers, responded to a higher proportion of their initiations, and engaged in more sustained social interactions. While age may be confounded with social competence for theoretical analysis in studies like this, it appears likely that the social skills and behavior of peers in integrated play groups affect social interaction rates for young children with autism.

Prior intervention may not need to target social interaction specifically to produce increases in this behavior. In a series of studies, children with and without autism (and other developmental disabilities) have participated in classwide "group affection activities" (McEvoy *et al.*, 1988) or "socialization activities" (Brown, Ragland, & Fox, 1988), in which standard classroom songs and games are adapted to include components of positive physical contact and affection. McEvoy *et al.* (1988) studied the effect of this intervention for three young children with autism, 4 to 7 years of age, and Brown and colleagues (1988) identified one subject as autistic. In both studies, changes in social interaction and its components were noted in generalization settings after introduction of intervention.

Effects of ecological variations may be due to behavioral characteristics of the typically developing children present in integrated play groups or settings; correlational evidence suggests that these children, as a group, are more likely to emit high rates of social initiations, respond to higher proportions of initiations from others, and sustain longer social interactions following initiation (Lord & Hopkins, 1986; Sigman &

Ruskin, 1999; Strain, 1983b). Higher rates of social initiations and responses may account for effects that appear as a result of structure and access alone (DeKlyen & Odom, 1989; Schleien *et al.,* 1988; Schleien *et al.,* 1995); as activities bring children into proximity, and as task demands of these activities occasion coordinated or joint effort (e.g., sharing materials, participating in sociodramatic games, or producing collaborative projects), social initiations from typically developing children will likely increase social interaction.

Summary

Ecological variations can, under some conditions, produce weak to moderate effects on the social interaction of young children with autism, but these effects appear variable across investigations, intervention strategies, and children. Some ecological variations (e.g., structured activities, developmentally integrated play groups) seem to be logical requirements for more intensive interventions. As a result, ecological variations in and of themselves may be viewed as necessary, but sometimes not sufficient, for producing changes in the social interaction and development of young children with autism.

Collateral Skills Interventions

Somewhat more specific than ecological variations, collateral skills interventions are those in which children with autism demonstrate increases in social interaction as a function of training in other, seemingly different, skills. This class of interventions includes treatments that increase social participation or play, academic responses, or sociodramatic play. The literature base for collateral skills interventions is relatively small, with nine studies reviewed here.

The most important effects in this area of research indicate a functional relation between social interaction and play or social participation. Haring and Lovinger (1989) demonstrated that teaching generalized play skills to three preschool and kindergarten-aged children with severe disabilities (one identified as having autistic behaviors) produced social interaction effects, especially in peer responsiveness to initiations from the child with autistic behaviors, above those obtained with training and reinforcement alone. In this study, participation in play activities and use of specific play skills functioned as a necessary condition for further improvement in social interactions. Baker *et al.* (Baker *et al.,* 1998) demonstrated that games and activities selected to match the perseverative or obsessive behaviors of three children (ages 5 to 7) with autism also increased observed rates of social interaction when compared to general play conditions. This intervention has been further evaluated, with similarly positive results (Baker, 2000). Additionally, evidence from a study of the effects of picture schedules at home demonstrated an increase in social participation and social initiations to family members for young (ages 6 to 8), elementary-aged boys with autism following instruction in the use of the photographic activity schedule at home (Krantz, MacDuff, & McClannahan, 1993).

A related line of research demonstrates that teaching (or otherwise supporting participation in) sociodramatic play—typically, more structured activities than free play—increases social interaction rates. This effect has been observed when sociodramatic skills are taught generally to children with autism ages 5 to 9 (Thorp, Stahmer, & Schreibman, 1995) or when specific skills are taught to preschoolers with and without autism using play scripts (Goldstein & Cisar, 1992; Goldstein, Wickstrom, Hoyson, Jamieson, & Odom, 1988). In all three studies, investigators have found increases in sociodramatic behaviors and in social participation and components of social and communicative interaction, following sociodramatic skill training.

There is some suggestion that children with autism acquire play skills differentially as a function of the developmental appropriateness or "match" of specific skills taught. Lifter, Sulzer-Azaroff, Anderson, and Cowdrey (1993) studied three preschool children with diagnoses of autistic behavior or pervasive developmental disorder (but no reported diagnostic evaluation for autism *per se*). Their analysis demonstrated that children more quickly acquired toy play skills, and were more likely to play in unprompted or generalized ways, when the skills being taught were matched to their assessed developmental skill level (compared to toy play skills matched to chronological age).

Research on language interventions also provides some evidence of collateral effects on social interaction. For example, Koegel, Camarata, Valdez-Menchaca, and Koegel (1998) have shown that preschool children with autism can be taught to ask questions, and that question-asking generalizes across settings and objects with concomitant increases in social interaction. Increases in social interaction have also been observed in intervention for academic responding; Kamps, Barbetta, Leonard, and Delaquadri (1994) found increases in social interaction after arranging for academic class-wide peer tutoring dyads that included 8- and 9-year-old elementary-aged children with autism and typically developing peers.

Summary

Like ecological variations, collateral skills interventions may increase social interaction by bringing children with autism into contact with typically developing peers, thus activating natural processes for social development (c.f., McConnell, 1987; Sigman & Ruskin, 1999). These interventions, which give children with autism greater competence for participation in social activities, may also increase the reinforcing value of social participation. Like ecological variations, a number of components of collateral skills interventions (particularly play and sociodramatic skill training) are components of more comprehensive interventions.

Child-Specific Intervention Procedures

Child-specific interventions are instructional and/or reinforcement procedures designed specifically to increase the skill, frequency, or quality of social behaviors emitted by children with autism. These interventions, with their focus on improving the social functioning of target children, are logical descendants of more traditional models of social skills training developed for other populations (Bornstein, Bellack, & Hersen, 1977; McConnell, Sisson, Cort, & Strain, 1991). Child-specific interventions include (a) general instructional interventions to increase knowledge and improve social problem solving (including social stories), (b) high-density reinforcement to "prime" social responding, (c) social skills training, (d) adult-mediated prompting and reinforcement, and (e) various generalization promotion techniques (particularly self-monitoring). A somewhat larger base of studies describes the effects of child-specific interventions, with 15 different investigations reviewed for this paper.

The most direct example of child-specific intervention is when social skills training is provided to children with autism, and social interaction is prompted and reinforced in one or more social settings. Odom and Strain (1986), in part of a multielement study that will also be reviewed later, deployed a "teacher-antecedent" intervention, in which three preschool children with autism were prompted to initiate socially to peers. Using an alternating-treatments design, Odom and Strain compared this teacher-antecedent condition to both baseline and peer-mediated conditions. The teacher-antecedent condition produced increased numbers of social initiations from children with autism and peers, and mean lengths of interaction increased.

Belchic and Harris (1994) provide a straightforward demonstration that child-specific social interventions, with explicit attention to programming for variation across interactive partners, can produce generalized increases in social interaction for young children with autism. Three 4- and 5-year-old children with autism were taught, in multiple-baseline fashion, to initiate and maintain social interaction with typically developing peers and were observed to increase time spent in social interaction (compared to baseline) in subsequent free play activities where prompts and praise were provided for social initiations.

Prompting procedures have also increased social interactions with adults in classroom settings. Embedding explicit prompts to engage in social behaviors ("look" or "listen") in a pre-existing classroom activity (picture activity scheduling) increased interactions with adults in classroom settings (Krantz & McClannahan, 1998).

Recently, child-specific interventions have been used to enhance generalization and maintenance of treatment gains, primarily through the use of self-monitoring. Following an initial demonstration of the effectiveness of a self-recording procedure for increasing social responsiveness in nontreatment settings among older children with autism (Koegel *et al.*, 1992), at least two other groups have applied similar procedures with preschool-aged children (Shearer, Kohler, Buchan, & McCullough, 1996; Strain, Kohler, Storey, & Danko, 1994). In Shearer *et al.'s* (1996) effort, three 5-year-old children with autism were first exposed to an adult-mediated intervention during play with typically developing peers. After effects were achieved, child monitoring of activity engagement and social interaction was introduced. Child monitoring appeared to be associated with maintained activity engagement and social interaction for children with autism. Strain *et al.* (1994) employed similar procedures—again introducing self-monitoring after adult-mediated intervention—and extended this intervention to home settings for two of the three participants, with positive effects. Although both studies demonstrate some degree of generalization or maintenance following implementation of a self-monitoring condition, the most pronounced differences were obtained when the self-monitoring condition followed a more intensive cross-setting intervention using adult prompts and praise for social interaction (Strain *et al.*, 1994). Such effects need to be confirmed, however, in more direct comparison studies.

Child-specific interventions have also employed reinforcement-based procedures that capitalize on the phenomenon of behavioral momentum. Davis, Brady, Hamilton, and McEvoy (1994) demonstrated increased social initiation rates for children with autism and other

disabilities using a "high-probability request" strategy; teacher requests to initiate social interaction with peers (requests associated with low probability of child response) were preceded by three rapid-sequence requests for high-probability behaviors already in the children's repertoires. Both direct and generalized treatment effects were obtained. Generalization effects included increases in unprompted initiations and extended interaction with trained and untrained peers, and in settings where intervention had not been introduced.

Zanolli and Daggett (Zanolli & Daggett, 1998; Zanolli, Daggett, & Adams, 1996) have demonstrated positive effects with a "priming" procedure. In two studies with a total of four children (three with autism), these authors introduced a procedure in which density of reinforcement for social initiations was manipulated in a training session, with effects assessed in a later social interaction setting. Both studies found positive effects for priming (i.e., increasing density of reinforcement) on social initiations in a subsequent classroom activity.

Although behavioral mechanisms associated with these effects need further analysis, these studies suggest that social interaction skills in treatment and generalization settings for young children with autism can be brought under the control of reinforcement contingencies. Direct effects have been obtained with training, prompting and praising, high-probability request sequences, and social skills priming. Generalization across settings and partners has been facilitated by variations in peer assignments and use of self-recording. Intervention effects appear robust enough to warrant inclusion of child-directed intervention procedures in more comprehensive interventions, as will be seen in a later section.

Several other classes of intervention for social interaction deficits for children with autism should be mentioned. Perhaps most prominent recently has been the suggested effect of social stories. Social stories are presumed to help improve social functioning of children with autism by improving social cognition or by providing multiple instances where social problem solving can be applied (Gray & Garand, 1993). As yet, however, no experimental analysis of the effects of social stories could be found in the research literature. Published accounts include program descriptions (Simpson, 1993), case studies (Gray, 1998; Gray & Garand, 1993; Steerneman & Huskens, 1996), or social stories combined with other interventions in ways that make their unique effects impossible to assess (Swaggart *et al.*, 1995).

In one recent addition to this evolving literature, Norris and Dattilo (1999) offered a data-based case study evaluation of the effect of social stories on social interaction of a 8-year-old girl with autism. The authors employed a quasi-experimental (AB) design, intervention was implemented for only one child, and independent evaluation of resulting data suggests a relatively weak and perhaps transitory effect on rates of inappropriate interaction only. Nonetheless, this manuscript provides detailed descriptions of development and implementation of the independent variable, and it may provide basis for further and more complete evaluation of social stories in the future.

The lay and professional literature is also periodically marked by "therapeutic" interventions, including pairing children with autism with pets or other animals (e.g., Redefer & Goodman, 1989). However, no well-controlled empirical investigations of the effectiveness of these interventions could be obtained for this review.

Summary

Child-specific interventions can increase social interaction for children with autism, both as direct effects of intervention and through promotion of generalization or maintenance. Under some conditions, particularly where intervention is provided to elements of social interaction (e.g., social initiations, responses to others' initiations), child-specific interventions also increase children's mean lengths of interaction. However, child-specific interventions for children with autism may, in isolation, have limited potential. These interventions tend to focus more on social initiations, rather than other elements of sustained and high-quality interaction. It is possible that the weak reinforcing qualities of social interaction for children with autism may set significant constraints for the long-term effectiveness of child-specific interventions used in isolation. Future studies may find that back-up reinforcers or other explicit generalization enhancement procedures (e.g., self-monitoring) are required for long periods of time.

Peer-Mediated Intervention Procedures

Peer-mediated intervention procedures provide social skills training and other manipulations (typically, prompts and praise in social play situations) to other children that are designed to change social interactions and skills for young children with autism. Peer-mediated interventions capitalize on social responsiveness (Odom & Strain, 1984); if peers direct social behaviors (including initiations and interaction-sustaining responses) to children with autism, and if children with autism respond to these peer social behaviors, then teachers can directly affect social interaction for high-need students through peer-mediated interventions. In the broadest sense, peer-mediated procedures reviewed here include interventions to increase peer social initiations, social

and communicative interactions, and other instructional interventions (including peer-mediated incidental teaching and more structured peer tutoring). Peer-mediated procedures are represented in the largest, and probably best-developed, group of social interaction interventions, with almost 30 experimental reports identified for this portion of my review.

Peer-mediated procedures represent a robust treatment approach for social interaction deficits among young children with autism. Peer-mediated social initiation strategies are generally as effective as child-specific interventions (Odom & Strain, 1986; Strain, Kerr, & Ragland, 1979), but produce different effects at the level of microanalysis. Odom and Strain (1986), in an alternating-treatments comparison of child-specific and peer-mediated procedures (also reviewed earlier), found that the mean length of interactions was comparable under both conditions. As expected, initiation rates were quite sensitive to intervention, with peer initiation rates higher in the peer-mediated condition and target child initiation rates higher in the child-specific condition. Responses to initiations were less influenced by intervention condition, but still showed differential effects in the expected directions (i.e., higher response rates for peers in child-specific intervention condition and for target children in peer-mediated intervention condition).

The basic premise of peer-mediated intervention has been elaborated and extended to a range of social behaviors, with equally promising and robust effects. For example, peer-mediated interventions have been used to increase communicative interactions between children with autism and peers (Goldstein & Ferrell, 1987; Goldstein & Wickstrom, 1986), verbal labeling of objects and associated reciprocal interactions by children with autism (McGee, Almeida, Sulzer-Azaroff, & Feldman, 1992), and use of an augmentative communication system to increase interactions between elementary-aged children with autism and their typically developing peers (Garrison-Harrell, Kamps, & Kravits, 1997). Peer-mediated interventions have also been adapted to focus on peer behaviors that less formally obligate responses from target children, such as commenting on or acknowledging the target child's behavior (Goldstein, Kaczmarek, Pennington, & Shafer, 1992); as with earlier interventions, this more nonspecific form of peer-mediated intervention produces changes in observed rates of social interaction.

Peer-mediated interventions have been used to demonstrate inverse functional relations between social interaction and challenging behaviors. Lee and Odom (1996) sequentially implemented and removed a peer-mediated intervention in an ABAB design to increase and decrease social interaction rates for two elementary-aged children with autism (ages 7 and 8). In addition to expected increases (compared to baseline) in social initiations and interaction during implementation of peer-mediated intervention, rates of stereotypic behavior declined compared to adjacent baseline rates, even though peer-mediated procedures did not appear to target these responses specifically.

Peer-mediated procedures have been used in nonclassroom settings as well. Coe, Matson, Craigie, and Gossen (1991) have shown that older elementary children can effectively implement procedures to increase social interactions of younger siblings. In this study, young children with autism received an at-school intervention to increase social behaviors. Subsequently, typically developing siblings were taught to increase rates of prompts and praise to children with autism for several behaviors at home. This latter intervention produced increases in targeted behavior for youngsters with autism, as well as increase in the social interactions of children with autism and their older siblings. Strain and Danko (1995) demonstrated that procedures such as those used in classroom-based interventions can be implemented in homes by parents or childcare providers. Parents or the babysitter of three preschoolers (two with autism) prompted siblings to increase social initiations to target children. Results indicated use of peer prompting strategy by caregivers in each home, and an associated increase in social interaction for participating children.

A small number of studies indicate that characteristics of the intervention peer group may affect outcomes for young children with autism. Sasso, Mundschenk, Melloy, and Casey (1998) varied either the size of integrated play groups (dyads versus triads) or the social status of nondisabled peers, and found that both size of play groups and high sociometric status of peers were associated with increased rates of social interactions. Although further research is needed to better isolate the specific and combined effects of different peer characteristics, these initial studies suggest their potential importance.

Peer-mediated interventions have been paired with procedures for promoting generalization of behavior change across settings, situations, or time. Research to date has demonstrated effectiveness of (a) fading teacher prompts to produce stable, maintained rates of peer initiations (Odom, Chandler, Ostrosky, McConnell, & Reaney, 1992), (b) using correspondence training with peers to cross-setting generalization of these initiations (Odom & Watts, 1991), and (c) using self-recording and self-evaluation to promote generalization of peer-mediated procedures across settings and play

partners with autism (Sainato, Goldstein, & Strain, 1992). In Odom *et al.'s* (1992) report, teachers implemented a prompt-intensive condition in which peers were taught, prompted, and praised for directing social initiations to disabled peers. Verbal prompts and visual feedback were faded, with no decrement in peer initiation rates of an extended intervention period and short maintenance phase. Both Sainato *et al.* (1992) and Odom and Watts (1991) asked typically developing peers to set specific goals and then reviewed performance for social initiations to target peers after each intervention session. Both investigations demonstrated that these conceptually similar procedures produced increases in peer initiations in otherwise untreated settings. Peer-mediated intervention procedures have also been built into social networks or small- to moderate-sized groups of nondisabled peers, in ways that change contingencies for social interaction between peers and young children with autism (Garrison-Harrell *et al.*, 1997; Mundschenk & Sasso, 1995).

Peer-mediated intervention procedures also serve as foundation for several interesting, and potentially important, variations. Pivotal response training can be conceptualized as an establishing operation, rather than manipulation of specific discriminative stimuli for social interaction (Schreibman, Stahmer, & Pierce, 1996). As such, pivotal response training may differ from other approaches to peer-mediated intervention in several ways: Pivotal response training may be a "looser" intervention (c.f., Stokes & Baer, 1977); it provides greater choice to peers in terms of interactions, and it focuses on a broader array of component or requisite behaviors for social interaction, such as joint attention (Pierce & Schreibman, 1995). Evaluations of pivotal response training for peers of young children with autism are indeed quite promising; although accounts published to date have only included children with autism who were more than 8 years old, these initial studies have demonstrated effects on language or communicative interaction, social interaction, and sociodramatic play (Koegel & Frea, 1993; Pierce & Schreibman, 1995; Pierce & Schreibman, 1997; Thorp *et al.*, 1995).

Peer-mediated interventions have been adapted into across-the-day interventions from their initial use in relatively brief (8 to 12-minute) periods. These across-the-day interventions follow the form of many peer-mediated interventions, teaching typically developing children to initiate and maintain interaction with classmates with disabilities. The critical difference, however, is that rather than massing teacher prompts for these peer-mediated interactions in a structured and time-delimited activity (c.f., Odom *et al.*, 1992), prompts are provided to peers throughout a school day (Goldstein, Kaczmarek, & Hepting, 1994; Kohler, Anthony, Steighner, & Hoyson, 2001). Kohler *et al.* (2001) present the first experimental evidence of across-the-day peer-mediated interventions for children with autism specifically, and this approach appears to have special promise (Strain & Hoyson, 2000).

Summary

Peer-mediated interventions have demonstrated powerful and robust treatment effects across a number of children, investigators, and intervention variations. Investigators have developed an array of procedures for increasing the generalization and maintenance of peer behaviors, and empirical investigations are beginning to describe potential effects of various peer and group characteristics. Research in this area is now examining adaptations and variations in selection of target behaviors, the relative "looseness" of intervention targets and procedures, and the density versus total time of intervention. These recent extensions of earlier research have direct implications for further understanding the mechanisms of peer-mediated intervention and for leveraging the effects of these mechanisms for maximum treatment gain.

Peer-mediated interventions are limited, however, by a pressing logical constraint. Unless these interventions can be shown to produce lasting effects on the social behavior of children with autism that generalize to untrained peers and situations, the ameliorative effects of these interventions require continuous access to "trained" peers, and thus likely ongoing training of new peer cohorts.

Comprehensive Interventions

Comprehensive social interaction interventions are those that include components of two or more of the intervention groups discussed previously. Empirical evaluations of comprehensive interventions typically have included social skills training for all participating children and delivery of teacher prompts and reinforcement in free play situations. A relatively small literature base, seven studies, is available for review of comprehensive interventions.

Rogers *et al.* (Rogers & DiLalla, 1991; Rogers, Herbison, Lewis, Pantone, & Reis, 1986) have reported two nonexperimental program evaluations of comprehensive intervention for social interaction and social-emotional development. These investigations have included children with autism, as well as those with pervasive developmental disorder and other behavioral

and developmental disorders, and have examined effects of a program model that provides play-based intervention with a structured classroom program, high positive affect, and naturalistic interventions for communication and social relationships. Both studies indicate intervention effects in developmental assessment and close-point measures of social interaction and social skill (including apparent developmental acceleration in acquisition of symbolic play skills), as well as positive affect and social initiations from children during interactions with their mothers.

Kohler, Strain, Maretsky, and DeCesare (1990) implemented both individual and group-oriented reinforcement contingencies during integrated play activities without extensive social skills training for two preschoolers with autism. Each reinforcement condition produced increases in interaction rates for target children, and neither condition singly produced changes in a "supportive peer prompt" response the authors sought.

Several investigations have shown the positive effects of treatment packages that include social skills training for children with autism and typically developing peers, along with reinforcement contingencies implemented during free play activities (Gonzalez-Lopez & Kamps, 1997; Kamps, *et al.,* 1992; Lefebvre & Strain, 1989). Subject pools in these studies have included preschool (Lefebvre & Strain, 1989) and early elementary-aged children (Gonzalez-Lopez & Kamps, 1997; Kamps *et al.,* 1992). The social skills training programs have varied somewhat, but each includes a teacher-led instructional group that provides didactic presentation and modeling. Reinforcement contingencies were either individual (Gonzalez-Lopez & Kamps, 1997; Kamps *et al.,* 1992) or group-oriented (Lefebvre & Strain, 1989). Across all three investigations, however, study results indicated that the package of social skills training and reinforcement directed at both young children with autism and their socially competent peers produced increases in social interaction (and its various components) in free play situations.

Although not solely directed to young children with autism, a recent study by Odom *et al.* (1999) suggests the relative contributions or effectiveness of different types of intervention (and the promises and potential pitfalls of large-sample group research in this area). In Odom *et al.'s* study, 22 classrooms serving 98 preschool children with a variety of disabilities were randomly assigned to five intervention conditions, including a control condition (where teachers continued their pre-existing social interaction interventions) or one of four standardized interventions: environmental arrangements, child-specific intervention, peer-mediated intervention, and a comprehensive intervention (including social skills training, prompts and praise for target children and peers during free play). Odom *et al.* used a variety of behavioral, social impact, and teacher rating measures and a repeated-measures experimental design. At the end of 55 to 60 days of treatment, three conditions—environmental arrangement, child-specific, and peer-mediated interventions—had produced significant changes in observed social interaction rates for young children with disabilities. By the following year, only the peer-mediated condition demonstrated an effect (compared to control condition) for frequency of interaction, although teacher ratings of social interaction quality suggested maintained effects for both peer-mediated and comprehensive intervention conditions. Odom *et al.* speculate that the comprehensive intervention, which was logistically most challenging, may have consequently not been implemented with sufficient fidelity to produce expected effects.

Summary

The relatively small base of empirical evaluations suggests that interventions directed to both young children with autism and their typically developing peers can produce pronounced effects on social interaction in intervention settings, with some evidence of generalization to other settings during the same time period. In the one large-sample comparison study conducted to date (which did not specifically target children with autism), results suggest that some caution be exercised in employing procedures that are logistically more demanding but not necessarily any more powerful (Odom *et al.,* 1999). Further research should explore the relation between intervention complexity, immediate intervention effects, and long-term intervention outcomes, as well as procedures for helping maximize the fidelity of complex and demanding interventions.

REVIEW SUMMARY

Committee Questions

The Committee on Educational Interventions for Children with Autism posed three questions regarding social interaction interventions. These questions can be answered, at least tentatively, by available research.

Are Social Irregularities in Children with Autism Amenable to Remediation?

Evidence accumulating in the empirical literature indicates quite clearly that, under at least some conditions, children with autism can benefit reliably from

social interaction skill interventions. Kennedy and Shukla (1995) assert that research in this area can be viewed as a series of empirical propositions. At this point, they argue that the accumulating body of research demonstrates that "(a) social interactions can be taught and learned, (b) social interaction in typical settings can be successfully accomplished, and (c) substantial positive outcomes accrue" (Kennedy and Shukla, 1995, p. 21). Independent reading of the literature reviewed for the current manuscript supports these conclusions.

For most children with autism, enough is known about promoting social interaction development that it should be a routine component (when needed) of any educational treatment program. Further, parents and teachers should expect these intervention services to produce discernible effects in the social interactions and social relationships of young children with autism, if appropriately designed and delivered.

Questions remain, however, regarding different treatment strategies and tactics, about the effects of different treatment components, and about the short- and long-term generalization effects of intervention. To date, empirical research on social interaction interventions for young children with autism has primarily represented what Hersen and Barlow (1976) call "technique building" research; questions have focused primarily on the identification or refinement of specific mechanisms for producing relatively specific intervention effects. Only limited examples can be found where investigators have explicitly compared the unique and combined effects of two or more contrasting intervention components (e.g., Odom & Strain, 1986). As yet, there are no published large-scale "technique testing" investigations that explore the relative effects of different social interaction interventions specifically for children with autism. Comparative investigations, either single-case or group experiments, will be essential to provide empirical guidance in the relative effects of different intervention conditions.

Further, intervention research available to date has focused primarily on short- or medium-term effects (generally far less than one year). Without long-term evaluations of intervention procedures, we are unable to determine whether conditions of intervention need to change over time, or if intervention for social interaction deficits and delays can be time-limited or must be continuous. Generalization assessment might reasonably extend beyond the form of child behaviors, to examine more directly changes in the natural contingencies of social interaction for young children who have received intervention (c.f., Baer & Wolf, 1970; McConnell, 1987). Such studies might consider not only whether intervention provides lasting effects in specific behaviors included in that intervention (e.g., social initiations, social responses, elements of social scripts), but also whether acquisition or use of these skills produces changes in the antecedent and consequence conditions. There are several promising leads for this type of intervention—including interventions that target play skills (Haring & Lovinger, 1989), pivotal response training (Pierce & Schreibman, 1997), social network interventions (Kamps, Potucek, Lopez, Kravits, & Kemmerer, 1997; Mundschenk & Sasso, 1995), and peer interaction studies (Kohler *et al.*, 1990)—that warrant further investigation.

An additional question, that of differential treatment effectiveness for young children with autism, may warrant attention in future studies. Although theoretical and empirical work suggests that children with autism are distinct and specific with regard to social interaction and social development (Sigman & Ruskin, 1999), it is still unknown whether children with autism require substantially or subtly different *interventions* (compared to children with other developmental disabilities or social interaction deficits) to address social interaction and social development concerns. Future research might profitably explore the extent to which any obtained "aptitude-treatment interactions" are a function of endogenous features of autism *per se* or a function of developmental (e.g., social attention as a conditioned reinforcer) or other characteristics.

What Social Skills Have Been Shown To Be Responsive to Intervention?

Investigators have shown intervention effects for social initiations, responses, and interaction bouts for children with autism (e.g., Krantz & McClannahan, 1998; Odom & Strain, 1986); social initiations and responses of typically developing peers (e.g., Goldstein *et al.*, 1992; Goldstein & Wickstrom, 1986; Lee & Odom, 1996; Odom & Strain, 1986); "pivotal responses" of children with autism and peers (e.g., Pierce & Schreibman, 1995); other collateral behaviors, including language and play (e.g., Haring & Lovinger, 1989; McGee *et al.*, 1992); and combinations of social and play/problem solving skills, including initiating, responding, keeping interactions going, greeting others, conversing on a variety of topics, giving and accepting compliments, taking turns, sharing, asking for help and helping others, and including others in activities (Kamps *et al.*, 1992). Additionally, some investigators have taught both young children with autism and peers a variety of self-monitoring or self-management skills

to promote generalization across time or settings (e.g., Sainato *et al.*, 1992; Shearer *et al.*, 1996).

What Are the Limitations of Current Procedures?

At least three limitations to widely adopted procedures can be identified from the literature reviewed here. First, there are few examples of empirical evaluations of intact, well-described and disseminable interventions or curricula (Odom *et al.*, 1999, is an exception, but did not specifically address children with autism). While it is likely that treatment manuals have been developed for many of the interventions described here, and while there are treatment manuals available from some of the authors contributing to this research base, studies are not available that specifically test or document the effectiveness of any one "package."

Second, at least some of the intervention procedures currently considered innovative in some segments of the professional community (including social stories and Circles of Friends) have little or no peer-reviewed empirical support. Not only are there no data documenting the effects of packages for these interventions, there are also few examples of empirical evaluations of the main components of these programs. This absence of evidence even for components of currently popular interventions establishes a significant challenge for individuals trying to argue that these innovative practices are empirically or practically valid.

Third, with a handful of exceptions (e.g., Coe *et al.*, 1991; Strain & Danko, 1995), most intervention studies have been conducted in classroom settings with teachers or other professionals as interventionists and classmates as interactive partners. Intervention targets and procedures must be further developed and evaluated for use in home and community settings. Research in this area may need to consider different social skill targets and likely will have to adapt specific intervention procedures to fit the ecological features of other environments. Greater attention to social interaction interventions in home and community settings will also provide a stronger base for expanding the treatment options available to children with autism, their parents, and the professionals who serve them.

OTHER ISSUES

Considerations with Respect to Inclusion of Young Children with Autism

As noted in this review, there is robust evidence that access to integrated play groups is a necessary condition for obtaining initial or generalized social interaction treatment effects (e.g., Myles *et al.*, 1993; Strain, 1983a). Further, socially competent children are an essential ingredient for peer-mediated interventions, one of the best-researched and effective classes of social interaction interventions for young children with autism (e.g., Garrison-Harrell *et al.*, 1997; Goldstein & Wickstrom, 1986; Odom & Strain, 1986). Indeed, in some published reports, the social competence of peers participating in interventions has proven to be a major consideration (e.g., Odom *et al.*, 1985; Sasso *et al.*, 1998). These data suggest strongly that inclusion is a necessary, but not likely sufficient, condition for social interaction interventions for young children with autism.

Recommendations for Educational Practice

Available research, including a growing body of increasingly sophisticated experimental research, suggests a set of educational practices that should be considered in intervention programs for young children with autism.

1. *Assess social interaction in naturalistic settings, including classrooms and homes, with children and adults as interactive partners.* Although children with autism, as a group, are at risk for social interaction skill delays and deficits, existing research suggests significant variation in the performance levels of individual children (Kennedy & Shukla, 1995; Sigman & Ruskin, 1999). As a result, educational and other interventionists must explicitly assess social interaction rates, under natural conditions and in multiple settings, to evaluate the needed scope (if any) for social interaction intervention.
2. *Arrange the environment to prompt and support social interaction.* Research on environmental arrangements and collateral skills interventions support the creation of "therapeutic" environments for promoting social interaction for young children with autism. Environmental features should include (a) overall schedule and activity structure that is predictable, preferred, and appropriate for social interaction (c.f., DeKlyen & Odom, 1989; Koegel *et al.*, 1987); (b) access to typically developing children and social interaction partners, particularly where those peers have been trained and receive direct intervention to initiate social interaction (c.f., Mundschenk & Sasso, 1995; Myles *et al.*, 1993; Odom *et al.*, 1999; Odom & Strain, 1986; Strain, 1983a); and

(c) extending into other settings, including children's home (e.g., Strain & Danko, 1995; Krantz *et al.,* 1993).

3. *Teach specific social skills to children with autism and typically developing peers and provide* in situ *intervention to prompt social interaction.* Perhaps the largest portion of experimental research highlights the relative success of child-specific and peer-mediated interventions. Many of these investigations have proceeded after teaching social skills to one or more children in quasi-naturalistic settings (e.g., Kamps *et al.,* 1992; Kohler, *et al.,* 1995; Mundschenk & Sasso, 1995; Odom *et al.,* 1999; Odom & Strain, 1986); virtually all have included teacher-, parent-, or caregiver-based prompts to participate in social interaction. While there are still questions regarding unique effects of interventions focused on peers versus children with autism (Odom *et al.,* 1999; Odom & Strain, 1986), contemporary educational practice should include some level of direct intervention for producing social interactions between children with autism and others.
4. *Fade direct intervention, transferring control for prompting social interactions to transportable or naturally occurring contingencies.* Peer initiations to children with autism can be maintained over time when teacher prompts for these initiations are faded systematically (Odom *et al.,* 1992) or when control over these initiations is moved from teacher verbal antecedents to self-monitoring or other "transportable" stimuli (Koegel *et al.,* 1992; Odom & Watts, 1991; Sainato *et al.,* 1992; Shearer *et al.,* 1996; Strain *et al.,* 1994). These procedures offer the advantage of extending the settings, and time intervention can be provided, and are likely to be related to long-term outcomes.
5. *Extend treatment throughout the day and to other activities.* Recent developments in this line of research—adaptation of social interaction interventions to activities with developmental goals above and beyond social interaction (e.g., Kamps *et al.,* 1994; Kohler *et al.,* 1997) and to activities occurring throughout the day (Goldstein *et al.,* 1994)—suggest that as research continues, educational practices may profitably extend social interaction interventions to settings other than the typical (and typically brief) procedures provided during free play. Similarly, research reviewed here suggests that interventions in other domains, particularly language (e.g., Koegel *et al.,* 1998; Krantz & McClannahan, 1998), as well as more comprehensive interventions (e.g., Rogers, 1991) may hold promise for continued elaboration of social interaction interventions for young children with autism.
6. *Monitor effects of interventions, and social interaction development, over extended periods of time.* Given that a range of intervention options is available, practitioners must be able to answer questions regarding the need for, and effect of, these interventions. While research has yet to offer solid tools for monitoring the effects of social interaction interventions in applied settings, or tools for monitoring effects of intervention on development over extended periods of time, such assessment is essential for educational interventions in this area. Concerned practitioners and advocates will have to monitor carefully the empirical developments in this area and adopt or adapt new practices as they become available.

Needs for Future Research to Improve Educational Practice

While a variety of future research directions might be discerned to help improve educational practice for young children with autism, a close reading of the literature reviewed here suggests five perhaps conservative speculations. First, to assist classroom teachers and the families they serve, the development, evaluation, and dissemination of standardized intervention programs seems essential. Although empirical support for various intervention components appears strong, the literature still requires practitioners to assume a significant burden in developing a logistically feasible yet sufficiently powerful package for use in their classroom. Researchers in this field may want to develop and evaluate one or more intervention packages that represent compilations of techniques identified in existing research.

Second, following initial evaluations of intervention packages, more carefully planned comparison evaluations may be warranted to identify relatively more effective intervention programs and to further inform the growing knowledge base regarding intervention effects. Such research will inform practice and conceptual understanding of social development.

Third, documentation of the long-term consequences of social interaction intervention for young children with autism, for both target children and their

peers, is needed. As suggested earlier, these evaluations might reasonably include measures of generalization and maintenance of specific components or skills of social interaction included in intervention (e.g., specific social initiations, as well as effects on contingencies of interaction between treated children and their interactive partners (e.g., length of interaction, positive affect, proximity). Additionally, researchers might develop interventions that are developmentally generative, where skills and characteristics acquired in treatment lead to ongoing development of increasingly sophisticated social behaviors or where intervention effects make it possible to use less intensive ongoing or future intervention.

Fourth, intervention needs and effects should be further described for younger children with autism. Studies reviewed here typically included children in the later preschool or elementary years (48 months or older), with occasional subjects as young as 36 months (primarily from the Pittsburgh group). Although this may be a result of typical age of diagnosis or typical service arrangements (i.e., preschool and elementary classrooms), the developmental characteristics of younger children warrant special attention to design and testing of intervention procedures. As diagnostic procedures make earlier identification possible, intervention studies can and should be extended to younger samples of children with autism. Research with younger children will make it possible to assess more directly theoretically and practically important questions regarding the mechanisms of social interaction among children with autism.

Finally, the review completed here yielded little information regarding the assessment of child status or progress in the development of social interaction. While individual studies used measures of adequate reliability, and some patterns of consistency have emerged across studies in the assessment of social interaction, to date there are few tools with known psychometric characteristics that practitioners can use to identify children in need of social interaction interventions, nor to assess progress after intervention begins.

Several important social issues also need additional attention. It should be noted that, while the empirical evidence suggests that inclusion is an important necessary condition for social interaction interventions for young children with autism, there are other reasons to advocate for (or against) inclusive programming. Perhaps similarly, there may be reason to explore the ethical dimensions of social interaction interventions for children with autism. Specifically, this ethical analysis might explore the conditions in which social interaction intervention is warranted and those conditions in which is not. As communities grapple with issues of accommodation and diversity, and as a wider range of social behavior becomes functional and acceptable through changing cultural standards and explicit efforts of accommodation, researchers and practitioners will need some guidance in determining when (or in what way) social interaction intervention and behavior change is appropriate, and when current status and nonintervention in this domain is preferred.

Need to Better Integrate Knowledge Across Disciplines and Subdisciplines

At this point, the empirical literature in social interactions and social relationships appears to be developing separately in "discipline" or "subdiscipline" areas (e.g., developmental psychology, psychiatry and allied medicine, special education, applied behavior analysis), sometimes with very little integration and acknowledgment of the work—at times highly relevant—being conducted in "other" areas. This is apparent in the citations of many papers in this area; many cited works are from the same or highly related journals or books as the citing source, with few references to works (even important works) in other areas. Regardless of differences in conceptualization or methodology, integration of related facts seems essential to achieving a better degree of understanding the full depth, breadth, and complexity of factors that relate to social interactions and social relationships of young children with autism. It seems essential that future research *and* theoretical or conceptual works better integrate related and relevant information that currently exists in separate silos of academic and scholarly publication and thinking.

CONCLUSION

Empirical research on social interaction interventions for young children with autism has advanced substantially in the past 20 years. This research has provided real and important guidance for the world of practice and has added substantially to our basic and applied understanding of conditions affecting the social development of children with autism. Several lines already established in this research should continue, and will likely offer more knowledge and practical guidance in the years ahead. Some other lines of research should be developed, to further expand and deepen our understanding, and capacity to contribute to, this important developmental domain.

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