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Problem Behavior Interventions for Young Children with Autism: A Research Synthesis

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This paper provides a summary of research on behavioral interventions for children with autism 8 years of age or younger published between 1996 and 2000. The analysis is divided into four sections: (1) emerging themes in the technology of behavior support, (2) a review of existing research syntheses focusing on behavioral interventions, (3) a new literature review of current pertinent research, and (4) an evaluative discussion of the synthesis results and the field's future needs to develop effective behavioral interventions for young children with autism. The authors offer recommendations for strengthening the existing research base and advancing behavioral technology to meet the needs of the defined target population.

KEY WORDS: Autism; behavior support.

INTRODUCTION

This paper provides a synthesis of published research on behavioral interventions for children 8 years of age or younger with autism. The paper was commissioned by the National Academy of Sciences to identify clinical and conceptual themes from published research that should guide both programs of interventions and future research. Attention was given to meta-analyses of behavioral research published since 1988 that include individuals with autism, and a specific search of research published between 1996 and 2000 that focus on behavioral interventions for children 8 years of age or younger.

Problem behaviors are a common concern for young children with developmental disabilities, including autism. Epidemiological studies suggest that 13 to 30% of young children engage in problem behaviors that warrant intervention (Emerson, 1995; McDougal & Hiralall, 1998), and that young children with limited communication skills and/or poor social development are particularly at risk for the development of problem behaviors (Borthwick-Duffy, 1996; Koegel, Koegel, & Surratt, 1992). Problem behaviors such as physical aggression, self-injury, property destruction, pica, stereotypy, defiance, tantrums, and disruption are major barriers to effective education and social development (Horner, Diemer, & Brazeau, 1992; Reichle, 1990). Young children who engage in problem behaviors are at increased risk for exclusion and isolation from educational settings, social relationships, typical home environments, and community activities (Sprague & Rian, 1993). The message from this literature is that problem behaviors are pervasive and young children with autism are particularly at risk for developing problem behaviors.

A related message is that once problem behaviors become an established part of a child's behavioral repertoire, the problem behaviors are not likely to decrease in the absence of intervention. Problem behaviors are maintained by their functional effect. Unless there are changes in the value of, availability of, or access to the consequences maintaining problem behaviors, there should not be an expectation that problem

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behaviors will decrease (Oliver, Murphy, & Corbett, 1987; Rojahn, 1994). Purposefully not intervening or "waiting out" problem behaviors in the hope that children will "outgrow" them is not effective.

Taken together, available research indicates that (a) young children with autism are at significant risk to develop problem behaviors, (b) without intervention, problem behaviors are more likely to worsen than improve, and (c) the impact of problem behaviors on educational, social, and community opportunities is dramatic and detrimental. Early intervention for young children with autism should include procedures for functional behavioral assessment and intervention for problem behaviors (McGee, Morrier, & Daly, 1999; Strain, Wolery, & Izeman, 1998).

Relevant Evaluation Questions

To examine the effectiveness, efficiency, and relevance of behavioral interventions for children 8 years of age or younger who have a formal diagnosis of autism and engage in problem behaviors, we addressed the following questions:

1. What problem behaviors are most commonly identified for intervention?
2. What interventions for problem behaviors are most frequently represented in the literature?
3. To what extent are behavioral interventions, particularly positive behavioral interventions, effective at reducing problem behaviors?
4. What events mediate or improve the likelihood of intervention effectiveness?
5. Are there behavioral interventions that are uniquely identified for, and effective with, young children with autism?
6. What directions are needed for future research?

Challenges in Addressing these Questions

Three important challenges affect adequate responses to these queries. The first is that the field of behavior support is itself in the midst of important developments. Our understanding of the mechanisms affecting behavior has improved over the past 12 years, and the "best practice" standards for behavioral interventions have changed. An important consideration for interpreting existing research is an understanding of how the broader field of behavior support is evolving.

The second challenge lies with the focus on young children with autism. Most existing research syntheses of behavioral interventions have examined behavior support across all people with disabilities, including autism. Some data exist targeting individuals with autism, but no literature currently is designed to filter out effects only for children under 8 years of age with autism. A response to (a) the evolving nature of behavioral technology, and (b) the absence of a targeted literature for young children with autism argues for a new literature review focused only on current research that addresses behavioral interventions for young children with autism.

This leads to the third challenge. At present, the number of studies examining behavior support for young children with autism is small. The size of this research base allows comparison with the larger syntheses, but is insufficient to build a comprehensive and independent picture for this narrowly targeted clinical group.

In response to these challenges we have organized this paper around four major sections. The first section reviews emerging themes in the technology of behavior support and provides a foundation for interpreting empirical findings. The second section provides a review of the existing research syntheses that examine behavioral interventions. Only papers that included research with individuals with autism were included. The major findings from these reviews are useful, but are not a direct examination of early intervention efforts. Therefore the third section provides a new literature review of current, published research on behavioral interventions with young children with autism. While limited by the small number of available studies, the findings from this literature may be compared with the findings from the more comprehensive research syntheses and meta-analyses. The final section of the paper integrates and summarizes the available information in an effort to provide direct responses to the evaluation questions identified above.

Major Developments in Behavior Support

Behavioral interventions for young children were first reported in the 1960s (Baer, Peterson, & Sherman, 1967; Baer & Sherman, 1964; Bijou & Baer, 1961, 1968; Bostow & Baily, 1969) and gained increasing recognition with publication of texts by Browning and Stover (1971) and Thompson and Grabowski (1972), and clinical reports in the *Journal of Applied Behavior Analysis* (1968 to present). The central contributions of this approach to reducing problem behaviors have been documentation of behavioral mechanisms that describe the relationship between environmental events and occurrence of specific behaviors and the development of

specific strategies for measuring behavior change across time. In addition, behavioral theory has given birth to an impressive clinical technology. At least four current developments are important for understanding the literature on behavioral interventions for young children with autism: prevention, functional assessment, comprehensive intervention, and systems change.

Prevention

Behavioral interventions now include and emphasize strategies for preventing problem behaviors (Carr, Horner, *et al.*, 1999; Koegel, Koegel, & Dunlap, 1996; Reeve & Carr, 2000). Initial behavioral procedures were reactive in structure. They were based on altering consequences: the events that contingently follow occurrences of problem behavior. An important development is the increased attention to intervention procedures that occur between bouts of problem behavior, not just procedures that focus on what to do during (or immediately after) an occurrence of problem behavior (Carr, Langdon, & Yarbrough, 1999; Carr, Levin, McConnachie, Carlson, Kemp, & Smith, 1994). Strategies for changing the physical characteristics of a setting, altering schedules, modifying curricula, and redesigning social groupings have all been demonstrated to alter the future likelihood of problem behaviors (Carr, Carlson, Langdon, Magito-McLaughlin, & Yarbrough, 1998; Dunlap, Kern-Dunlap, Clarke, & Robbins, 1991). The net result has been a shift from viewing behavior support as a process by which individuals were changed to fit environments, to one in which environments are changed to match the behavioral needs of people in the environments. It is through environmental engineering that problem behavior can be prevented and patterns of problem behavior altered.

Functional Assessment

Functional assessment is the process of identifying the variables that reliably predict and maintain problem behaviors (Horner & Carr, 1997). The logic for functional assessment comes from a compelling body of research documenting that operant behavior is affected by (a) the consequences that the behavior has on the environment, (b) the antecedent events that serve as discriminative stimuli signaling a link between occurrence of a behavior and a consequence event, and (c) setting events (establishing operations) that alter the momentary value of available consequences (Bijou & Baer, 1961; Bijou, Peterson, & Ault, 1968). Among the more consistent findings of recent reviews has been documentation that interventions built from functional assessment information are more likely to produce reduction in problem behaviors (Carr, Horner *et al.*, 1999; Didden, Duker, & Korzilius, 1997).

The process of conducting a functional assessment typically involves (a) identifying the problem behavior (or class of behaviors), (b) building hypotheses about the events that reliably occasion and maintain problem behavior, (c) testing/confirming the hypothesis, and (d) designing an intervention based on the confirmed information (Carr *et al.*, 1994; Dunlap *et al.*, 1993; O'Neill *et al.*, 1997). The initial identification of problem behavior and hypothesis development often occur through interviews with the people who have the most experience with the problem behavior, and/or through direct observation. Testing or confirming the hypothesis may occur through additional direct observation or, in some cases, through systematic functional analysis, i.e., direct observation paired with systematic manipulation of environmental events to test the validity of the hypothesis (Carr, *et al.*, 1994; Dunlap *et al.*, 1993; Iwata, Dorsey, Slifer, Bauman, & Richman, 1982; O'Neill *et al.*, 1997; Repp & Horner, 1999).

A central effect of the recent research on functional assessment has been to focus attention on the importance of assessing the events that reliably predict and maintain problem behavior. Traditional efforts that emphasize diagnostic labels or categories of problem behavior appear less relevant for developing effective interventions than the information gleaned from a functional assessment (Koegel *et al.*, 1996).

Interventions based on functional assessment information have proven more likely to be associated with reduction in problem behavior (Carr, Horner *et al.*, 1999; Ellingson, Miltenberger, Stricker, Galensky, & Garlinghouse, 2000). In addition, functional assessment is recommended not just at the time an intervention is initiated, but as an ongoing element of effective interventions (O'Neill *et al.*, 1997). Repeated functional assessments may also be needed in cases in which the events that are associated with the initial onset of a specific problem behavior are different from the events (e.g., consequences) that control the behavior at a later time (Carr & McDowell, 1980; Guess & Carr, 1991).

Comprehensive Intervention

Comprehensive interventions (a) address all problem behaviors performed by a child, (b) are driven by the functional assessment outcomes, (c) are applied across all (or an extended part) of the child's day, (d) typically incorporate multiple intervention procedures, and (e) fit the context where they are implemented. Comprehen-

sive interventions stand in contrast to research-based interventions that often focus on a narrow response pattern in a limited context over short instructional sessions. Comprehensive interventions are designed to meet the more expansive expectations and needs of teachers, families, and children with autism (Carr, Levin *et al.,* 1999; Turnbull & Ruef, 1996).

Comprehensive behavioral interventions have been reported infrequently in the literature (Berkman & Meyer, 1988; Carr, Horner *et al.,* 1999; Carr, Levin *et al.,* 1999; Horner *et al.,* 1996; Lucyshyn, Olson, & Horner, 1995; Reeve & Carr, 2000). The success of existing research that documents focused effects, however, has blended with the expanded expectations of families and providers to produce an intervention approach that more closely meets the needs of children (Turnbull & Reuf, 1997). This approach to behavioral intervention fits well with early intervention approaches for young children with autism (McGee *et al.,* 1999).

Systems Change

The fourth, and least developed, behavior support theme is an emphasis on systems change. Systems change is reflected in three distinct areas. The first is a change in the outcomes expected from behavioral interventions. It no longer is sufficient to simply reduce rates of problem behavior in narrow contexts across narrow time periods. Consistent with the emphasis on comprehensive interventions, there now is an expectation that behavioral support will both provide generalized problem behavior reduction and result in added elements to a child's life that improve the richness and/or effectiveness of living, learning, and community activity. It is now expected that effective behavioral intervention will not only reduce the self-injury and tantrums of a young child, but that this reduction will be accompanied by improved social interaction with peers, improved language development at school, and improved opportunities for the family to participate in community and social activities. The expected outcomes of behavioral interventions have expanded (Horner, 1999).

The second systems-level change lies in recognition that if "best practice" behavioral interventions are to be available in preschools, home settings, and schools, then the systems that control funding, staff development, staff time allocation, and organizational evaluation must support these practices. Systems change means including interventions at the level of organizational systems needed to support effective practices. The application of school-wide behavioral interventions is an example of systems change efforts designed to alter the organizational structure of an environment in an effort to produce behavior change of many people in the environment (Lewis & Sugai, 1999; Sugai *et al.,* 2000).

A third level of systems change reflects the emphasis on the need for adults within a setting to change their own behavior in an effort to produce durable and important change in the behavior of children. The efforts of teachers, families, and staff to modify the curriculum of a program and to ensure adequate opportunities for social engagement to monitor systematically the impact of treatment are all examples of systems-level change as part of behavioral interventions.

We anticipate that the area of systems change will continue to be defined and refined in coming years, but it is clear that any attempt to apply current best practice in behavior support must acknowledge that the unit of intervention is expanding. There continues to be strong emphasis on the traditional antecedent and consequence events that control problem behavior. But if the interventions based on these variables are to produce durable, generalized effects with lifestyle relevance, they must be blended with attention to the systems variables that affect basic opportunities to engage in relevant activities, staff support, and modifications in the event of problems. It is the need to meet this expanded level of expectation that is forcing attention on systems change as a central part of effective behavioral interventions.

EXISTING RESEARCH SUMMARIES AND META-ANALYSES

Since 1988 at least nine important research summaries have been published that examined reduction of problem behaviors by individuals with disabilities. Five of these summaries included some studies of individuals with autism and individuals under 8 years of age. Four of these five studies also provided analysis of intervention effectiveness. Research summaries were identified through a hand search of the journals listed in Table I from January, 1988 to January, 2000, and through references provided in each identified summary (cf. Carr, Horner *et al.,* 1999). A research summary was included if it met the following criteria: (a) examined research over at least a 5-year period, (b) included research based on subjects with autism, (c) included research based on subjects under 8 years of age, and (d) examined reduction in problem behavior. The five review papers that met those criteria are listed in Appendix A.

Table I. Journals Examined

American Journal on Mental Retardation (formerly American Journal of Mental Deficiency)
Analysis and Intervention in Developmental Disabilities
Applied Research in Mental Retardation
Augmentative and Alternative Communication
Australia and New Zealand Journal of Developmental Disabilities
Behavior Modification
Behavior Therapy
Behavioral Disorders
Behavioral Interventions
Behavioral Residential Treatment
Behaviour Research and Therapy
Behavioural Psychotherapy
Child and Family Behavior Therapy
Education and Training in Mental Retardation (formerly Education & Training of the Mentally Retarded)
Education and Treatment of Children
Exceptional Parent
Journal of Applied Behavior Analysis
Journal of the Association for Persons with Severe Handicaps
Journal of Autism and Developmental Disorders
Journal of Behavioral Education
Journal of Behavior Therapy and Experimental Psychiatry
Journal of Consulting and Clinical Psychology
Journal of Developmental and Physical Disabilities
Journal of Intellectual Disability Research
Journal of the Multihandicapped Person
Journal of Visual Impairment and Blindness
Mental Handicap Research
Mental Retardation
Research in Developmental Disabilities
School Psychology Review
Special Services in the Schools
Teaching Exceptional Children
Topics in Early Childhood Special Education

From Carr, E. G., Horner, R. H., Turnbull, A. P., Marquis, J. G., Magito-McLaughlin, D., McAtee, M. L., Smith, C. E., Anderson-Ryan, K. A., Ruef, M. B., & Doolabh, A. (1999). Positive behavior support for people with developmental disabilities: A research synthesis. Washington, DC: *American Association on Mental Retardation Monograph Series.*

Each of the five selected research syntheses was evaluated on the following variables: (a) the years covered in the review; (b) the diagnostic categories of participants; (c) the age range of participants; (d) the total number of studies/comparisons included in the synthesis; (e) the total number of subjects, the proportion with autism, and the proportion who were under 8 years old (if provided); (f) the proportion of studies/comparisons using a functional assessment; (g) interventions assessed; and (h) the major findings. For the purposes of this analysis a "comparison" was defined as a data set that allowed comparison of problem behavior level before implementation of an intervention with the level of problem behavior after implementation of an intervention.

Demographic Variables

The method section of each summary paper listed (a) the journals/publications and years reviewed and (b) the number of studies, participants, and participant age range. The method sections also listed whether subjects with autism were included in the analysis, and whether individuals younger than 97 months were included in at least some of the studies reviewed.

Units of Comparison

Each summary paper established a unit of comparison that guided the analysis. The unit of comparison was used to summarize results across studies. This unit may have been a research paper (e.g., the percentage of research papers that demonstrated an effect), a research study (where there were multiple studies within a paper), or a comparison of a pre-intervention condition (baseline) with a post-intervention condition (treatment). The use of individual comparisons as the unit of analysis was possible only when the data for individual participants was included.

Assessment

Each summary paper was examined to identify the proportion of comparisons in which a pre-intervention functional assessment was conducted. While different papers employed slightly different definitions of an assessment, the general pattern was to include any study that employed a formal interview, direct observation of antecedent and/or consequence events, and/or the use of formal functional analysis (Iwata *et al.*, 1982).

Interventions

Each summary paper also defined a set of intervention procedures that were assessed. To compare effects across syntheses, we have integrated these intervention taxonomies into the following eight categories:

1. *Stimulus-Based Procedures:* Procedures that involved altering antecedent events prior to a problem behavior were labeled as "stimulus-based." Modifications in curriculum, scheduling, social organization, instructional design, or physical setting were examples of stimulus-based procedures.
2. *Instruction-Based Procedures:* Any procedure that included direct instruction on appropriate behaviors was included in the "instruction-based procedure" category. This included using functional communication training, instruction

on self-management skills, or instruction on picture communication schedules.

3. *Extinction-Based Procedures:* Intervention procedures designed to withhold or minimize delivery of presumed reinforcers following problem behavior were included as "extinction-based" procedures.
4. *Reinforcement-Based Procedures:* Intervention procedures designed to increase desired behaviors through contingent delivery of events were identified as "reinforcement-based" procedures.
5. *Punishment-Based Procedures:* Intervention procedures designed to reduce problem behavior via delivery of contingent events were labeled "punishment-based interventions." There was insufficient variability in intervention procedures to require separation into positive versus negative punishment-based procedures (e.g., intervention procedures designed to reduce problem behavior via contingent delivery of aversive stimuli versus contingent removal of positive stimuli).
6. *Systems Change:* Intervention procedures that were designed to alter structural features of an environment were identified as "systems change" procedures. These included change in staffing pattern, change in outcome measures used to assess success, and change in administrative oversight of the intervention implementation.
7. *Pharmacology-Based Procedures:* Interventions that included the administration of medications to reduce problem behaviors were identified as "pharmacology-based" procedures.
8. *Unclear/Other:* If the description of an intervention did not fit one of the above categories, or was not described in a manner that allowed clear identification, then it was included in the "unclear/other" category.

Effects

Summary papers typically reported the effects of specific interventions as (a) reduction in problem behavior, (b) durability of behavior reduction across time, and (c) observed changes in generalized, nontrained settings/conditions. Measurement of the level of behavior change was not consistent across reports. In some cases, the percent of nonoverlapping data (PND) was used as the metric to assess behavior reduction. This metric reports the percentage of data points in an intervention phase that are below the range of data for problem behavior reported for a baseline phase. There are both important advantages and serious disadvantages to the use of this metric (Busk & Serlin, 1992; Marquis *et al.,* 2000). Other papers used mean level change from a baseline to an intervention, or mean level change of a portion of a phase (e.g., last three data points in a phase), as metrics of change. In some reports formal effect-size measures were computed (Marquis *et al.,* 2000), and in others more descriptive analyses guided the paper.

In four of the five review papers, some level of percentage of change in problem behavior linked to application of intervention procedures was reported.

Major Findings

Each review paper concluded with a summary of major findings (cf. Appendix A). While the research summaries varied substantially in the manner in which they selected papers for analysis, defined interventions, and clustered intervention options, some common themes were identified in a summary of the major findings.

1. *Stereotypy, self-injury, and aggression are the problem behaviors most often studied.* The behaviors that are most likely to be identified for intervention are stereotypy, aggression toward others, self-injury, property destruction, and tantrums/disruption. Didden *et al.* (1997) report the largest database and organized 34 types of problem behaviors into three classes (a) external destructive (e.g., aggression, property destruction), (b) internal maladaptive (e.g., self-injury, stereotypy, pica), and (c) socially disruptive (disruption, inappropriate verbalizations, noncompliance). Across the 1451 research comparisons in the Didden *et al.* (1997) summary, 11% addressed externally destructive behaviors, 68% addressed internally destructive behaviors, and 19% addressed socially disruptive behaviors.
2. *A wide range of interventions has been studied.* Punishment and reinforcement were the intervention classes most studied before 1990. The trend during the past 10 years has been toward increasing analysis of stimulus-based and instruction-based interventions. Figure 1 summarizes the proportion of comparisons that assessed stimulus-based and instruction-based interventions per research review. The reviews are ordered by the date of the majority of studies included in the review. The pattern indicates an increasing likelihood that studies included stimulus-based and

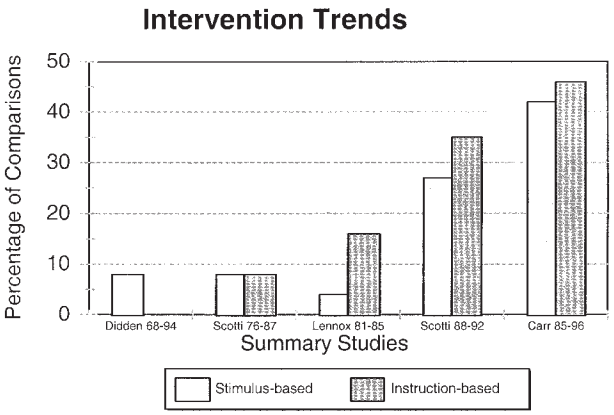

Fig. 1. The percentage of comparisons with stimulus-based procedures in three 4-year clusters. (From Carr, Horner *et al.,* 1999.)

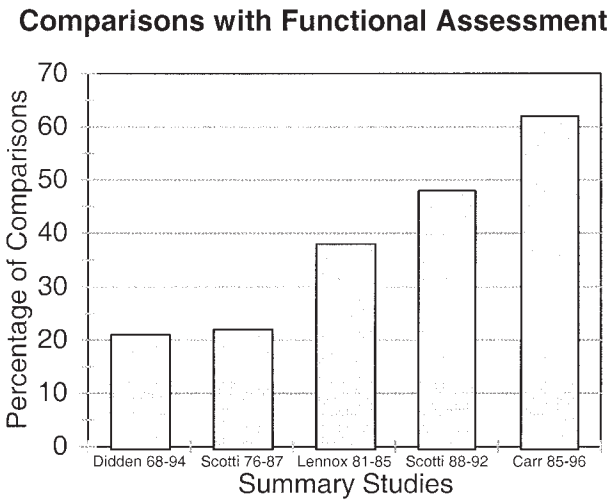

Fig. 2. The proportion of comparisons including a pre-intervention functional assessment.

instruction-based interventions. Pharmacological interventions are the procedures least frequently included in the reviews.

3. *Behavioral interventions are effective.* The available intervention technology is reasonably effective at reducing problem behaviors performed by people with developmental disabilities, including autism. Reductions of 80% or greater were reported in half to two thirds of the comparisons. Reductions of 90% or greater were reported for all classes of problem behavior, and with individuals with all diagnostic labels. Behavioral interventions are not universally effective, yet there is a substantial database indicating reduction in problem behaviors.
4. *The diagnosis of autism is not related to the type of intervention employed or likelihood of intervention success.* Across the five research summaries there was no indication that autism was related to (a) the type of problem behavior reported, (b) the type of intervention that was effective, or (c) the likelihood of intervention success (e.g., reduction of 90% or greater). Type of disability has not been found to predict level of intervention success (Carr, Horner *et al.,* 1999; Didden *et al.,* 1997). It should be noted, however, that although each research summary included some subjects under 8 years old and some subjects with autism, it was not possible to identify those subjects who were both 8 years or younger and diagnosed with autism.
5. *Functional assessment increases the likelihood of intervention success.* The use of functional assessment procedures is the strongest covariate with intervention success. The more precise the assessment, the more likely the intervention will result in intervention success (Didden *et al.,* 1997; Scotti, Evans, Meyer, & Walker, 1991). There is concern, however, with the number of reports in which functional assessments were not conducted, or conducted but not used for design of the intervention (Scotti, Ujcich, Weigle, Holland, & Kirk, 1996).

   There has been an increase across time in the likelihood that research reports will describe at least some form of functional assessment (interview, direct observation, or functional analysis). The results reported in Fig. 2 index this trend.
6. *Typical agents are associated with improved effects.* The magnitude of behavior reduction is greater when the intervention is implemented by typical agents (families, teachers) than when atypical agents and settings (e.g., hospitals, specialists) are involved. This may, however, be due to more difficult behavior problems being referred to atypical contexts.
7. *Systems change procedures increase the likelihood that interventions will be effective.* When there is structural change in the organization of the environment, or the behavior of significant others, the likelihood of the intervention succeeding increases. However, the limited number of reports assessing systems change variables must force this to be a preliminary finding.
8. *Insufficient data are available to document factors affecting generalization and maintenance.*

TARGETED REVIEW OF RESEARCH PUBLISHED BETWEEN 1996 AND 2000

A brief research synthesis was needed to address two serious limitations of the existing research summaries. The first limitation is that although existing summaries each included some subjects 8 years of age or younger, and some with autism, it was impossible in any of the existing summaries to isolate intervention patterns designed only for young children with autism. Therefore one goal was to isolate published studies that allow within child assessment of behavior reduction for this subpopulation. The second limitation addressed by the brief synthesis was to include the most current published studies. Recent reviews (Carr, Horner *et al.,* 1999; Didden *et al.,* 1997; Scotti *et al.,* 1996) noted substantial changes occurring in the field of behavioral intervention. Given the growth in use of functional assessment procedures, and the increasing emphasis on positive behavioral support, inclusion of information from the most current published research is warranted, even if the total size of the available literature is small.

Selection of Studies for Targeted Review

A summary of peer-reviewed research published from 1996 to 2000 was conducted by first selecting research reports identifying studies from three separate literature searches: (a) ERIC search with descriptors "autism *and* behavior problems *and* 1996–2000, *and* young children *or* children;" (b) EXCEPTIONAL CHILD search with descriptors "autism, *and* children *or* young children *or* preschool children *or* kindergarten children *and* behavior problems *and* 1996–2000;" and (c) PSYCH INFO search with descriptors "autism *or* autistic children *and* behavior problems *and* 1996–2000." In addition, a hand search of the most current issues of the journals listed in Table I was conducted to identify any study published between 1996 and 2000 that included children with autism and focused on reduction of problem behavior. This process resulted in identification of 41 published research articles.

Identified articles were then reviewed by the first, fourth, and fifth authors, and articles were retained for further analysis if they (a) included subjects with autism who were less than 97 months old, (b) used problem behavior as a dependent variable, (c) employed an experimental design that allowed identification of a causal relationship between reduction in problem behavior and application of an intervention, (d) provided data for individual subjects, and (e) included at least three data points for pre-intervention and three data points for post-intervention phases. Nine articles were identified that met these criteria. (These articles are identified in the references with an asterisk).

Agreement on Article Selection

Inter-rater agreement on article selection was assessed by taking the nine articles identified by the first author for inclusion in the analysis and randomly selecting nine articles identified by the first author for noninclusion. These 18 articles were randomly ordered and independently reassigned by the fourth author. There was 100% agreement on article assignment for inclusion.

Article Evaluation

Each article included in the review was assessed on four sets of variables, (a) demographics, (b) assessment practices, (c) intervention strategies, and (d) outcome effects.

1. *Demographics.* Demographic variables scored for each article included (a) the year of publication, (b) the number of participants involved in the study, (c) the gender of each participant, (d) the age of each participant, (e) whether each participant had a diagnosis of autism, (f) additional diagnoses if a participant had other diagnoses in addition to autism, (g) level of mental retardation (if any), (h) type of problem behavior (cf. Table II for list of problem behaviors considered), and (i) the number of "comparisons" available within the study. A "comparison" was defined as an independent opportunity to compare the level of problem behavior during a baseline for a participant with the level of problem behavior during an intervention phase. An individual participant within an ABAB reversal design would have the level of the initial baseline compared to the level in the last intervention phase as one comparison. An individual participant in a multiple baseline across four settings would have four comparisons (e.g., four baselines and four intervention phases). Given this procedure, the number of comparisons may exceed the number of participants.
2. *Assessment Practices.* Assessment practices are the procedures used to identify the events that reliably set the occasion for and/or maintain problem behaviors. Four options were available: (a) no functional assessment conducted; (b) an indirect functional assessment was con-

Table II. Problem Behaviors

1. Aerophagy/swallowing
2. Aggression
3. Bruxism/teethgrinding
4. Coprophagy/feces eating
5. Dawdling
6. Destruction
7. Depression
8. Disruption/tantrum
9. Drooling
10. Elective mutism
11. Elopement (run)
12. Feces smearing
13. Fears
14. Food refusal
15. Food theft
16. Genital stimulation
17. Hallucinating
18. Hyperactive behavior
19. Hyperventilation
20. Inappropriate vocalizations
21. Insomnia
22. Noncompliance
23. Obesity
24. Obsessive compulsive disorder
25. Pica
26. Public disrobing
27. Rapid eating
28. Rectal digging
29. Rumination
30. Seizure behavior
31. Self-injurious behavior
32. Stereotypy
33. Tongue protrusion
34. Vomiting

ducted in which interviews or rating scales were used to identify setting events, immediate antecedents to problem behavior, and/or the consequence events that maintain the problem behavior; (c) direct observation of the problem behavior under natural conditions without manipulation of the environment; and (d) functional analysis (e.g., the direct observation of problem behavior under controlled conditions where the environmental events were manipulated within an experimental design that allowed documentation of a functional relationship (Iwata *et al.*, 1982).

3. *Intervention Procedures.* Each intervention was assessed for component "procedures" (e.g., Stimulus-based, Instruction-based, Extinction, Reinforcement, Punishment, Pharmacology, Systems Change, Other/Unclear). Interventions also were coded by the type of intervention agent employed (e.g., typical or atypical) and the intervention context (regular school/home or community context versus special context such as hospital or assessment setting).
4. *Research Design Integrity.* Each of the nine studies selected for analysis was subjected to the NAS "Criteria for Assessing Intervention Studies." These criteria focus on (a) internal validity of the research design and measurement procedures, (b) external validity controls for selection bias, and (c) external validity controls for generalization of results. Each study was assessed independently by the first and fourth authors, with 100% agreement. The results of the assessment and definitions for assessment levels are provided in Appendix D.
5. *Outcome Measures.* Each comparison was assessed on four outcome measures. The first, percent reduction in problem behavior, was calculated by taking the mean of the last three data points from the first intervention phase, subtracting the mean of the last three data points from the last intervention phase, dividing by the baseline mean, and multiplying by 100%. This process replicated that used by Carr, Horner *et al.* (1999).

   The second outcome measure was the duration or maintenance of intervention/maintenance/follow-up phases. This index documented the number of weeks across which the intervention effects were assessed. The third outcome measure was the extent to which specific nonproblem behaviors were assessed, and the fourth was whether any documentation was provided for broader lifestyle changes such as alteration in activity patterns, social relationships, or educational opportunities.

Inter-rater Agreement

The fourth and fifth authors independently scored 33% of the articles (e.g., 11 comparisons) on all variables. There was a 90% or higher agreement on all variables except "impact on nonproblem behavior" and "lifestyle change." Given low agreement on these variables, they were not included in the final analysis.

RESULTS OF TARGETED REVIEW

A summary of the results across the nine studies is provided in Appendixes B and C. A total of 24 participants and 37 comparisons were evaluated. The

24 children averaged 57 months of age (SD = 20.9), and five (14%) were girls. The type and level of disability was assessed differently across studies. Taken together, the 24 participants all were identified with autism and were distributed across the mild to severe range for intellectual disability. In most cases insufficient information was provided to define a more precise index of the developmental level of each child.

Type of Problem Behavior

In 28 of the 37 comparisons (76%), the problem behavior of concern was tantrums. Aggression was the next most common problem behavior (22 comparisons, 59%). Stereotypy (5 comparisons, 14%) and self-injury (4 comparisons, 11%) were the remaining problem behaviors studied. Note that an individual could be identified as displaying more than one type of problem behavior.

Assessment

Some form of functional assessment was conducted in 25 of the 37 comparisons (68%). The most common functional assessment approach was to interview a person who knew the child, and then confirm the interview results via direct observation (18 comparisons, 49%). In 5 of the comparisons (14%), a full functional analysis was conducted.

Intervention Procedures

The interventions were most likely to employ stimulus-based (43% of comparisons) and instruction-based (81% of comparisons) procedures. Sixty-two percent of the comparisons included multiple intervention components. Extinction was part of 19 comparisons (51%), and reinforcement of appropriate behavior was a formal element in 11 (30%) of the comparisons. Punishment was used in 12 (32%) of the comparisons, and systems change was part of 10 (27%) of the comparisons. None of the comparisons included pharmacological procedures (cf. Appendix C).

Intervention Agent and Setting

In 23 of the 37 comparisons (62%), the intervention agent and the intervention context were typical. Interventions were most likely to occur in the home or school, and the intervention agent was most likely to be a parent or teacher.

Reduction of Problem Behavior

Reduction in problem behavior was impressive. The 37 comparisons described a mean reduction in problem behavior of 85% (SD = 19), with a median reduction level of 93.2% and a mode of 100%. Twenty-two of the comparisons (59%) recorded problem behavior reduction of 90% or greater, and 25 comparisons (68%) included problem behavior reduction of 80% or greater. The Charlop-Christy and Haymes (1996) paper contributed 12 comparisons to the database (32%). This study employed an innovative procedure (access to obsessions as a reinforcer for reduced levels of problem behavior), designed to be part of a comprehensive intervention. In addition, the study took advantage of natural conditions that allowed comparison of intervention effects against a baseline that included a DRO intervention. The results allowed assessment of the targeted interventions, but given the use of an intervention during baseline, and the appropriate focus on a narrowly targeted intervention, the study artificially lowered percentages of behavior reduction. If the Charlop-Christy and Haymes (1996) study is excluded from the analysis of effects, the average percentage of behavior reduction across the remaining 25 comparisons was 94.6%, with 84% of the comparisons documenting reduction of 90% or greater, and 96% documenting behavior reduction of 80% or greater. The distribution of all 37 comparisons by percentage of problem behavior reduction is provided in Fig. 3.

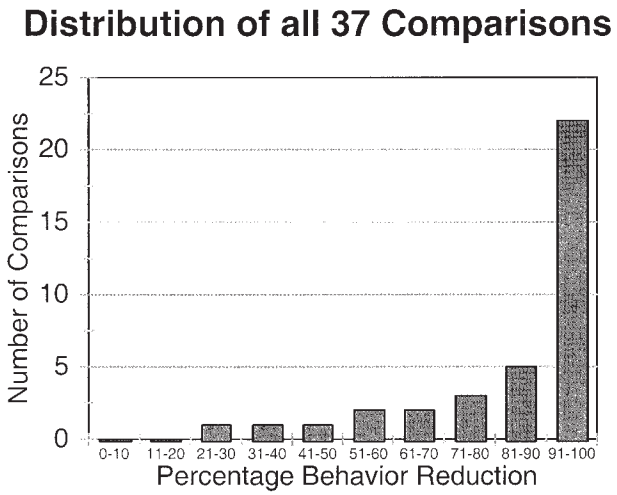

Fig. 3. The number of comparisons from the nine studies (37 comparisons) by percentage of reported problem behavior reduction.

Maintenance and Generalization

Maintenance effects were assessed by determining the longest period of time (in weeks) over which the intervention was monitored, and the proportion of comparisons with maintenance data in which the level of problem behavior remained within 15% of initial behavior reduction levels. Six of the nine studies (21 of 37 comparisons [57%]) included some form of post-intervention maintenance data. The mean length over which maintenance was assessed was 12 weeks, with the longest assessment occurring at 1 year after intervention (Koegel, Stiebel, & Koegel, 1998). In all cases in which maintenance was assessed, the level of behavior reduction remained within 15% of initial levels documented during the intervention phase.

Generalization of effects was defined as examination of problem behavior levels in nonintervention settings or conditions. Only two of the nine studies examined generalization (Schreibman, Whalen, & Stahmer, 2000; Charlop-Christy & Haymes, 1996). No patterns for generalization data were computed given this low percentage of participating studies.

SUMMARY OF FINDINGS

The nation is in the midst of a debate about what constitutes effective early intervention for young children with autism (Brown, 1999). A portion of that debate includes identifying the features of effective intervention for problem behaviors. Young children with autism are at significant risk to develop problem behaviors, and if these problem behaviors are not addressed, there is every reason to expect that they will maintain or worsen. Any comprehensive effort to define early intervention procedures for young children with autism should include strategies for preventing and intervening with problem behaviors.

The present synthesis provides a summary of existing literature reviews of behavioral interventions for people with developmental disabilities, including autism, and a targeted review of problem behavior-reduction research with young children with autism published between 1996 and 2000. Taken together these databases provide preliminary responses to the identified evaluation questions.

1. *What problem behaviors are most commonly identified for intervention?* Aggression/destruction, disruption/tantrums, self-injury, and stereotypy are the behaviors most likely to be targeted in published research. Didden *et al.* (1997) identified 34 classes of problem behavior represented in the research literature. Each of the existing review articles, however, used a unique format for organizing problem behavior categories. Table III provides a summary of behaviors targeted in the existing summaries and in the current review. The existing research summaries that included an older population indexed an emphasis on self-injury, stereotypy, and aggression as the primary targets for behavioral intervention. In the nine studies included in the current review of young children with autism, disruption/tantrums was the most likely behavior targeted, with aggression being

Table III. Percentages of Comparisons/Studies by Type of Problem Behavior Targeted

	Didden *et al.*, 1997	Scotti *et al.*, 1997	Lennox *et al.*, 1997	Scotti *et al.*, 1996*	Carr *et al.*, 1999	Current summary*
Years assessed	1968–1994	1976–1987	1981–1985	1988–1992	1985–1996	1996–2000
Aggression	9	—	11	8 (40)	22	(61)
Destruction	2	33***	11**	12 (40)**	3	—
Disruption/Tantrum	12	—	11**	—	5	(76)
Inappropriate Verbal/Social	3	15	12	—	—	—
Self-Injury	29	24	26	41 (42)	34	(11)
Stereotypy	23	28	26	17 (32)	36	(5)
Other	22	—	14	22 (40)	—	—

*Numbers in parentheses include percentages of comparisons where problem behavior was addressed in combination (e.g., tantrum/aggression; self-injury/stereotypy).
**Includes Destruction and Disruption/Tantrum.
***Includes Aggression, Destruction, and Disruption/Tantrum.

the second most likely. Self-injury and stereotypy were less likely to be behaviors of concern.

Care should be taken, however, not to infer that prevalence of problem behaviors in research reports represents prevalence in clinical settings. An array of factors influences the prevalence of problem behaviors studied in experimental analyses.

2. *What interventions for problem behaviors are most represented in the literature?* There is a rich and diverse literature on interventions for problem behavior. Didden *et al.*, (1997) list over 60 different intervention categories. In an effort to summarize this extensive literature. Table IV provides the percentages of comparisons across the five existing research syntheses and the nine studies in the current analysis. Studies conducted within the past 10 years are more likely to employ stimulus-based and instruction-based intervention procedures, and studies conducted before 1990 are more likely to focus on consequence-based procedures.
3. *To what extent are behavioral interventions, particularly positive behavioral interventions, effective at reducing problem behavior?* There is reason for significant optimism that early use of behavioral interventions can result in reductions of problem behaviors by 80 to 90%. The five existing research summaries span a significant period of time and a dramatic period of growth in behavioral technology. Across these summaries, however, the results indicate that the manipulation of environmental events (behavioral interventions) is associated with at least an 80% reduction in problem behavior in 50% of the comparisons. Across the nine studies in the current analysis, nearly 60% of the comparisons reported 90% reduction in problem behavior.
4. *What events mediate or improve the likelihood that interventions will be effective?* Considerable attention has been given to identifying possible features of behavioral interventions that may predict improved effects. Efforts to identify intervention procedures that were more effective with particular types of problem behavior, types of diagnostic label, or age have been inconclusive. The one consistent finding has been that interventions developed from functional assessment information appear more likely to result in significant behavior reduction (Carr, Horner *et al.*, 1999; Didden *et al.*, 1997, Scotti *et al.*, 1991). There is concern, however, that there are too few interventions developed from functional assessment information and that there is a disturbing pattern in the research literature of employing interventions that are contraindicated by the pretreatment functional assessment (Scotti *et al.*, 1996).

   Taken together the data from the present literature support the use of functional assessment, and suggest that considerable care should be taken in incorporating functional assessment results into the content of comprehensive behavioral interventions.
5. *Are there behavioral interventions that are uniquely identified for, and effective with, young children with autism?* The databases reviewed

Table IV. The Percentage of Comparisons/Studies by Type of Intervention Class

	Didden *et al.*, 1997	Scotti *et al.*, 1991	Lennox *et al.*, 1998	Scotti *et al.*, 1996*	Carr *et al.*, 1999	Current summary*
Years assessed	1968–1994	1976–1987	1981–1985	1988–1992	1985–1996	1996–2000
Total Comparisons	366	1451	176	403	162	
Stimulus based	8	8	4	27	42	43
Instruction based	—	8	16	35	46	87
Extinction	—	3	3	37	—	51
Reinforce	85	18	15	55	—	30
Punish	—	62	44	54	—	33
Systems change	—	—	—	—	—	29
Pharmacology	8	1	6	23	—	—
Other	—	—	—	—	11	—

*Includes multiple intervention components in a single comparison.

for this paper do not identify any type of intervention that is uniquely effective with young children with autism. The compelling message is that interventions should be developed based on a thorough analysis of the biological, antecedent, and consequence events that control them. Children with autism appear to behave based on the same mechanisms (e.g., reinforcement, punishment, extinction) that control the behavior of children without autism.

Taken together, the existing literature promotes a picture of behavioral support for young children with autism that incorporates the following elements:

a. Prevent problem behaviors by organizing environments that minimize presentation of aversive events, maximize contingent access to rewarding activities and outcomes, and minimize the likelihood that problem behavior will be rewarded. Environments likely to prevent the emergence of problem behaviors include the following features (a) a high level of child engagement, (b) access to preferred activities and rewards, (c) consistent and predictable system of scheduling (especially systems that incorporate visual schedules), (d) continual access to typical peers, and (e) an immediate and effective system of communication (Strain, Hoyson, & Jamieson, 1985; Strain *et al.*, 1998).

   Given that children with autism are less likely to find typical social praise or attention rewarding, an especially important feature for effective prevention will be efforts to identify and include individually functional reinforcers. Effective procedures for identifying and assessing the extent to which objects or activities may be reinforcing are now available (Fisher et al., 1992; Mason, McGee, Farmer-Dougan, & Risley, 1989; McGee & Daly, 1999; Roane, Vollmer, Ringdahl, & Marcus, 1998).

b. When problem behaviors are identified, conduct a functional assessment that (a) operationally defines the problem behavior, (b) identifies the antecedent events that reliably predict both occurrence and nonoccurrence of the behavior, (c) identifies the contingent events that maintain the problem behavior, and (d) incorporates direct observation data confirming the variables controlling the behavior.

c. Build a behavioral intervention that (a) emphasizes control of stimulus-based events that make the problem behavior irrelevant (e.g., reduce access to aversive events, present regular access to preferred events); (b) teaches socially appropriate behaviors that both make the child more competent in the environment, and produces the same environmental effect as the problem behaviors (Carr, 1988); (c) organizes consequences to prevent reinforcement of problem behavior; (d) organizes consequences to maximize reinforcement of competing, appropriate behaviors; (e) ensures that the specific procedures employed are within the skills, resources, and values of those who must implement them; and (f) maintains systems of data collection to ensure that the effects of the intervention may be assessed.

6. *What directions are needed for future research?*
   a. The small size of the current summary (nine studies) indicates that additional research on problem behavior reduction with young children with autism will be needed before confident conclusions can be drawn. Future reviews may also benefit by including studies selected from a larger window of time.
   b. More research is needed on how to ensure that functional assessments will be conducted and used in the design of behavioral interventions.
   c. Given that interventions will most often occur in typical home, school, and community settings, there is a real need for more research on the feasibility of using behavioral interventions in typical contexts by typical support agents. Some intervention and assessment procedures require highly skilled individuals for implementation. It will be important to ensure that individuals skilled in effective procedures are available for school, community, and home support. It is encouraging, however, to note that typical intervention agents (teachers, families) were reported to implement behavior support effectively and produce effective outcomes (Carr, Horner *et al.*, 1999).
   d. There is insufficient information about generalization and maintenance of effects in the reviewed literature. A growing and encouraging body of descriptive research is emerging, but the experimental database to guide documentation of the variables that promote

generalization and maintenance is meager (McGee *et al.,* 1999; Strain *et al.,* 1985; 1998).

e. Additional research is needed on the prevention of problem behaviors (cf. Reeve & Carr, 2000). This research will help to identify the features of environments that prevent the development of problem behaviors (e.g., high rates of activity, choice, clear communication systems, predictability, social integration access, high rates of reinforcement, and low rates of negative reinforcement for problem behavior), in addition to features that result in reduction of emerging problem behavior patterns. Of particular need is research that assesses the structural features of effective settings (ratio of individuals, training and support for staff, efficient funding models, operating policies, programmatic flexibility).

f. The clear trend toward use of multicomponent interventions targeting change across all parts of a child's day requires a new look at the research designs and methods that are employed. Multiple outcome measures and more longitudinal research designs will be needed to address the challenges presented by the current literature and by the queries from families and teachers attempting to implement the current technology (Turnbull & Ruef, 1997). Of special value will be studies that include assessment of collateral gains (increased rate of learning, social relationships, improved activity patterns) when behavioral interventions are employed.

g. A final direction for future research summaries is clarification of the potential bias imposed by publication procedures. Both single-subject and group design studies are more likely to be published if important effects are demonstrated than if no effects are found. This logical standard for publication means that the pattern of effects (or effect size) experienced in clinical contexts may not match that observed in published research (cf. Marquis *et al.,* 2000).

APPENDIX A

Reference	Years covered	No. of studies	No. of subjects	Age range	% subjects ≤8 years	No. subjects with autism	% of subjects with autism	No. comparisons	No. of comparisons with autism	% comparisons with autism	Comparisons based on form of FA	No. and % of comparisons by interventions assessed		
												Intervention	No.	%
Didden, Duker, & Korzilius (1997)	1968–1994	482	Not reported	1–66 M = 16.4 SD = 10.8	Not reported	Not reported	Not reported	1451	172	12%	21%	Pharmacological	68	7%
												Stimulus/ Prevention	80	8%
												Instruction		
												Extinction		
												Reinforcement (Response contingent & Response non-contingent)	855	85%
												Punish		
												Systems change		
												Other/Unclear		

Major Findings:
1. Most common problem behaviors were stereotypy, self-injury, disruption, and aggression.
2. 26.5% of all problem behaviors can be treated effectively (90% PND); 47:1% of problem behavior can be treated fairly effectively (70–90% PND).
3. Behaviors that are defined as externally destructive tend to be less successfully treated than behaviors that are internally or socially maladaptive.
4. Response contingent procedures tend to be more effective than other categories of treatment with pharmacological procedures being the least effective.
5. Conducting a functional analysis is significantly related to improved level of reduction.
6. No differences in type of intervention or effectiveness of intervention associated with specific type or level of disability.

Scotti, Evans, Meyer, & Walker (1991)	1976–1987	Studies, 403; articles, 318	Not reported	Not reported	Not reported	Not reported	Not reported	Studies used as unit of analysis	Not reported	Not reported	22%	Pharmacological	5	1%
												Stimulus/Prevention	34	8%
												Instruction	32	8%
												Extinction	11	3%
												Reinforcement	73	18%
												Punish	243	62%
												Systems Change		
												Other/Unclear		

Major Findings:
1. Behaviors of concern: stereo = 111 studies; self-injury = 99 (aggression the lowest).
2. Only 30% of studies reported generalization data.
3. Medication had lowest effect.
4. Follow-up of at least 6 months reported in only 47% of studies.
5. “Interventions at all levels of intrusiveness were implemented for behaviors at all levels of severity” p. 251.
6. FA was conducted in 22% of studies, but even in these there was not a clear link between intervention and FA outcomes.
7. “PND scores at follow-up were higher for those studies in which investigators performed a prior functional analysis than for those in which they did not.” p. 252.
8. “The use of functional analysis of multiple responses is perhaps a necessity for adequate treatment design.” p. 252.
9. “The present data indicate that although any other type of intervention is more effective than DRO alone, adding DRO does improve the effectiveness of other interventions.” p. 252.
10. “Interventions conducted in integrated settings were more effective than those conducted in segregated settings.” p. 253.
11. “The effectiveness of interventions . . . was not strongly influenced by the participant’s level of functioning” p. 253.

APPENDIX A-CONT'D

Reference	Years covered	No. of studies	No. of subjects	Age range	% subjects ≤8 years	No. subjects with autism	% of subjects with autism	No. comparisons	No. of comparisons with autism	% comparisons with autism	Comparisons based on form of FA	No. and % of comparisons by interventions assessed		
												Intervention	No.	%
Lennox, Miltenberger, Spengler, & Erfanian (1988)	1981–1985	162	491	2–56	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	38% with some form of FA (only 6% used a functional analysis)	Pharmacological	31	6%
												Stimulus/ Prevention	20	4%
												Instruction	89	6%
												Extinction	15	3%
												Reinforcement	80	15%
												Punish	240	44%
												Systems change		
												Other/Unclear		

Major Findings:
1. Self-injury, aggression, and stereotypy most common problem behaviors studied.
2. No indication of intervention selection or effectiveness linked to subject diagnosis.
3. No indication of intervention selection or effectiveness linked to subject age.
4. For treatment of inappropriate social behavior, Level 1 (minimally intrusive) procedures appear to be preferable (81% effective). p. 498.
5. For treatment of stereotypy reinforcement was most often used, and overcorrection was the most effective.
6. Medication was the least effective intervention.

Scotti, Ujcich, Weigle, Holland, & Kirk (1996)	1988–1992	179	972	<6 to >22	At least 136 indiv (14%) were <6 yr old	54 studies (30% unclear how many subjects)	Not reported	Not reported	Not reported	Not reported	48% of studies included some form of FA	Pharmacological	41	23%
												Stim/Prev	49	27%
												Instruction	63	35%
												Extinction	66	37%
												Reinforcement	99	55%
												Punish	96	54%
												Systems change		
												Other/Unclear		

Major Findings:
1. Self-injury was problem behavior most often studied.
2. Young children were more likely to display stereotypy.
3. FA is occurring more, but there remain many studies that examine interventions that are inconsistent with the FA in the study.
4. An FA was unlikely to be conducted if the intervention was pharmacology (4 of 30 studies).
5. Less intrusive procedures becoming more common and more likely to be paired with more intrusive procedures.

Carr *et al.*, (1999) and Marquis *et al.*, (in press)	1985–1996	109	230	Birth to adulthood	Unclear (27 ≤ 4; 78 were 5–12)	59	26%	366	81	22%	62%	Stimulus/ Prevention	155	42%
												Instruction	169	46%
												Extinction		
												Reinforement		
												Punish		
												Systems change		
												Other/Unclear	42	11%

Major Findings:

1. Self-injury, aggression towards others, and combinations of problem behavior were the most common problem behaviors addressed in research studies.
2. There has been an increase in the use of Stimulus-Based interventions in the research literature across the time period 1985–1996.
3. PBS interventions (stim and reinf based) are associated with at least a 90% reduction in problem behavior in 52% of comparisons, and at least an 80% reduction in problem behavior in 68% of the comparisons.
4. The use of functional assessment to guide design of the intervention doubles the likelihood that the intervention will produce a 90% reduction in problem behavior.
5. No difference in type of intervention or intervention effectiveness were found to be associated with diagnosis of autism.
6. No intervention identified as universally superior.
7. Success rates were better when intervention was done by typical agents in typical contexts.
8. There is evidence that effects generalize, maintain and are related to broader lifestyle change, but the number of studies and duration of the analysis limit firm conclusions.
9. Interventions that employed systems change procedures were more likely to produce 90% reduction levels than those that did not. However, the number of studies employing systems change was small.

APPENDIX B

Study				Instrument/score			Assessment		
Charlop-Christy & Haymes (1996)	Subject	Age in months	Gender	Leiter international performance scale	Instrument/score	Problem behavior	No assessment	Interview/ observation	Functional analysis
	1a	65	M	129		Tantrum/Aggress		X	
	1b							X	
	1c							X	
	2a	72	M	Untestable		Tantrum/Aggress	X		
	2b						X		
	2c						X		
	3a	81	M	Untestable		Tantrum/Aggress	X		
	3b						X		
	3c						X		
	4a	90	F	Untestable		Tantrum/Aggress	X		
	4b						X		
	4c						X		
Charlop-Christy & Haymes (1998)	Subject	Age in months	Gender	Merrill-Palmer scale of mental tests		Problem behavior	No assessment	Interview/ observation	Functional analysis
	1	93	F	67 IQ		Tantrum	X		
Dunlop & Fox (1999)	Subject	Age in months	Gender	Autism behavior checklist	Battele development inventory	Problem behavior	No assessment	Interview/ observation	Functional analysis
	1	29	F	68	10 mo	Stereo		X	
	2	32	M	71	17 mo	Tantrum		X	
	3	37	M	64	15 mo	Tantrum		X	
	4	44	M	79	20 mo	Tantrum		X	
	5a	29	M	90	15 mo	Tantrum		X	
	5b	29	M	90	15 mo	Tantrum		X	
	6	33	M	75	14 mo	Tantrum		X	
Hechaman, Alber, Hooper, & Heward (1998)	Subject	Age in months	Gender	Standford-Binet	Childhood autism rating scale	Problem behavior	No assessment	Interview/ observation	Functional analysis
	1	72	M	50		Tantrum/Agress			X
	2	84	M		47	Tantrum/Agress			X

Koegel, Stiebel, & Koegel (1998)	Subject	Age in months	Gender	Peabody picture vocabulary tests	Express one word vocabulary test	Problem behavior	No assessment	Interview/ observation	Functional analysis
	1	70	M	4th percentile		Aggress		X	
	2	51	M	1st percentile	2nd percentile	Aggress		X	
	3	58	M	1st percentile		Aggress		X	

Newman, Tuntigian, Ryan, & Reinecke (1997)	Subject	Age in months	Gender	DSM IV		Problem behavior	No assessment	Interview/ observation	Functional analysis
	1	50	F	Mild-Mod MR		Tantrum	X		
	2	48	M	Mild-Mod MR		Tantrum	X		

Reeve & Carr (2000)	Subject	Age in months	Gender	Stanford-Binet 4th Edition		Problem behavior	No assessment	Interview/ observation	Functional analysis
	1	53	F	75 IQ		Tantrum			X

Schreibman Whalen, & Stahmer (2000)	Subject	Age in months	Gender	Differential abilities scale		Problem behavior	No assessment	Interview/ observation	Functional analysis
	1	39	M	71 IQ		Tantrum/Aggress		X	
	2a	55	M	62 IQ		Tantrum/Aggress		X	
	2b	55	M	—				X	
	3a	41	M	46 IQ		Tantrum/Aggress		X	
	3b	41	M	—				X	

Sigafoos & Meikle (1996)	Subject	Age in months	Gender		Reyrell Dev. language scales	Problem behavior	No assessment	Interview/ observation	Functional analysis
	1	96	M	No scores available		SIB/Stereo			X
	2	96	M	71	2.5 yrs	SIB/Stereo			X

APPENDIX C

Study		Interventions								Maintenance and Generalization	
Charlop-Christy & Haymes (1996)	Subject	Stimulation-based	Instruction	Extinction	Reinforcement	Punishment	Systems change	Other	Weeks of intervention	% Behavior reduction	Maintenance	Generalization
	1a		X	X		X			15	75%	Yes	Yes
	1b		X	X		X			9	90%	Yes	Yes
	1c		X	X		X			13	93%	Yes	Yes
	2a		X	X		X			14	40%	Yes	Yes
	2b		X	X		X			12	72%	Yes	Yes
	2c		X	X		X			14	68%	Yes	Yes
	3a		X	X		X			15	56%	Yes	Yes
	3b		X	X		X			18	76%	Yes	Yes
	3c		X	X		X			16	84%	Yes	Yes
	4a		X	X		X			15	27%	No	No
	4b		X	X		X			14	60%	No	No
	4c		X	X		X			10	61%	No	No
Charlop-Christy & Haymes (1998)												
	1		X		X				8	100%	Not measured	Not measured
Dunlap & Fox (1999)												
	1	X	X				X		12	99%	Not measured	Not measured
	2	X	X	X			X		16	96%	Not measured	Not measured
	3	X	X	X			X		24	92%	Not measured	Not measured
	4	X	X	X			X		8	100%	Not measured	Not measured
	5a	X	X	X			X		8	100%	Not measured	Not measured
	5b	X	X	X			X		8	100%	Not measured	Not measured
	6	X	X	X			X		24	93%	Not measured	Not measured
Hechaman, Alber, Hooper, & Heward (1998)												
	1		X		X				4	90	Not measured	Not measured
	2		X		X				5	89	Not measured	Not measured

Koegel, Stiebel, & Koegel (1998)									
	1	X	X			X	14	48%	Yes	Not measured
	2	X	X			X	12	100%	Yes	Not measured
	3	X	X			X	14	88%	Not measured	Not measured
Newman, Tuntigian, Ryan, Reinecke (1997)									
	1		X		X		2	100%	Yes	Not measured
	2		X		X		30	100%	Not measured	Not measured
Reeve & Carr (2000)									
	1	X	X	X	X		2	100%	Yes	Not measured
Schreibman Whalen, & Stahmer (2000)									
	1	X			X		8	100%	Yes	Not measured
	2a	X			X		17	95%	Yes	Yes
	2b	X			X		17	100%	Yes	?
	3a	X			X		12	98%	Yes	Yes
	3b	X			X		12	97%	Yes	?
Sigafoos & Meikle (1996)									
	1a		X				5	100%	Yes	Not measured
	1b		X				5	100%	Yes	Not measured
	2a		X				6	82%	Yes	Not measured
	2b		X				6	100%	Yes	Not measured

APPENDIX D: CRITERIA FOR ASSESSING

	Internal validity				External validity (selection)				External validity (generalization)			
	I	II	III	IV	I	II	III	IV	I	II	III	IV
	Group treatment to treatment blind observation	SS experiment design blind observation	SS experiment design nonblind observation	Other	Random assign group large	Nonrandom assign group adequate	Population defined at least three subject in SSD	Other	Nontrained setting social validity	Nontrained setting or maintenance	Natural setting experiment control	Other
Charlop-Christy & Haymes (1996)			X				X			X		
Charlop-Christy & Haymes (1998)			X				X				X	
Dunlap & Fox (1999)			X				X				X	
Hechaman, Alber, Hooper, & Heward (1998)			X				X				X	
Koegel, Stiebel, & Koegel (1998)			X				X			X		
Newman, Tuntigian, Ryan, & Reinecke (1997)			X				X			X		
Reeve & Carr (2000)			X				X				X	
Schreibman Whalen, & Stahmer (2000)			X				X			X	X	
Sigafoos & Meikle (1996)			X					X		X		

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