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REDUCING SELF-INJURIOUS BEHAVIORS
IN INDIVIDUALS WITH AUTISM: BENEFITS
OF FUNCTIONAL COMMUNICATION TRAINING

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Reducing Self-Injurious Behaviors in Individuals With Autism: Benefits of Functional Communication Training

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Case Scenario

During an IEP meeting, Beth, a special education teacher reports that Keith, her 8-year-old student with autism, is increasingly exhibiting self-injurious behaviors (SIBs) throughout the day. The behavior occurs more frequently during individual seatwork. Helen, the school speech-language pathologist (SLP), reports that she too has noticed an increase in his negative behaviors, in general, including some instances of SIB during her sessions with Keith. Both Beth and Helen report that they have tried to get him to stop the behavior, but with only modest and short-term success. After some discussion, the IEP Team agrees that the most pronounced behavior is hand-biting, and a consistent approach needs to be incorporated into Keith's IEP that addresses the elimination of the SIB.

Juanita, the Behavior Analyst suggests that functional communication training (FCT) may be a good approach to consider and suggests that Beth and Helen do some investigation of the effectiveness of this approach. The IEP team suggests that they reconvene in two weeks to hear what Beth and Helen have found. They intend to decide then on modifications to Keith's IEP to address the SIBs and answer two primary questions: 1), "Is FCT effective in reducing SIB for individuals with autism?" and 2), "What is the long-term effectiveness of FCT?"

Introduction

Beth and Helen's concerns are not unique. Practitioners and caregivers of individuals with autism often are faced with similar behaviors. The management of aggressive behaviors has become more apparent as the prevalence of autism increases 10% to 17% annually (Autism Society of America, 2006). Among individuals with developmental disabilities, 4% to 16% exhibit aggressive behaviors such as SIBs (Rojahn, 1994). *Aggression* refers to destructive and/or harmful behavior

towards people or property while SIB refers to self-inflicted behavior that is aggressive in nature, such as self-pinching, self-hitting, or self-biting.

Though there is no consensus as to why individuals with autism display SIBs, experts in the field offer several possible explanations. One of the most prominent hypotheses stemming from the behavioral sciences is that aberrant behaviors are learned through the maintenance of consequences in an individual's environment (Carr, 1977). For example, if Keith displays SIBs because he is assigned a task, the aversive stimuli (task) may need to be removed to stop him from engaging in SIBs. By doing so, however, Keith learns to escape aversive tasks by displaying SIBs. SIBs may also be a way to convey information, such as frustration or anxiety, as well as to gain access to desired items, activities, or attention (Sigafos & Mirenda, 2002). In an example of the latter, if Keith's favorite book is removed, but he does not have the means to protest this appropriately (i.e., asking for the book), he may resort to SIB until the book is returned. Overall, research indicates that SIBs result from a combination of different causes, including biological and behavioral factors (Lewis, Gluck, Bodfish, & Mailman, 1996).

Regardless of the etiology, SIBs continue to trouble practitioners, parents, and others who interact with individuals with autism. SIBs often prevent individuals with autism from participating in educational and community settings and when they do participate, the behavior is often a barrier to learning (McDonnell, Hardman, & McDonnell, 2000; Symons & Thompson, 1997). According to Harris (2006), aggressive behaviors are one of the primary reasons individuals with developmental disorders are excluded from social activities with their peers.

Functional Communication Training

Many studies have established that a functional relationship exists between SIB and certain behaviors an

individual uses to control his or her environment, such as escaping a nonpreferred activity or seeking attention (Harding et al., 2001). Predictable, challenging behaviors that function as communicative intents can be addressed with systematic behavior intervention (Carr, Coriary, & Dozier, 2000). Functional communication training (FCT, occasionally referred to as *functional equivalence training*) is a systematic intervention with an extensive research base to support its utility with challenging behaviors including SIB (Carr & Durand, 1985a; Durand & Carr, 1992; Durand & Merges, 2001; Wacker et al., 2005). The premise of the intervention is to teach individuals with challenging behaviors a functionally equivalent communicative behavior to replace the challenging behavior (Carr & Durand, 1985a). For instance, if Keith displays SIB to request teacher assistance, then a functionally equivalent behavior would be to teach him how to appropriately request teacher assistance. This request may be in the form of speech, the use of a manual sign to indicate “help,” or the selection of a graphic symbol. The principle of FCT is that challenging behaviors serve a communicative purpose (Carr & Durand, 1985b; Horner & Day, 1991) hence, there is a need to ensure that the replacement behavior is functionally equivalent (Day, Horner, & O’Neill, 1994).

Reviewing the Literature Base

A preliminary search of the literature suggests that FCT is an effective intervention for reducing challenging behavior in individuals with developmental disabilities. Some areas of demonstrated effectiveness have been shown in various school and home environments (Braithwaite & Richdale, 2000; Wacker et al., 1998, 2005), the use of parents as interventionists (Wacker et al., 2005), maintenance of positive outcomes over time (Derby et al., 1997; Durand & Carr, 1991), and increased time on task (Lalli, Casey, & Kates, 1995). Although FCT effectiveness has been documented in many studies, practitioners, parents, and others interested in adhering to evidence-based practices should benefit from information about the utility and effectiveness of various treatment options. For example, Keith’s IEP team is interested in the effectiveness of FCT as a viable treatment option for him; therefore, it is important for the team to closely examine the specific research about its effectiveness with individuals similar to Keith. In doing so, the team is able to make an appropriate decision based on empirically validated information. In principle, it lessens the time spent using

therapies that may or may not be effective in reducing Keith’s SIB. Certainly, attention to the time–efficiency issues is crucial when targeting severe SIBs to reduce any potential physical damage that may result from the SIB.

Practitioners should understand the process of appraising studies and filtering high from low quality studies. It is beyond the scope of this Brief to adequately address this process. For an in-depth look about the process of appraising studies, see Schlosser, Wendt, Angermeier, & Shetty (2005), Schlosser, Wendt, & Sigafoos (2007), and Wendt (in press). Instead, the purpose of this Brief is to provide SLPs with information about the effectiveness of functional communication training to reduce SIB in children with autism. In addition, with the increased emphasis on engaging in interventions that adhere to evidence-based practices, this Brief is intended to provide the SLP with a process example of an information retrieval, data analysis, and summary judgment of the research that would inform the clinical decision making process.

Method

Inclusion Criteria

To be included in this Brief, a study had to meet the following criteria: a) employ experimental, quasi-experimental, or single-subject research designs; b) describe a subject as being diagnosed with Autistic Disorder; c) target SIB; d) use FCT as the intervention (not within a treatment package); e) report data that allowed for effect size calculations; f) available in English; and g) be published in a peer-reviewed journal on or prior to February 2009.

Search Strategy

The search strategy consisted of using six general purpose databases (Academic Search Premier, Cumulative Index to Nursing and Allied Health Literature [CINAHL], Education Resources Information Center [ERIC], MEDLINE, PsycINFO, and PubMed Central), and conducting a journal hand search (Journal of Applied Behavior Analysis). The references of the potential studies identified from these databases also were reviewed for other studies not identified in the database searches. Some of the keywords used to retrieve studies from the databases included a combination of the following terms: *functional*

communication training, self-injurious behavior, self injury, autism, FCT, functional equivalence, and numerous truncations of the keywords. Several of these keywords yielded hundreds of results; however, from 92 potential studies only 8 met the inclusion criteria and are summarized in this Brief. For practitioners interested in locating similar information or yielding comparable results, it may be necessary to seek access to databases not typically available beyond the university setting. One avenue is to use free web search tools such as Google Scholar™ or Scirus™. Another avenue is available through professional organizations (e.g., American Speech-Language-Hearing Association [ASHA]) that enable members to access their publications.

Data Extraction

Several study characteristics were extracted from the studies identified: research design, participant age, total participants, communicative replacement modality (e.g., speech, manual signs, and graphic symbols), SIB function, SIB rates, treatment integrity, and interobserver agreement.

Guidelines for Interpretation of Studies

One of the components of FCT is the use of appropriate communicative behavior as the replacement behavior for challenging behavior. The replacement behavior components used to group the included studies were (1) speech, (2) manual signs/gestures, and (3) graphic symbols/line drawings. For example, studies that used speech as the replacement behavior are presented in Tables 1 and 2. Likewise, Tables 3 and 4 summarize studies that used manual signs/gestures, and Tables 5 and 6 summarize those that used graphic symbols/line as the replacement behavior. Although SIB was the target behavior, several studies targeted aggression as a secondary behavior to SIB. These studies were analyzed separately, but were grouped with their corresponding replacement behavior.

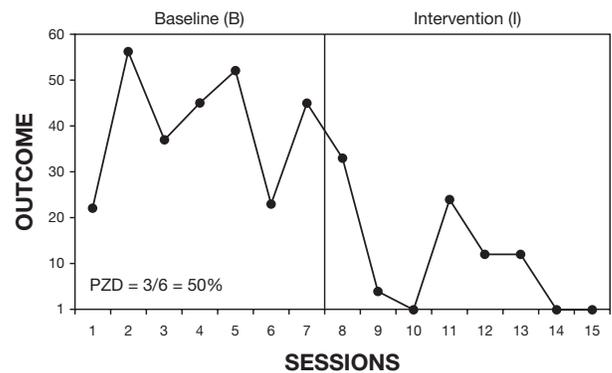
Data Analysis and Interpretation

Because all included studies were single-subject research designs, two of several nonparametric measures were used to calculate an effect size. These statistics consisted of percentage of zero data (PZD; Scotti et al., 1991) and mean baseline reduction (MBR; Campbell, 2003; 2004). As illustrated in Figure 1, the PZD score is determined by identifying the first data point to reach zero in the intervention phase, then calculating the

percentage of treatment data points that remain at zero from the first zero data point onward. The PZD scores ranges are as follows:

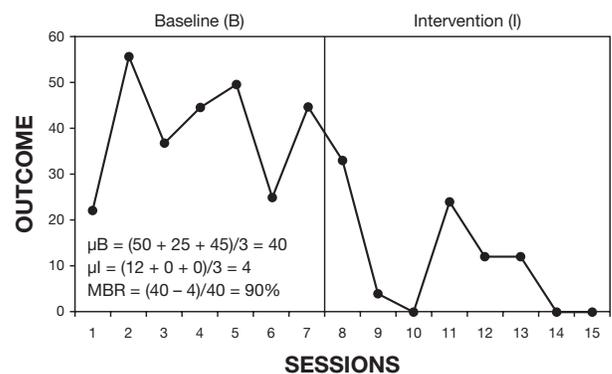
- Above 80% = Highly Effective
- 55% to 80% = Fairly Effective
- 18% to 54% = Questionable Effectiveness
- Below 18% = Unreliable Treatment (Scotti et al., 1991)

Figure 1. Example of PZD calculation



Mean baseline reduction is calculated by averaging the last three treatment data points and dividing it by the average of the last three baseline data points, and multiplying by 100 to obtain the percentage of baseline reduction (Campbell, 2003; 2004). See Figure 2 for an example on how to calculate MBR. At this time, guidelines do not exist for interpreting MBR scores. It is up to the practitioner to determine the extent of treatment effectiveness by giving a subjective value to each MBR score.

Figure 2. Example graph of MBR calculation



A certainty framework by Simeonsson and Bailey (1991) was used to classify the evidence based on three quality criteria: 1) appropriateness of research design, 2) inter-observer agreement, and 3) treatment integrity. Depending on the degree of evidence within each study, the results were appraised as:

- a. *conclusive* (great degree of confidence in treatment effectiveness),
- b. *preponderant* (minor research design flaws but good degree of confidence in treatment effectiveness),
- c. *suggestive* (numerous minor design flaws lead to plausible conclusion of treatment effectiveness), or
- d. *inconclusive* (inability to determine treatment effectiveness based on significant design flaws).

Results

Eight single-subject studies were appraised to determine the effectiveness of FCT in reducing SIB in individuals with autism. Of the eight studies, four were reported and analyzed separately because the target behavior comprised both SIB and aggression toward others. From an experimental point of view, it may be necessary to distinguish data for each behavior. Because the behaviors typically co-occur, it was deemed beneficial to include data from the studies that combined both types of challenging behaviors.

Participant Characteristics

A total of 10 participants were included in the studies with an average age of 10.6 years (range, 5 to 27 years). All but one of the participants had a secondary diagnosis of intellectual disability or was described as functioning at a moderate-to-severe intellectual impairment level. Gender distribution consisted of eight males and two females. Communicative ability was also reported and can be found in Table 7.

Research Design

The included studies were all single-subject research designs, with the most common being multiple baseline designs followed by alternating treatment designs. Two studies used designs other than the two previously

mentioned (Horner & Day, 1991; Kahng, Hendrickson, & Vu, 2002). (See Tables 1 to 6.)

Treatment Integrity

Treatment integrity (TI) refers to the data collected on the independent variable (e.g., FCT use) and is a component that is typically attributed to studies of high quality (Kennedy, 2005). When TI is high, the intervention was implemented as designed. Unfortunately, none of the reviewed studies reported TI; so no studies were ranked as *conclusive* or *preponderant*.

Interobserver Agreement

Interobserver reliability (IOA) refers to the data accuracy obtained about the occurrence or nonoccurrence of a behavior of interest (e.g., SIB; Kennedy, 2005). All studies reported adequate interobserver reliability for at least 20% of the sessions.

Study Appraisal

The quality of the studies was comparable in that seven out of eight studies were ranked as *suggestive*, meaning that treatment effectiveness was plausible. Only one study was ranked as inconclusive because it lacked replication for one condition and TI was not reported (Kahng et al., 2002).

Treatment Effectiveness

As previously noted, studies were grouped by replacement behavior for summary purposes. Studies that also targeted aggression were referred to as “SIB-aggression group” and were separated from studies that only targeted SIB “SIB-only group” so that results would not be confounded.

Speech

The PZD and MBR calculations and study appraisals are presented in tables 1, 2, and 8. The combined PZD score across all speech conditions for the SIB-only group was 52% (range, 7% to 92%) indicating Questionable Effectiveness. For the same group, the MBR score was 71% (range, 0% to 100%). The mean PZD score for the SIB-aggression group was 83% (range, 0% to 100%), signifying High Effectiveness and the average MBR score was 87% (range, 7% to 100%).

Manual Signs/Gestures

Only one study was placed in the SIB-only group (Day, Horner, & O'Neill, 1994) with a PZD score of 33% and a MBR score of 92%, indicating Questionable Effectiveness. Similarly, the SIB-aggression group consisted of one study (Sigafoos & Meikle, 1996); however, both PZD and MBR scores for this study were 100%, indicating a Highly Effective intervention (see Tables 3, 4, and 8).

Graphic Symbols

Only one study was placed in the SIB-only group, but it used two conditions (Horner & Day, 1991). The mean PZD score for the study was 30% (range, 0% to 60%) and the mean MBR score was even lower at 14% (range, 0% to 27%), resulting in Questionable Effectiveness. For the SIB-aggression group, the mean PZD score was 83% (range, 50% to 100%) and the mean MBR score was 67% (range, 0% to 100%), indicating a Fairly Effective intervention (see Tables 5, 6, and 8).

Discussion

It is common practice for practitioners to make treatment decisions for clients without consulting the evidence about its efficacy. By systematically evaluating the evidence, questions like the two asked by the IEP team, can be answered using the best available evidence.

The first question (Is FCT effective in reducing SIB for individuals with autism?) can be answered. Using the average PZD score across all SIB-only studies (regardless of the replacement behavior), FCT appeared to have Questionable Effectiveness. When the SIB-only and SIB-aggression studies were combined, the PZD score increased to 64%, yielding Fairly Effective results. Unfortunately, because there are no guidelines for interpreting MBR scores, the practitioner would have to determine if a mean score of 59% across all SIB-only studies constitute treatment effectiveness. When all SIB-only and SIB-aggression studies were combined, the average score increased to 72%. Given the data presented in this Brief along with the results presented in each study, it appears that FCT is a reasonable intervention to use with individuals with autism who display SIB or a combination of SIB and aggression and see at least a modest impact on behavior.

In regard to the second question (What is the long-term effectiveness of FCT?), there was insufficient evidence in the studies to make a determination about long-term effectiveness. Only two studies reported follow-up data (Durand & Carr, 1991; Sigafoos & Meikle, 1996); however, the data in both studies demonstrated long-term success of FCT. For one participant, SIB increased temporarily because the quality of his replacement behavior (i.e., saying, "I don't understand") had deteriorated to the point where it was no longer understood by novel teachers (Durand & Carr, 1991). As a result, his replacement behavior was not acknowledged by teachers because they could not understand his request for attention. Consequently, SIB increased because it was more efficient than the replacement behavior in gaining immediate attention. Once FCT was reintroduced, SIB diminished, supporting the view that maintenance of skills is critical to the well-being of the child. In general, the data available from these studies suggest that it is good practice to use interventions that temporarily decrease challenging behaviors in addition to planning for long-term success.

In terms of the expected magnitude of behavior change (i.e., "how much SIB reduction can be expected when FCT is used with individuals with autism?"), the evidence from this review suggests, using conservative estimates, that practitioners can expect their clients to decrease their SIB use by 14% to 92% (mean scores). Studies that targeted SIB and aggression reported higher success rates yielding from 67% to 100% behavior reduction.

It is important to address the accuracy of the results when using measures such as PZD and MBR. Percentage of Zero Data is considered to be a very conservative estimator of treatment effectiveness because it only considers the data points that reach zero (Campbell, 2003, 2004). It does not consider other nonzero data points even if they represent low behaviors on the graph. Therefore, behavior reduction is not reflected in the PZD scores, only complete behavior suppression. On the other hand, MBR is not as conservative as PZD because its purpose is to demonstrate behavior reduction as the name implies, not behavior suppression. As stated earlier, the disadvantage of MBR is the lack of guidelines for interpreting the scores.

Practitioners must remember when making evidence-based decisions that they need to consider the quality of

the studies. Drawing any conclusions from low quality studies can be problematic. For the most part, the data presented here supports the notion that FCT is an effective behavioral intervention. However, none of the studies reported treatment integrity leading us to downgrade the results and make conservative conclusions about its effectiveness.

Limitations

As with any evidence-based assessment of research literature, the limitations of the included studies should be recognized. First, all the studies used single-subject research designs, which creates a problem with external validity (Rapoff & Stark, 2008). Practitioners should know that the use of this research methodology makes it more difficult to generalize the findings due to the small number of subjects used in each study. Second, unpublished studies were not considered, thereby possibly creating publication bias. Third, a limited number of studies were analyzed; thus, a conclusion was based on a small amount of data. In light of the limitations, however, the results presented in this Brief are similar to those that might be obtained from a practitioner searching for similar evidence. Finally, several potential biases were introduced by not using a second person to evaluate and confirm the inclusion and exclusion of studies, to verify the accuracy of data extraction from included studies, or to independently assess the quality of the included studies. Although working as a team to retrieve and analyze information is considered more effective, practitioners may be required to appraise information without additional assistance and without a significant amount of publication resources.

IEP Meeting Two Weeks Later

Using these studies, Beth and Helen report back to the IEP Team that FCT appears to be an efficacious intervention in decreasing SIBs in children with autism. Not only is FCT an appropriate intervention to use with Keith at school, the alternative communicative behavior should be encouraged with parental involvement at home to promote generalization. By supporting all appropriate communication in Keith's environments, any behavior suppression should be maintained—which is the team's long-term goal. The team agrees and starts the planning stage for implementing FCT.

In summary, issues encountered in classrooms, therapy rooms, or other settings require practitioners to take a different approach when providing intervention service. Questions about the appropriateness of interventions should be answered systematically using sound evidence. It is the responsibility of the practitioner to make sound decisions given the best evidence available while considering the needs of the client.

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Table 1. Self-Injurious Behavior (Speech)

Study	Participants, Age	Design	Condition	Replacement Behavior	MBR Score	PZD Score	Appraisal
Casey & Merical (2006)	Karl, 11	multiple baseline across settings	Escape	"I would like a break please."	0%	57%	Suggestive. Sound design; good IOA; missing TI
Day, Horner, & O'Neill (1994)	Brandi, 9	alternating treatment w/in subject	Escape	"Go"	96%	50%	Suggestive. Sound design; good IOA; missing TI
Durand & Carr (1991)	Tim, 12 Hal, 12	multiple baseline across subjects	Attention Attention	"Help me." "I don't understand."	100% 89%	92% 7%	Suggestive. Sound design; good IOA; missing TI

Table 2. Self-Injurious Behavior and Aggression (Speech)

Study	Participants, Age	Design	Condition	Replacement Behavior	MBR Score	PZD Score	Appraisal
Braithwaite & Richdale (2000)	Michael, 7	multiple baseline across behaviors	Escape (2s / 5s) Access (2s / 5s)	"I need help please." "I want ___ please."	100 / 100% 100 / 100%	89 / 100% 100 / 100%	Suggestive. Sound design; good IOA; missing TI
Sigafoos & Meikle (1996)	Pete, 8	multiple baseline across subjects	Attention (1s / 3s) Access (1s / 3s)	teacher's name "Beth" "drink", "toy"	82 / 82% 100 / 100%	67 / 83% 100 / 91%	Suggestive. Sound design; good IOA; missing TI
Kahng, Hendrickson, & Vu (2002)	Ashby, 7	ABACAC w/ reversal	Access (single) Access (mult.)	"I want treats." "I want chips."	7% 100%	0% 100%	Inconclusive. Good IOA; both Tx not replicated; missing TI

Table 3. Self-Injurious Behavior (Manual Sign/Gesture)

Study	Participants, Age	Design	Condition	Replacement Behavior	MBR Score	PZD Score	Appraisal
Day, Horner, & O'Neill (1994)	Brandi, 9	alternating treatment w/in subject	Access	ASL "want"	92%	33%	Suggestive. Sound design; good IOA; missing TI

Table 4. Self-Injurious Behavior and Aggression (Manual Sign/Gesture)

Study	Participants, Age	Design	Condition	Replacement Behavior	MBR Score	PZD Score	Appraisal
Sigafoos & Meikle (1996)	Dale, 8	multiple baseline across subjects	Attention (1s/3s)	tapping teacher's hand	100 / 100%	100 / 100%	<u>Suggestive</u> . Sound design; good IOA; missing TI

Table 5. Self-Injurious Behavior (Graphic Symbol)

Study	Participants, Age	Design	Condition	Replacement Behavior	MBR Score	PZD Score	Appraisal
Horner & Day (1991)	Mary, 27	ABAB w/ reversal	Escape (1s/20s)	card indicating "break"	27 / 0%	60 / 0%	<u>Suggestive</u> . Sound design; good IOA; missing TI

Table 6. Self-Injurious Behavior and Aggression (Graphic Symbol)

Study	Participants, Age	Design	Condition	Replacement Behavior	MBR Score	PZD Score	Appraisal
Sigafoos & Meikle (1996)	Dale, 8	multiple baseline across subjects	Access (1s/3s)	line drawings ("food," "drink," "toy")	100 / 100%	100 / 100%	<u>Suggestive</u> . Sound design; good IOA; missing TI
Hanley, Piazza, Fisher, & Maglieri (2005)	Jay, 5	alternating treatment w/ reversal	Attention	card indicating "play"	0%	50%	<u>Suggestive</u> . Sound design; good IOA; missing TI

Table 7. Participant Characteristics

Participants	Age	Sex	2nd Diagnosis	Communicative Ability
Jay	5	M	ID	not reported
Ashby	7	M	ID	limited speech; PCS
Michael	7	M	ID	limited speech
Dale	8	M	ID*	line drawings; manual sign "eat"
Pete	8	M	ID*	echolalia
Brandi	9	F	ID	simple gestures
Karl	11	M	none	speech
Tim	12	M	ID	limited speech; echolalia
Hall	12	M	ID	limited speech
Mary	27	F	ID	limited speech

* no formal diagnosis of intellectual disability (ID) but reported to function at the ID level

Table 8. Average Scores Across All Conditions

SIB only	MBR Score	PZD Score	SIB & Aggression	MBR Score	PZD Score
Speech	71%	52%	Speech	87%	83%
Manual Signs/Gestures	92%	33%	Manual Signs/Gestures	100%	100%
Graphic Symbols	14%	30%	Graphic Symbols	67%	83%