Function-based Interventions for Children with Autism Spectrum Disorders in Schools: A Review

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Abstract

An increasing numbers of students with autism spectrum disorder (ASD) are serviced in special and general education settings. Many students with ASD need behavioral supports in order to participate meaningfully in school settings. Function-based intervention has been shown to be effective in decreasing problem behavior and increasing appropriate behavior for students with ASD, however, there are still a number of gaps in the literature. The purpose of this study was to synthesize and examine the research on function-based intervention used in the reduction of problem behavior for students with ASD in school settings. Thirty-seven studies representing 62 participants were included in this review. Descriptive information on various characteristics of the participant, assessment, intervention, and study is provided. Limited teacher involvement and lack of evaluation of generalization and maintenance were common across the studies reviewed. Implications of the findings, study limitations, and recommendations for future research are discussed.

***Keywords**: function-based intervention; functional behavioral assessment; autism; school; behavior*

Introduction

The field of special education for children with autism spectrum disorders (ASD) has progressed significantly since the 1970s. Educational programs based on applied behavior analysis (Lovaas, 1987), TEACCH (Mesibov, Shea, & Schopler, 2005), and pivotal response training (Koegel & Koegel, 2006) have contributed to the field of special education for children with ASD. In the United Kingdom, the prevalence rates of ASD are approximately 3.8/1000 boys and 0.8/1000 girls (Taylor, Jick, & MacLaughlin, 2013). While in Australia, the 2012 Survey of Disability, Aging and Carers (SDAC) estimated that the prevalence rates of ASD are 8/1000 and 2/1000 for males and females respectively (Australian Bureau of Statistics, 2014). However, the prevalence in the United States is increasing with the latest data showing that 14.7/1000 (one in 68) children has been diagnosed with an ASD (Centers for Disease Control and Prevention, 2014). Schools will need to be prepared to educate an increasing number of students with ASD in the years to come.

The number of research studies focused on ASD, particularly in the areas of education and treatment, has increased tremendously. Still, the education of children with ASD continues to be a challenge for school professionals. One area that causes significant challenge in the education of students with ASD is problem behavior. Teachers often indicate that problem behaviors are a significant stressor in their profession (Hastings & Brown, 2002). These problem behaviors include aggression, self-injurious behavior (SIB), stereotyping, and repetitive behavior (Horner, Carr, Strain, Todd, & Reed, 2002). The prevalence of aggression in children with ASD has been found to be around 53% (Mazurek, Kanne, & Wodka, 2013). Students with ASD who exhibit aggression or obsession with certain topics that involve violence can often be suspended from school. While these challenging behaviors very often have communicative intent, teachers have difficulty understanding and managing these behaviors in their classrooms (Starr & Foy, 2012).

In the past, interventions for problem behaviors tended to be punitive and aversive (Morrison, Redding, Fisher, & Peterson, 2006). However, researchers are emphasizing the need for positive behavior supports (PBS), involving functional behavioral assessment (FBA) and the design of interventions to match the function of the problem behavior (Snell, Voorhees, & Chen, 2005). FBA is a process of gathering information to identify the maintaining contingencies for problem behavior in the individual's environment (O'Reilly, 1997). Interventions are then based on the function of the problem behavior. The use of FBA and the principles of PBS have changed the goal of behavior support from a sole focus on removal of problem behavior to a more holistic approach of preventing problem behaviors, teaching alternative skills, and on improving the individual's quality of life (Carr, et al., 2002).

Many research syntheses have examined the effectiveness of behavioral interventions for challenging behavior either for individuals with ASD specifically (e.g., Campbell, 2003; Machalicek, O'Reilly, Beretvas, Sigafoos, & Lancioni, 2007) or for individuals with disabilities that include ASD (e.g., Carr et al., 1999). Overall, previous research syntheses have found that function-based interventions are effective in reducing problem behaviors in children with ASD. However, there are two consistent findings from these reviews that point to limitations of existing research on function-based interventions. First, an area that has been sorely neglected is the evaluation of maintenance and generalization effects (Snell et al.,

2005). Many researchers have called for further research to evaluate the maintenance and generalization effects of behavioral interventions for problem behaviors (Horner, et al., 2002; Scotti, Evans, Meyer, & Walker, 1991) as this may provide further evidence of the effectiveness of these interventions to promote lasting and meaningful outcomes. Second, many of the existing research studies on function-based interventions have been led by researchers with limited involvement of teachers (Goh & Bambara, 2012). As a key component of PBS is ensuring social validity and acceptability of interventions by typical intervention agents, researchers must ensure that teachers have an integral role in research in order to demonstrate the feasibility of applying these interventions by teachers in the classrooms. More importantly, teachers need to be adequately trained to plan and implement FBA and function-based interventions. Research has shown that teachers can be trained successfully to conduct FBA and write appropriate behavior support plans (e.g., Bethune & Wood, 2013).

Although Machalicek and colleagues (2007) conducted a review of studies addressing challenging behaviors in school settings for students with ASD, however, not all the studies in their review were FBA-based. Thus, missing from the existing literature is a review of function-based interventions specific to students with ASD in school settings. Such a review is warranted as it could provide evidence to support the use of function-based interventions in schools and would be of use to researchers in determining gaps in the research base for this specific population of students. Therefore, the purpose of this literature review is to provide a descriptive overview of function-based interventions used in school settings for students with ASD.

Method

Search Procedures and Selection Criteria

The literature search was conducted in three phases. First, an electronic search of databases (*Education Research Complete*, *ERIC*, and *PsycInfo*) was conducted for studies published between 2000 and 2012. The database of studies for the present review was established from a broad search using the following keywords: behavior problems, behavior modification, behavioral assessment, self-injurious behavior, positive behavior support, functional behavioral assessment, functional analysis, and functional assessment. In addition, the terms autism, pervasive developmental disorders, and autism spectrum disorders were included in the search. Second, a hand search of journals in which function-based interventions is frequently published was conducted: *Behavior Modification, Behavioral Disorders, Behavioral Interventions, Child and Family Behavior Therapy, Education and Training in Autism and Developmental Disabilities, Education and Treatment of Children, Focus on Autism and Other Developmental Disabilities, Journal of Applied Behavior Analysis, Journal of Autism and Developmental Disorders, Journal of Positive Behavior Interventions, Research and Practice in Severe Disabilities, Research in Autism Spectrum Disorders,* and *Research in Developmental Disabilities*. Third, we conducted ancestral searches of studies referenced in the included studies and in the reference lists of literature reviews on FBA-based interventions (Beavers, Iwata, & Lerman, 2013; Goh & Bambara, 2012; Machalicek, et al., 2007; Reed, Hirst, & Hyman, 2012).

Studies were included based on the following criteria: (a) school-aged participant had a diagnosis of autism, Asperger's, or pervasive developmental disorder (PDD), (b) the study

was conducted in a K-12 school setting, (c) assessment was conducted using one or more FBA methods to identify variables associated with challenging behavior (d) an individualized intervention to address problem behavior was implemented, (e) the study employed a single-subject research design that demonstrated experimental control with the exclusion of AB design and group designs, and (f) graphed data included at least two points in baseline and intervention respectively.

Coding Procedures

Four categories of independent variables were coded for each study. The four categories were (a) Participant features: gender, grade level, classroom setting, and target behavior; (b) Assessment features: FBA method, function of problem behavior, teacher involvement in FBA, and physical context of FBA; (c) Intervention features: intervention component implemented, teacher involvement in intervention, and physical context of intervention; and (d) Study features: research design, procedural fidelity, and social validity. A description of each of the independent variables is provided in the Results section.

Inter-rater Agreement

The first and second authors served as the primary coders in this study. Several graduate students in special education were trained in the coding system and independently coded a random sample of 38% (n = 14) of the included research studies. Inter-rater agreement was calculated separately for each item coded under participant, assessment, intervention, and study features. Inter-rater agreement was calculated by dividing the number of agreements by the number of agreements plus disagreements, multiplied by 100. The mean inter-rater agreement for the coding of participant, assessment, intervention, and study features was 94% (range, 78%-100%). After the inter-rater agreement was conducted, any disagreement was resolved through a consensus from both the primary and secondary coders.

Results

Research Studies

Thirty-seven research studies in 12 different journals met the inclusion criteria. These studies included a total of 62 participants with ASD. The two journals that published the highest number of research studies in this review were *Journal of Applied Behavior Analysis* (n = 8) and *Behavior Modification* (n = 7). These two journals made up approximately 41% of the research studies on school-based function-based intervention for students with ASD. Table 1 presents detailed information for each study, including the independent variables that were coded (features of the participant, assessment, intervention, and study). All of the studies reported positive findings in terms of reduction in problem behaviors and/or increase in appropriate behaviors.

Table 1. Function-Based Interventions for Students with Autism Spectrum Disorders

Author(s)	**Participant:** Participant Description; Typical Setting; Target Behavior. **Study:**Design; Social Validity; Procedural Fidelity	**Assessment:** FBA Type; Function of Behavior; Teacher Involvement; Assessment Context. **Intervention:** Intervention Type; Teacher Involvement; Intervention Context	**Results**
Athens & Vollmer (2010)	2 male elementary student with autism; NS; Aggression; Reversal design; No; No.	Experimental FBA; (i) Attention & (ii) Tangible; Yes; Typical. Consequence intervention (DRA without extinction); No; Typical.	Aggression decreased and appropriate behavior increased for both students during intervention and 1- & 2-month follow-up.
Banda et al. (2009)	1 male middle school student with severe autism; Special education; SIB. ABAC reversal design; Yes; Yes.	Descriptive & experimental FBA; Multiple functions; Yes; Typical. Antecedent & consequence interventions (positive social attention & extinction); Yes; Typical.	SIB decreased.
Braithwaite & Richdale (2000)	1 male elementary student with autism & ID; General & special education; SIB. Multiple-baseline across behavioral outcomes design; No; No.	Descriptive FBA; Escape & tangible; Yes; Typical. Skill instruction & consequence intervention (FCT & extinction); Yes; Typical.	SIB decreased and correct use of taught phrase increased.
Buckley & Newchok (2005)	1 male elementary student with autism; Special education; Aggression. Reversal design; No; No.	Experimental FBA; Tangible; No; Atypical. Skill instruction & consequence intervention (functional communication training & extinction); No; Atypical.	Aggression lower during low effort mands condition compared to high effort mands condition.
Butler & Luiselli (2007)	1 female middle school student with autism; Special education; SIB. Reversal design; No; No.	Experimental FBA; Escape; Yes; Typical. Antecedent & consequence interventions (non-contingent escape, blocking, & instructional fading); Yes; Typical.	Problem behavior decreased and frequency of requests increased.
Cale et al. (2009)	5 male & 3 female elementary student with ASD; General & special education; Disruption, aggression, & SIB. Multiple-baseline across participants design; Yes; Yes.	Descriptive FBA; Not identified; Yes; Not applicable. Antecedent interventions (environmental modifications); Yes; Typical.	High rates of completion of routines and near total elimination of problem behaviors.
Campbell & Tincani (2011)	2 male & 1 female elementary student with ASD; General & special education; Non-engagement (noncompliance & task refusal). Multiple-baseline across participants design; Yes; Yes.	Descriptive FBA; (i) & (ii) Tangible, & (iii) Escape & tangible; Yes; Not applicable. Skill instruction (Power Card strategy); Yes; Typical.	Direction following improved for all students during intervention. Skill maintained for 2 out of 3 students during follow-up.

Author(s)	**Participant:** Participant Description; Typical Setting; Target Behavior. **Study:**Design; Social Validity; Procedural Fidelity	**Assessment:** FBA Type; Function of Behavior; Teacher Involvement; Assessment Context. **Intervention:** Intervention Type; Teacher Involvement; Intervention Context	**Results**
Casey & Merical (2006)	1 male middle school student with autism; General & special education; SIB. Multiple-baseline across settings design; No; No.	Descriptive & experimental FBA; Escape; Yes; Typical. Skill instruction (functional communication training); Yes; Typical.	SIB reduced and maintained at 24-month follow-up.
Chung & Canella-Malone (2010)	1 female elementary student with autism & ID; Special education; Stereotypy. Multiple-baseline across participants design; No; No.	Experimental FBA; Automatic reinforcement; No; Atypical. Antecedent intervention (presession response blocking); No; Atypical.	Stereotypy reduced and correct responding increased.
Cihak et al. (2012)	4 male middle school student with autism; General & special education; Non-engagement (off-task). BAB reversal design; Yes; Yes	Descriptive & experimental FBA; (i) & (ii) Attention, & (iii) & (iv) Escape; Yes; Typical. Skill instruction & consequence intervention (Social Stories™, video self-modeling, teacher contingent responses); Yes; Typical.	Task engagement higher during intervention for all students.
Clarke et al. (2002)	1 female middle school student with autism; Special education; SIB. Multiple-baseline across activities design; Yes; No.	Descriptive FBA; Escape; Yes; Typical. Antecedent & consequence interventions (e.g., environmental & material modifications, praise); Yes; Typical.	Problem behaviors reduced and engagement increased during intervention and 1-yr follow-up.
Conroy et al. (2005)	1 male elementary student with mild autism; General & special education; Stereotypy. Alternating treatments with an initial baseline design; No; No.	Descriptive & experimental FBA; Automatic reinforcement; Yes; Atypical. Antecedent intervention (stimulus cards); Yes; Typical.	Stereotypy decreased but engagement did not increase.
Crozier & Tincani (2005)	1 male elementary student with autism; Special education; Disruption (talking out). ABAC reversal design; Yes; Yes.	Descriptive FBA; Attention; Yes; Typical. Skill instruction & antecedent intervention (Social story & verbal prompts); No; Atypical.	Talk-outs reduced and maintained at 2-week follow-up.
Devlin et al. (2009)	1 male elementary student with autism; Special education; SIB. Alternating treatments with a final best treatment phase design; No; No.	Experimental FBA; Escape; No; Typical. Antecedent & consequence interventions (interpersonal requests, positive reinforcement, & extinction); No; Typical.	Frequency of SIB lower with behavioral intervention compared to sensory-integration therapy.
Devlin et al. (2011)	4 male elementary students with autism; Special education; SIB & stereotypy. Alternating treatments with an initial baseline & final best treatment phase design; No; No.	Descriptive/experimental FBA; Escape & Tangible or Escape; No; Atypical. Antecedent & consequence interventions (multi-component interventions); No; Typical.	Frequency of problem behavior lower with behavioral intervention compared to

Author(s)	**Participant:** Participant Description; Typical Setting; Target Behavior. **Study:**Design; Social Validity; Procedural Fidelity	**Assessment:** FBA Type; Function of Behavior; Teacher Involvement; Assessment Context. **Intervention:** Intervention Type; Teacher Involvement; Intervention Context	**Results**
			sensory-integration therapy for all students.
English & Anderson (2006)	1 male elementary student with autism; NS; SIB. ABACAB reversal design; No; Yes.	Descriptive & experimental FBA; Multiple functions; Yes; Typical. Antecedent & consequence interventions (physical guidance & attention during 15-s break); Yes; Typical.	Intervention based on SDA more effective compared to intervention based on analog functional analysis.
Franco et al. (2009)	1 male elementary student with autism; Special education; Disruption (making sounds). Multiple-baseline across settings design; No; Yes.	Experimental FBA; Escape & tangible; Yes; Typical. Skill instruction (FCT); No; Typical.	Problem behaviors reduced and engagement increased.
Friedman & Luiselli (2008)	1 male middle school student with autism; Special education; Non-engagement (sleeping). Reversal design; No; No.	Descriptive FBA; Escape & automatic reinforcement; Yes; Typical. Antecedent & consequence interventions (stimulus change, response interruption & redirection, & positive reinforcement); Yes; Typical.	Daytime sleep eliminated during intervention and 6-month follow-up.
Hoch et al. (2002)	1 male & 1 female elementary students with autism, Special education; Aggression & SIB. Reversal design; No; Yes.	Experimental FBA; Escape; Yes; Typical. Consequence intervention (negative reinforcement with preferred activities); Yes; Typical.	Problem behaviors reduced & task completion increased during intervention and follow-up. Behaviors generalized to novel instructors and tasks.
Kelley et al. (2002)	1 male elementary student with autism & severe ID; Special education; Aggression. Multiple-baseline across participants design; No; No.	Experimental FBA; Escape; No; Atypical. Skill instruction & consequence intervention (FCT with extinction); No; Atypical.	Aggression decreased and communication responses increased.
Kennedy et al. (2000)	1 male elementary student with autism; Special education; Stereotypy. Multiple-baseline across behavioral functions design; No; No.	Experimental FBA; Multiple functions; No; Atypical. Skill instruction & consequence intervention (FCT, response interruption, extinction, prompting of alternative response); No; Atypical.	Stereotypy decreased and signing increased.
Kern et al. (2006)	1 male high school student with autism & severe ID; Special education; SIB. Reversal design; No; No.	Descriptive FBA; Automatic reinforcement; Yes; Typical. Skill instruction & consequence intervention (exchange inedible	Pica decreased and exchanges for edibles increased.

Author(s)	**Participant:** Participant Description; Typical Setting; Target Behavior. **Study:**Design; Social Validity; Procedural Fidelity	**Assessment:** FBA Type; Function of Behavior; Teacher Involvement; Assessment Context. **Intervention:** Intervention Type; Teacher Involvement; Intervention Context	**Results**
		items for edibles & response blocking); Yes; Typical.	
Lang et al. (2009)	1 female elementary student with severe autism; NS; Stereotypy. Alternating treatments with a baseline design; No; No.	Experimental FBA; Automatic reinforcement; NS; NS. Antecedent intervention & skill instruction (play intervention with AOC); No; Atypical.	Reduced stereotypy and problem behavior and increased functional play during play intervention with AOC.
Lang et al. (2010)	1 male & 1 female elementary students with severe autism; Special education; Stereotypy. Alternating treatments with a baseline design; No; Yes.	Descriptive & experimental FBA; Automatic reinforcement; Yes; Atypical. Antecedent & skill instruction (play intervention with AOC); Yes; Atypical.	Reduced stereotypy and challenging behavior and increased functional play during play intervention with AOC for both students.
Langdon et al. (2008)	1 male & 1 female elementary students with autism & severe ID; Special education; SIB. BAB reversal design; No; No.	Descriptive & experimental FBA; Escape; Yes; Atypical. Skill instruction (FCT using PECS); No; Atypical.	Problem behavior reduced and communication responses increased for both students.
Liu-Gitz & Banda (2010)	1 male elementary student with autism; Special education; Stereotypy. Reversal design; Yes; Yes.	Experimental FBA; Automatic reinforcement; Yes; Typical. Consequence intervention (Response Interruption & Redirection); Yes; Typical.	Vocal stereotypy reduced.
Luiselli et al. (2004)	1 male elementary student with autism; Special education; Stereotypy. Alternating treatments design; No; No.	Experimental FBA; Escape & automatic reinforcement; No; Typical. Antecedent intervention (alternative sensory consequence with a chew object); No; Typical.	Saliva play eliminated.
Mace et al. (2011)	1 male middle school student with autism; Special education; Aggression. Reversal design; No; No.	Experimental FBA; Tangible; No; Typical. Consequence intervention (offering alternative preferred activity or permitting delayed access contingent on completion of low-preference demands); No; Typical.	Problem behaviors reduced.
Machalicek et al. (2009)	2 female elementary student with autism & moderate ID; Special education; SIB.	Experimental FBA; Attention & escape; No; Atypical. Antecedent & consequence	Challenging behaviors reduced and engagement

Author(s)	**Participant:** Participant Description; Typical Setting; Target Behavior. **Study:**Design; Social Validity; Procedural Fidelity	**Assessment:** FBA Type; Function of Behavior; Teacher Involvement; Assessment Context. **Intervention:** Intervention Type; Teacher Involvement; Intervention Context	**Results**
	Alternating treatments design; No; No.	interventions (positive attention with academic demands interspersed among preferred activities); No; Typical.	increased for both students.
O'Reilly et al. (2005)	1 male middle school student with autism & ID; Special education; SIB. Reversal design; No; No.	Experimental FBA; Escape; No; Typical. Antecedent intervention (individualized schedule); No; Typical.	SIB reduced and engagement increased during intervention & 5-month follow-up.
Patel et al. (2000)	1 male elementary student with autism; Special education; Stereotypy. Reversal with a multi-element component design; No; Yes.	Experimental FBA; Automatic reinforcement; No; Atypical. Consequence intervention (DRO with preferred sensory stimuli); No; Atypical.	Stereotypy reduced.
Pennington et al. (2012)	1 male elementary student with autism; Special education; Non-engagement (elopement). ABA reversal design; No; No.	Descriptive FBA; Attention; Yes; Typical. Consequence intervention (DRA); Yes; Typical.	Elopement reduced during intervention but did not fully return to baseline levels when intervention was withdrawn.
Rapp et al. (2009)	2 male elementary students with autism; Special education; Stereotypy. Multiple baseline across participants with multi-element & reversal design; No; No.	Experimental FBA; Automatic reinforcement; No; Typical. Antecedent & consequence interventions (stimulus cue cards & verbal reprimands); No; Typical.	Vocal stereotypy reduced for both students.
Romaniuk et al. (2002)	1 female elementary student with autism; General & special education; Disruption. ABABAB reversal design; No; No.	Experimental FBA; Escape; No; Atypical. Antecedent intervention (provided with choices); No; Atypical.	Problem behaviors reduced.
Ross (2002)	1 male & 1 female elementary students with autism; Special education; Socio-communication skills. ABA reversal design; No; Yes.	Experimental FBA; Attention; No; Atypical. Skill instruction & consequence intervention (FCT & token reinforcement); No; Atypical.	Faulty responses decreased and conversational units increased for both students. Effects generalized to novel person for one student.
Stichter et al. (2009)	3 male elementary students with autism; General & special education; Aggression, stereotypy, & non-engagement. Multiple-baseline across educational contexts design;	Descriptive & experimental FBA; Not identified; Yes; Typical. Antecedent intervention (individualized antecedent strategies, such as, proximity, pre-correction, scheduling); Yes; Typical.	Problem behaviors reduced and engagement and social interaction increased during intervention and

Author(s)	**Participant:** Participant Description; Typical Setting; Target Behavior. **Study:**Design; Social Validity; Procedural Fidelity	**Assessment:** FBA Type; Function of Behavior; Teacher Involvement; Assessment Context. **Intervention:** Intervention Type; Teacher Involvement; Intervention Context	**Results**
	No; Yes.		maintenance for all students.
Waters et al. (2009)	2 male elementary student with autism; General & special education; Aggression. Multiple-baseline across participants design; No; No.	Experimental FBA; Escape & tangible; No; Typical. Antecedent & consequence interventions (Visual schedule, DRO plus extinction); No; Typical.	Transitions with problem behaviors reduced for both students.

Note: NS = not specified; FBA = functional behavioral assessment; DRA = differential reinforcement of alternative behavior; SIB = self-injurious behavior; ID = intellectual disability; FCT = functional communication training; ASD = autism spectrum disorders; AOC = abolishing operation component; SDA = structured descriptive assessment; PECS = *Picture Exchange Communication System*; DRO = differential reinforcement of other behavior.

Participant Features

Gender and grade level. Thirty-one studies involved male participants and 12 studies involved female students. In the majority of the studies, the studies were conducted with elementary students (grades K-5; *n* = 28), followed by middle school students (grades 6-8; *n* = 8). Of the 37 studies, only one study (i.e., Kern, Starosta, & Alderman, 2006) included a high school student (grades 9-12).

Classroom setting. This independent variable described the classroom placement of the participant. Twenty-six studies were conducted with participants in special education settings, eight studies for students in inclusive settings, and one study included students who were placed in general education settings. Finally, in three studies, the classroom placements of the participants were not specified in the research studies.

Target behavior. This independent variable described the problem behavior that was targeted for intervention in the research studies. Problem behaviors were grouped into the following five categories listed here by decreasing severity: Stereotypy/self-injurious behavior (e.g., hand flapping, hand biting, head hitting), aggression (e.g., hitting or throwing objects at others), disruption (e.g., talking out loud and crying), non-engagement (off-task behaviors that were not disruptive in the class setting, such as looking out the window or sleeping in class), and socio-communication skills (e.g., conversational skill or appropriate interaction). The most prevalent type of behavior was stereotypy/self-injurious behavior, targeted in 24 studies. Aggression was the next most prevalent category of behaviors reported (*n* = 8), followed by non-engagement (*n* = 5). Four studies targeted disruption and one study focused on the lack of socio-communication skills (i.e., Ross, 2002).

Assessment Features

FBA type. This variable described the specific descriptive and experimental assessment procedures that were employed to assess the environmental influences on the participant's behavior. Experimental FBA included functional analysis, hypothesis testing, or

structural analysis. Descriptive FBA included interview and questionnaire, rating scales, direct observation of behavior, and record review. Twenty-one studies utilized experimental FBA only. Seven studies used descriptive FBA only. The use of a combination of both experimental and descriptive FBA was carried out in nine studies.

Function of problem behavior. This variable referred to the function of problem behavior that was identified in the study based on the FBA results. In the research studies where a single function was identified for the problem behavior, the most common function was escape (n = 11), followed by automatic reinforcement (n = 8), attention (n = 5), and tangible (n = 4). When the FBA indicated more than one function, the function of the problem behavior was coded as having multiple functions. In 11 studies, multiple functions were identified. Finally, the function of the problem behavior was not identified in two studies (i.e., Cale, Carr, Blakeley-Smith, & Owen-DeSchryver, 2009; Stichter, Randolph, Kay, & Gage, 2009). The function of the problem behavior was typically not reported when the researchers utilized a structural analysis or hypothesis testing for the FBA without identifying the function of the problem behavior.

Teacher involvement in FBA. This variable examined whether or not teachers were involved in the FBA. Of the 37 studies, 21 studies involved teachers in the FBA. Most of the teacher involvement in FBA was in the form of providing information for the FBA through interviews or questionnaires regarding the students' behavior. However, there were some studies in which the teachers had a more active involvement in the FBA process. In these studies, teachers participated in the functional analysis (e.g., Cihak, Kildare, Smith, McMahon, & Quinn-Brown, 2012), observed and recorded behavioral data (e.g., Franco et al., 2009; Kern et al., 2006), and/or formulated the hypothesis with the researcher (e.g., Clarke, Worcester, Dunlap, Murray, & Bradley-Klug, 2002). Typically, for studies that did not involve teachers in the FBA, researchers or clinicians, were the assessment agents (e.g., Athens & Vollmer, 2010; Mace, Pratt, Prager, & Pritchard, 2011).

Physical context of FBA. This variable described the location in which the FBA was conducted. In 22 studies, the FBA was conducted in typical settings such as the participants' respective classrooms. However, participants in 12 studies were pulled out to atypical settings (e.g., behavioral observation room) for the FBA. When only teacher interviews or questionnaires were carried out, with no involvement of the participants in the FBA, the physical context of FBA was coded as not applicable (n =3).

Intervention Features

Intervention component implemented. This variable described whether the study included the four key components of a comprehensive behavior support plan: (a) antecedent interventions, (b) skill instruction, (c) consequence interventions, and (d) long-term supports (Bambara, 2005). In this review, none of the studies implemented a long-term support intervention. Because a study could consist of more than one intervention component, the percentage of studies implementing each of the three intervention components (i.e., antecedent intervention, consequence intervention, skill instruction) totals to more than 100%.

The most prevalent component of behavior support utilized was consequence intervention. Consequence interventions comprise strategies that direct the provision of responses for problem behavior and/or appropriate behavior. Among the 37 studies, 23

(62%) included a consequence intervention component. The consequence strategies that behavior, response cost, and extinction.

The next most prevalent component of behavior support utilized was antecedent intervention. Antecedent interventions are strategies that focus on restructuring the environment to prevent the occurrence of problem behaviors (Kern & Clarke, 2005). Antecedent strategies were implement in 54% of the studies (n = 20). A diverse variety of antecedent strategies were implemented, including curricular modifications, environmental arrangement, and choice-making.

The final component of behavior support that was examined was skill instruction. Skill instruction comprises strategies that teach the students an alternative skill to replace the problem behavior or a skill that improves their functioning in school settings (Halle, Bambara, & Reichle, 2005). Slightly more than one third of the studies (n = 14) included a skill instruction component. The skills that were taught included communication skills, social skills, and play skills.

Teacher involvement in intervention. This variable examined whether or not teachers were involved in designing and implementing the intervention strategies. Teachers were involved in intervention in 46% of the studies (n = 17). Teachers often took the role of intervention agent to implement the strategies. In a small minority of studies, teachers were involved in designing the intervention plan (e.g., Clarke, et al., 2002). Studies that did not involve teachers in intervention typically utilized therapists as the intervention agent.

Physical context of intervention. This variable described the location in which the intervention was implemented. In the majority of the studies (n = 26, 70%), the intervention was implemented in typical settings, such as, participants' classrooms. However, a small number of the studies were implemented in atypical settings, such as the assessment room or an empty room within the school building.

Study Features

Research design. This variable described the single-subject research design that was utilized in the study. Almost half of the included studies (n = 18) used a reversal design. A multiple baseline design was utilised in 12 studies, and seven studies employed an alternating treatments design.

Maintenance. Maintenance refers to the ability to continue to demonstrate behavioral reduction or gains after the intervention has been discontinued. Slightly less than a quarter of the studies (n = 9) measured maintenance effects. Among the studies where maintenance data were collected, the shortest maintenance duration examined was two weeks, while the longest was 24 months. In some studies, maintenance was examined but the maintenance duration was not stated in the study.

Generalization. Generalization refers to the ability to demonstrate behavioral reduction or gains in novel environments or conditions. Only two studies evaluated the generalization effects of the intervention (i.e., Hoch, McComas, Thompson, & Paone, 2002; Ross, 2002).

Procedural fidelity and social validity. This variable documented whether the study measured procedural fidelity (i.e., the extent to which the intervention was implemented as planned) and social validity (i.e., the acceptability of the intervention components to typical

intervention agents). In 13 studies, procedural fidelity was measured. However, social validity was only evaluated in seven studies (19%).

Discussion

The purpose of this study was to synthesize research on function-based interventions for students with ASD in school settings. In general, the findings for student characteristics were consistent with the research syntheses of function-based interventions for school-aged participants that included students with and without disabilities (Goh & Bambara, 2012; Snell et al., 2005). The majority of the students who were involved in the function-based interventions were male; this finding was also reported in other research syntheses on behavioral interventions that included individuals with ASD (Campbell, 2003; Carr, et al., 1999; Didden, Korzilius, Van Oorsouw, & Sturmey, 2006), and this aligns with the greater proportion of males identified with ASD (Centers for Disease Control and Prevention, 2014). Only about a fifth of the participants were middle school students and there was only one high school student out of all of the 62 participants in this research synthesis. This is a disturbing finding and suggests the need for more research using function-based interventions with this student population.

Traditionally, interventions for problem behavior have been implemented in restrictive settings (e.g., hospitals and inpatient settings). Although there were studies conducted with students with ASD in inclusive settings, the majority of the studies reviewed were conducted with students who were in special education settings. Function-based interventions have customarily been utilized with more severe problem behaviors such as self-injurious behaviors and aggression (Carr,et al., 1999). However, in this research synthesis, we found that function-based interventions were utilized across a wide range of problem behaviors, from severe SIB to common off-task behaviors in the classroom. Further, a majority of the FBA and interventions were implemented within the students' classrooms. This is a welcome finding, demonstrating the use of function-based interventions for various problem behaviors that occur in inclusive classroom settings.

With regard to the use of FBA, experimental FBA (i.e., functional analysis, structural analysis and hypothesis testing) alone or in combination with descriptive methods was the most commonly used FBA method; a finding consistent with other research syntheses (e.g., Campbell, 2003; Carr, et al., 1999; Didden, et al., 2006; Goh & Bambara, 2012). The function of the problem behaviors also varied across the studies with escape and automatic reinforcement being two of the most commonly identified functions of the problem behavior.

Although a large majority of the studies involved teachers, the extent of their involvement was not typically described in the studies reviewed. Generally, the teachers did not assume primary responsibilities for the design of assessment and intervention. In addition, few research studies reported social validity results. As teachers often prefer interventions that fit the context of their classroom and as they often choose interventions based on their own beliefs about problem behavior and its intervention (Boardman, Argüelles, Vaughn, Hughes, & Klingner, 2005), evaluating the teachers' satisfaction with the intervention would be an important measure of the sustainability of the intervention.

In terms of intervention components implemented, the use of consequence intervention and antecedent intervention were the most common, followed by skill instruction. Comprehensive lifestyle change has been advocated by many researchers as an important component in the intervention of problem behaviors that may produce meaningful and lasting change to the individual's quality of life (Carr, et al., 2002). However, research syntheses have found few or no studies that incorporated this intervention component (Goh & Bambara, 2012; Snell et al., 2005), a finding that was echoed in the present review.

As stated earlier, researchers have called for further research to evaluate the maintenance and generalization effects of behavioral interventions for problem behaviors (Horner, et al., 2002; Scotti et al., 1991) in order to provide further evidence of the effectiveness of these interventions to promote long term and meaningful outcomes. However, as reported by other researchers (Snell, et al., 2005), we also found that very few studies measured maintenance and generalization effects. Since many interventions were implemented in the student's classroom, perhaps generalization may not be as critical as compared to an intervention that is being implemented in a segregated setting. Even so, generalization of intervention effects could be demonstrated across novel settings or people within the school or in the home and community.

Limitations

The results on this review should be interpreted in accordance with several limitations. First, as with any review, the results are dependent on what can be ascertained from published research. Intervention studies that are published in scholarly journals are likely to report positive findings, and this leads to the possibility that the results of the present review may be positively skewed. Second, this review examined the components of published research studies and did not take into consideration the quality of the research that has been published. Although there is a great deal of overlap between the components that were examined in this studies and accepted quality indicators for special education research (e.g., Horner et al., 2005), beginning with a selection of only those research studies deemed to be high quality may have yielded different results.

Conclusion and Future Research

This research synthesis of function-based interventions with students with ASD in school settings resulted in several encouraging findings. Function-based interventions were found to be effective across various target problem behaviors in both inclusive and special education settings. An important future research agenda should target the collateral gains, such as social relationships and lifestyle change, that Horner, et al. (2002) and Scotti, et al. (1991) advocated as important outcome measures as indicators of the effectiveness of behavioral interventions for problem behaviors. Aside from this, future research is needed to evaluate the effectiveness of function-based interventions for high school students with ASD. Other important characteristics that warrant examination in future research include maintenance and generalization effects, the involvement of teachers in designing and decision-making process during assessment and intervention, and assessment of the social validity of the function-based intervention.

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