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# Individualized Positive Behavior Support in School Settings: A Meta-Analysis

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## Abstract

This meta-analysis examined school-based intervention research based on functional behavioral assessment (FBA) to determine the effectiveness of key individualized positive behavior support (IPBS) practices in school settings. In all, 83 studies representing 145 participants were included in the meta-analysis. Intervention, maintenance, and generalization effects were measured by computing the percentage of nonoverlapping data points (PND). Overall, FBA-based interventions were found to be equally effective across diverse student populations and educational settings, including inclusive classrooms. In terms of key IPBS practices, results indicated that team decision making during intervention planning led to significantly larger PNDs. Descriptive analysis revealed that there has been an increase in the use of IPBS practices in school-based FBA-based intervention research; however, some deficiencies were noted. Implications and recommendations for future research are discussed.

## Keywords

positive behavior supports, school, meta-analysis

Students who engage in problem behaviors, such as disruption, noncompliance, and aggression, continue to challenge school systems (Demaray, Malecki, & DeLong, 2006). Traditionally, punishment or exclusion-based interventions (e.g., detentions, loss of privileges) have been the most common approach to discipline (Morrison, Redding, Fisher, & Peterson, 2006). Research indicates that such reactive consequences alone may show some immediate reduction in problem behavior, but the effect is usually short lived (Zhang, Katsiyannis, & Herbst, 2004). Instead, researchers now recommend the use of proactive or preventive interventions as a means for reducing problem behaviors in schools (Sprague & Horner, 2006).

Gaining popular recognition and increased research support (Safran & Oswald, 2003), positive behavior support (PBS) is an alternative to traditional disciplinary practices. Built on the foundation of applied behavior analysis, person-centered planning, and inclusion, PBS employs educational and systems change methods to minimize problem behavior and improve an individual's overall quality of life (Carr et al., 2002). When applied in schools, PBS can be directed at three levels of intervention (Horner, Sugai, Todd, & Lewis-Palmer, 2005): (a) primary prevention, universal strategies applied to all students across all settings; (b) secondary prevention,

targeted strategies applied to groups of students at risk for developing chronic behavior problems; and (c) tertiary prevention, assessment-based and comprehensive supports used to address the individual needs of students with pervasive behavioral challenges.

Tertiary prevention, or individualized PBS (IPBS), enjoys the longest history of empirical support because of the extended evaluation of behavioral interventions with individuals with developmental disabilities in both school and nonschool settings (Carr et al., 1999). For students with disabilities, the Individuals with Disabilities Education Act of 1997 (IDEA, 1997) and its reauthorization in 2004 encourage the use of IPBS practices in schools. Specifically, IDEA requires school professionals to use functional behavior assessment (FBA) when students are at risk for a change of placement because of problem behaviors and to consider

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the use of positive behavioral approaches whenever an individualized behavior support plan is needed.

Although there is not one universally accepted definition of IPBS, many would agree on these common features that distinguish IPBS from other behavioral approaches (Bambara, 2005; Carr et al., 2002): (a) IPBS is FBA based, interventions are logically linked to assessment information to address the environmental determinants and the function of the problem behavior, identified through multiple sources of information; (b) IPBS is proactive, emphasis is on preventing problem behavior through environmental modifications and teaching alternatives to problem behavior through skills training; (c) IPBS is comprehensive and emphasizes the use of multicomponent behavior intervention plans that modify antecedents and setting events to problem behavior, teach alternative skills, respond to problem behaviors when they occur, and facilitate lifestyle improvements for the student; (d) IPBS advocates that interventions be designed such that typical agents (e.g., teachers, paraeducators, parents) can implement them reliably in the individual's typical setting and that the interventions fit well in the individual's environment; (e) IPBS is team based, which advocates that stakeholders (e.g., parents, teachers, related service personnel) be involved collaboratively, not only during the planning and implementation of the intervention but also in decision making and ownership of the whole IPBS process; (f) IPBS promotes the design of interventions that increase positive outcomes for the individual that maintain across time and generalize across all relevant environments; and (g) IPBS emphasizes social validation, including the acceptability and perceived viability of an intervention by key consumers.

With regard to the efficacy of IPBS interventions, several quantitative syntheses of the single-case research literature, using one or a combination of single-case effect size measures, such as percentage of nonoverlapping data (PND; Scruggs, Mastropieri, & Casto, 1987), percentage of zero data (Scotti, Evans, Meyer, & Walker, 1991), standard mean difference (SMD; Busk & Serlin, 1992), Allison mean plus trend (Allison & Gorman, 1993), and percentage reduction in problem behavior (e.g., Carr et al., 1999), have evaluated the effectiveness of FBA-based interventions for reducing problem behaviors exhibited by individuals with disabilities (e.g., Campbell, 2003; Carr et al., 1999; Didden, Korzilius, van Oorsouw, & Sturmey, 2006; Harvey, Boer, Meyer, & Evans, 2009; Horner, Carr, Strain, Todd, & Reed, 2002; Marquis et al., 2000). Several syntheses (i.e., Campbell, 2003; Carr et al., 1999; Didden et al., 2006; Harvey et al., 2009; Horner et al., 2002) found FBA-based interventions to be more effective than non-FBA-based interventions on producing positive outcomes (i.e., reduction of problem behavior). In addition, a number of variables of potential intervention significance also have been identified, including the use of typical intervention agents, implementing interventions in

typical setting, utilizing multicomponent interventions, teaching replacement skills, and conducting experimental FBAs.

The findings of these research syntheses yield important information on intervention effectiveness; however, in terms of their generalized applicability to the use of IPBS interventions in school settings, they are limited in several ways. First, although Harvey et al. (2009) and Horner et al. (2002) focused primarily on school-aged participants and other research syntheses (Campbell, 2003; Carr et al., 1999; Didden et al., 2006) included this population as part of their overall sample, none of these research syntheses focused exclusively on this group in typical school settings. Thus, the conclusions are not specific to interventions conducted in school settings, nor can they be generalized to school settings.

Second, the research syntheses are further limited by their focus on select target populations. The research syntheses either focused only on developmental disabilities (Carr et al., 1999; Harvey et al., 2009; Marquis et al., 2000) or targeted specific developmental disability classifications, such as autism (Campbell, 2003; Horner et al., 2002) and mental retardation (Didden et al., 2006), and did not analyze IPBS across a range of disabilities. Thus, the effectiveness of IPBS with the full range of students typically present in schools has yet to be explored.

Third, with the exception of Didden et al. (2006) and Harvey et al. (2009), whose meta-analyses focused exclusively on individuals with mild mental retardation and developmental disabilities respectively, none of the research syntheses included research studies published after 2000. Meanwhile, the reauthorization of IDEA in 2004 continued to emphasize the use of FBA and IPBS practices for students with challenging behaviors. Furthermore, as research and practices in FBA and IPBS have continued to evolve in recent years, more research studies in these areas have been published.

Finally, the research syntheses are limited in one other important way. Although all of them investigated particular participant and intervention characteristics on overall effectiveness of behavioral interventions (both FBA based and non-FBA based) to reduce problem behavior, none exclusively evaluated the impact of intervention features characteristic of IPBS (e.g., teaming, social validity). This lack of focus on IPBS features may be explained by the relative recent emphasis on the use of IPBS interventions in school settings. Such an analysis is important if we are to understand the extent to which IPBS interventions are being applied, with which population of students, and whether or not certain IPBS features affect effectiveness.

To date, the only comprehensive review of IPBS interventions that focused on school-age individuals with disabilities has been descriptive in nature. Snell, Voorhees, and Chen (2005) reviewed 111 FBA-based intervention studies, published between 1997 and 2002, to examine the use of key IPBS features employed in research. In general, they

concluded that FBA-based studies conducted in more natural settings were more likely to incorporate key features of IPBS interventions than those FBA-based studies conducted in atypical settings. This review suggests a shift in intervention characteristics as more FBA-based interventions are applied in natural or typical settings. Their analysis, however, was limited by the lack of quantitative synthesis of intervention effectiveness and the inclusion of studies conducted in non-school settings (e.g., inpatient hospital).

The primary purpose of our meta-analysis was to quantitatively synthesize research on FBA-based interventions conducted exclusively in school settings to determine overall effectiveness and to analyze the relation between intervention effectiveness with various participant characteristics and IPBS assessment and intervention features. Specifically we sought to answer the following questions: (a) Overall, how effective are FBA-based interventions conducted in school settings for reducing problem behavior, increasing alternative or appropriate skills, and facilitating maintenance and generalization outcomes? (b) Is intervention effectiveness related to participant characteristics (e.g., gender, disability label), grade level, or classroom setting? and (c) Is the effectiveness of FBA-based interventions related to the incorporation of key IPBS features in assessment, planning, and implementation of the intervention? A secondary purpose was to descriptively analyze school-based FBA-based intervention studies in terms of participant characteristics and IPBS assessment and intervention features.

## Method

### Literature Search Procedures and Inclusion Criteria

Potential studies for inclusion in the meta-analysis were located using three strategies. First, a computerized search of the PsycINFO and ERIC online databases was conducted for studies published from 1997 to 2008. IDEA 1997 was the first legislation to encourage the use of IPBS approaches in schools; thus, 1997 was chosen as the start year for this meta-analysis. Only articles that were published in peer-reviewed journals were considered. The following descriptors were used for the computerized search: *behavior problems, behavior modification, behavioral assessment, self-destructive behavior, positive behavior support, functional behavioral assessment, functional analysis, and functional assessment.*

Second, a hand search of journals in which research in IPBS is commonly published was conducted: *American Journal of Mental Retardation, Behavior Modification, Behavior Therapy, Behavioral Disorders, Behavioral Interventions, Child and Family Behavior Therapy, Education and Training in Developmental Disabilities, Education and Treatment of Children, Exceptional Children, Focus on Autism and Other*

*Developmental Disabilities, Journal of Applied Behavior Analysis, Journal of Autism and Developmental Disorders, Journal of Behavior Education, Journal of Emotional and Behavioral Disorders, Journal of Positive Behavior Interventions, Psychology in the Schools, Research and Practice in Severe Disabilities, Research in Developmental Disabilities, School Psychology Quarterly, and School Psychology Review.* Third, we conducted an ancestral search of studies using the reference lists of literature reviews on IPBS and FBA-based interventions (e.g., Lane, Karlberg, & Shepcaro, 2009; Snell et al., 2005).

The abstract and method of each potential article were examined to determine whether the article met inclusion criteria. Six criteria were used. First, the study must have been conducted in a school setting, in a K–12 public, private, or residential school.

Second, participants, either with or without disabilities, must have been identified as school aged, attending elementary, middle, or high school. For participants with disabilities, the categories of diagnosis included mental retardation (MR) or developmental disabilities (DD), autism or pervasive developmental disorder (PDD), emotional and behavioral disorder (EBD), learning disabilities (LD), attention-deficit/hyperactivity disorder (ADHD), other health impairment (OHI), physical disabilities, and other disabilities.

Third, the study must have used one or more FBA methods (e.g., indirect observation, direct observation, or experimental) to identify environmental variables associated with targeted problem behaviors and have implemented individualized interventions based on the FBA results.

Fourth, the study must have assessed the effects of an FBA-based intervention on reducing problem behavior. The study may have included any combination or variation of the following interventions: antecedent modifications, alternative skill training, consequence-based strategies, and/or lifestyle intervention. Antecedent modifications included any intervention that removed or modified variables that elicited problem behaviors. Alternative skill training involved teaching the participant a functional skill that could replace or compete with the problem behavior. Consequence-based strategies included reactive interventions (e.g., extinction, differential reinforcement) delivered after a targeted behavior occurred. Lifestyle interventions included broad changes aimed at improving the quality of life of a participant.

Fifth, the study must have employed a single-participant research design that demonstrated experimental control, such as reversal, multiple baseline, changing criterion, or alternating treatment designs. Studies that utilized AB design were excluded. Because the focus of this meta-analysis was on IPBS, no study employed a group design.

Sixth, the graphed data of a study must have displayed at least two data points in each initial baseline and intervention phases, respectively. A criterion of a minimum of two data

points was selected to allow for a larger pool of studies, which provides for a more comprehensive picture of IPBS research that is being applied in schools.

### Coding Study Features

An adapted version of the instrument developed by Snell et al. (2005) was used to code each article included in the meta-analysis with respect to three categories of independent variables: (a) participant characteristics, (b) assessment characteristics, and (c) intervention characteristics. As participant, assessment, and intervention characteristics could vary within the same study, each characteristic was coded individually by each participant of each included study. A list of operational definitions and coding criteria of each term or category was developed to ensure reliability of coding and is available for review from the first author.

### Participant Characteristics

*Grade level, gender, classification label, and classroom placement.* Grade level described the grade level of the study participants and comprised three categories: (a) elementary (Grades K–5), (b) middle school (Grades 6–8), and (c) high school (Grades 9–12). Gender referred to the gender of the participant: (a) male or (b) female. Classification label described the primary diagnosis of the participant and comprised three categories: (a) DD (i.e., autism spectrum disorder, MR), (b) other disabilities (e.g., ADHD, EBD, LD, OHI, physical disabilities, other disabilities), and (c) no diagnosed disability. Other disabilities formed one category because there was an insufficient number of participants to form smaller diagnostic subgroups.

*Classroom placement.* This variable described the classroom placement of the participant and was separated into three categories: (a) general education (i.e., participant received instruction in a general education classroom only), (b) special education (i.e., participant received instruction in a special education classroom only), and (c) combination of general and special education (i.e., participant received instruction in a both general and special education classrooms). This variable did not take into consideration the type of school placement (e.g., typical public, alternative, or residential school). If a student was attending an alternative school for students with EBD, the classroom placement was coded as special education. However, if a student was attending a private residential school but was placed in a general education classroom, the classroom placement was coded as general education.

### Assessment Characteristics

*FBA method.* This variable described the FBA method that was used to assess the environmental influences of the

participant's behavior and comprised three categories: (a) experimental only (e.g., functional analysis, structural analysis, hypothesis testing), (b) descriptive only (e.g., indirect measures, such as interview, rating scales, archival record review, and/or direct observation), and (c) combination of experimental and descriptive methods.

*Assessment participant.* This variable described the participants who conducted and/or contributed information during the FBA process: (a) atypical (i.e., researcher or research assistant only) and (b) typical (i.e., involving at least one school employee). As it was unlikely that a researcher would not participate in the assessment at all, the assessment participant was coded as "atypical" only if the researcher was the only person involved in the assessment phase. For example, if a functional analysis was conducted by the researcher alone with no input from the teacher, the assessment participant was coded as "atypical." However, if the teacher or parent participated in either providing the information needed for the assessment or conducting the assessment itself, the assessment participant was coded as "typical."

*Assessment physical context.* This variable described the physical context where the assessment was conducted: (a) atypical (i.e., pull-out setting, such as an empty classroom) or (b) typical (i.e., participant's typical classroom setting whether in a general or special education classroom).

*Team decision making during assessment.* This variable described evidence of team decision making during assessment and was coded as either (a) yes or (b) no. A team was defined as the collaboration of at least two individuals involving at least one school-based employee (e.g., researcher and teacher). The presence of team decision making was recorded as yes when the study cited discussions and decision making that reflected input from relevant members of the team during the assessment phase.

### Intervention Characteristics

*Intervention type.* This variable described the types of interventions implemented with the participant and comprised four categories: (a) skills training, interventions that targeted skill acquisition (e.g., self-management, functional communication training); (b) antecedent-based intervention, interventions that made environmental modifications before problem behavior occurred (e.g., curricular modification, noncontingent reinforcement, choice making); (c) consequence-based intervention, interventions that were implemented following the occurrence of a targeted behavior (e.g., positive reinforcement, differential reinforcement, extinction); and (d) multicomponent interventions (i.e., combinations of two or more intervention categories).

*Intervention agent.* This variable described the agent who implemented the intervention and was separated into two categories relevant to the school setting: (a) atypical

(i.e., researcher or research assistant only) and (b) typical (i.e., involving at least one school employee).

**Intervention physical context.** This variable described the physical context where the intervention was implemented: (a) atypical (i.e., pull-out setting, such as an empty classroom) and (b) typical (i.e., participant's typical classroom setting whether in a general or special education classroom).

**Team decision making during intervention.** This variable described evidence of team decision making during intervention planning and implementation and was coded as either (a) yes or (b) no. The presence of team decision making was recorded as yes when the study cited discussions and decision making that reflected input from relevant school members in the team during the intervention planning and implementation phase. For example, when a study described a discussion between the researcher and classroom teacher about potential interventions that would be implemented with the student, team decision making was coded as yes.

**Social validity.** This variable described the inclusion of measures that evaluated the acceptability of intervention goals, procedures, and/or outcomes by relevant stakeholders. This variable was coded as either (a) yes or (b) no.

**Length of treatment.** This variable described the duration of treatment (i.e., total treatment data points across all treatment phases) and comprised two categories: (a) long (i.e., 21 or more data points) and (b) short (i.e., 20 or fewer data points). The criterion for the length of treatment was based on Snell et al. (2005).

### Computation and Analysis of Effectiveness

PND, a nonparametric procedure, provides a measure of intervention effectiveness for single-participant research studies (Scruggs et al., 1987). It is calculated by determining the percentage of intervention data that do not overlap with the highest (if the purpose of the intervention is to increase the dependent measure) or lowest (if the purpose of the intervention is to reduce the dependent measure) baseline data point. Although parametric approaches have been used to measure effect size (e.g., SMD), Scruggs and Mastropieri (2001) argue that because (a) data derived from single-participant research are nonindependent, therefore violating a primary assumption of inferential statistics, which is independence, and (b) single-participant research presents a limited number of data points, the use of PND is preferred over the use of conventional effect sizes. PND scores were interpreted based on the framework suggested by Scruggs and Mastropieri (1998): (a) greater than 90% is a large effect, (b) 70% to 90% is a moderate effect, (c) 50% to 70% is a low effect, and (d) less than 50% is not effective.

As this meta-analysis focused on individualized FBA-based interventions where participant, assessment, and intervention characteristics could vary within any one study, PND scores were computed individually by participant on all

dependent measures in a study. The individual participant was the unit of analysis. PND was calculated by dividing the total number of data points in the intervention phase that exceeded the highest or lowest baseline data point (depending on the purpose of the intervention) and multiplying by 100. PND scores were calculated across three categories of dependent measures (a) reduction of problem behavior, (b) increase in appropriate skills (e.g., alternative skills, academic skills), and (c) overall behavior change (combined measures). If a study included both dependent measures (i.e., reduction of problem behavior and increase in appropriate skill), the PND scores of both dependent measures were averaged for a PND score of overall behavior change. In addition to evaluating primary intervention effects, maintenance and generalization PND scores were calculated and analyzed separately on overall behavior change.

To evaluate the effects of particular participant, assessment, and intervention characteristics, individual PND scores were calculated and analyzed separately for each coded independent variable across all participants in all the studies. Overall behavior change was used as the dependent measure as there were too few cases of the other dependent measures that could be meaningfully compared across independent variable categories. Likewise, only intervention, and not generalization or maintenance effects, could be analyzed across independent variables because of an insufficient sample size. Median PND was used to aggregate scores across independent variables. Because PND is often not normally distributed, the median score was preferred to the mean as a summary statistic because median scores are less likely to be affected by outliers (Scruggs, Mastropieri, Cook, & Escobar, 1986). To test for significant differences among categories for each independent variable, two nonparametric tests, Mann-Whitney *U*, which allows for comparisons two independent samples, and Kruskal-Wallis *H*, which allows for multiple independent sample comparisons, were used.

### Interrater Agreement

The first author served as the primary coder in this study. A random sample of 30% ( $n = 25$ ) of the included studies was independently coded by a second coder (one of four graduate students in special education trained in the coding system). Interrater agreement was calculated separately for each item coded under participant and intervention characteristics. Interrater agreement was calculated by dividing the number of agreements by the number of agreements plus disagreements, multiplied by 100. The mean interrater agreement for the coding of participant, assessment, and intervention characteristics was 93% (range = 88%–100%). For PND, the overall interrater agreement was 93% for all outcomes. After the interrater agreement was conducted, any disagreement was resolved through a consensus from both the primary and secondary coders.

**Table 1.** Description of Articles

| Characteristic  | <i>n</i> | Percentage of studies |
|---|----------|-----------------------|
| Journal title   |          |                       |
| <i>Journal of Positive Behavior Interventions</i>             | 19       | 23.0                  |
| <i>Journal of Applied Behavior Analysis</i>                   | 18       | 21.7                  |
| <i>Education and Treatment of Children</i>                    | 11       | 13.3                  |
| <i>Behavioral Disorders</i>                                   | 9        | 10.8                  |
| <i>Education and Training in Developmental Disabilities</i>   | 4        | 4.8                   |
| <i>Journal of Emotional and Behavioral Disorders</i>          | 4        | 4.8                   |
| <i>Behavior Modification</i>                                  | 3        | 3.6                   |
| <i>Research in Developmental Disabilities</i>                 | 3        | 3.6                   |
| <i>Behavioral Interventions</i>                               | 2        | 2.4                   |
| <i>Child and Family Behavior Therapy</i>                      | 2        | 2.4                   |
| <i>Focus on Autism and Other Developmental Disabilities</i>   | 2        | 2.4                   |
| <i>Journal of Behavioral Education</i>                        | 2        | 2.4                   |
| <i>School Psychology Review</i>                               | 2        | 2.4                   |
| <i>Journal of Autism and Developmental Disorders</i>          | 1        | 1.2                   |
| <i>Journal of Early and Intensive Behavioral Intervention</i> | 1        | 1.2                   |
| Year published  |          |                       |
| 1997–2000   | 24       | 28.9                  |
| 2001–2004   | 22       | 26.5                  |
| 2005–2008   | 37       | 44.6                  |

Note: *N* = 83.

## Results

### Overall Study Characteristics

A total of 83 studies representing 145 participants met the inclusion criteria. The list of articles included in the meta-analysis is available from the first author. Table 1 provides information regarding the percentage of FBA-based intervention articles in schools published in leading special education and disabilities journals. Of the studies, 69% were found in four journals (*Journal of Positive Behavior Interventions*, *n* = 19; *Journal of Applied Behavior Analysis*, *n* = 18; *Education and Treatment of Children*, *n* = 11; *Behavioral Disorders*, *n* = 9). Of the 83 studies, 24 (28.9%) were published between 1997 and 2000, 22 (26.5%) between 2001 and 2004, and 37 (44.6%) between 2005 and 2008.

In terms of dependent variables targeted in the 83 studies, 33 studies (39.7%) were focused on the reduction of problem behavior only. Studies that targeted the reduction of problem behavior typically collected data on the student's off-task or disruptive behavior, aggressive or self-injurious behavior, and stereotypy. In all, 13 studies (15.7%) targeted the increase of appropriate behavior. For studies that targeted the increase in appropriate behavior, the common dependent variables were the student's on-task or engagement behavior and the increase in social or communication skills. Last, 37 studies (44.6%) targeted both the reduction of problem behavior and the increase of appropriate behavior.

### Overall Intervention, Maintenance, and Generalization Effects

With regard to the overall effectiveness of FBA-based interventions to occasion behavior change (i.e., reduction of problem behavior and increasing appropriate behavior) in school settings, the median PND was 88% (*n* = 145, range = 0%–100%, PND effect = moderate). When analyzed separately, intervention cases that targeted reduction of problem behavior yielded a slightly lower median PND of 80% (*n* = 122, range = 0%–100%, PND effect = moderate) when compared to the overall behavior change effects. Intervention cases that focused on increasing appropriate behavior yielded PND median of 90% (*n* = 76, range = 0%–100%, PND effect = moderate).

A total of 17 studies measured maintenance effects across 28 students and resulted in a PND median of 100% (range = 0%–100%, PND effect = large). The duration of maintenance ranged from 1 week to 24 months; however, 3 studies did not provide specific duration of maintenance.

Six studies evaluated generalization effects; however, in two studies, generalization data were collected during the intervention phase but no generalization data were collected during baseline. Thus, with no generalization baseline data for comparison, PND could not be calculated in these studies. The other four studies obtained a PND median of 94% (*n* = 12, range = 0%–100%, PND effect = large) for generalization. Three studies evaluated generalization across settings, and one study evaluated generalization across instructor. Because of the limited number of studies evaluating maintenance and generalization and the limited number of data points (i.e., usually one or two data points) involved in the calculation of PND scores for maintenance and generalization, we must be cautious when interpreting the maintenance and generalization effects of FBA-based interventions.

### Differences Across Participant Characteristics

Table 2 presents an overview of PND median and mean rank scores and *z* (derived from a Mann–Whitney *U* test) or  $\chi^2$  (derived from a Kruskal–Wallis *H* test) values of each participant, assessment, and intervention characteristic. With reference to participant characteristics, the majority of the participants (*n* = 108, 74%) were male students. FBA-based intervention implemented with male (PND = 89%) and female (PND = 87%) students resulted in moderate effect sizes. A Mann–Whitney test indicated that there was no significant difference in PND scores across the two gender groups.

Regarding participants' grade level in school, elementary school students were the majority (*n* = 100, 69%), followed by middle school students (*n* = 31, 21%) and high school students (*n* = 14, 10%). In terms of grade level differences, interventions applied across elementary (PND = 88%) and

**Table 2.** Results of Intervention Effectiveness (PND) by Participant, Assessment, and Intervention Characteristics

| Characteristic ( <i>n</i> )                               | PND median | Effect <sup>a</sup> | Mean rank | <i>z</i>           |
|---|------------|---------------------|-----------|--------------------|
| <b>Participant</b>  |            |                     |           |                    |
| <b>Gender</b>   |            |                     |           |                    |
| Male (108)  | 89         | Moderate            | 72.8      | -0.412             |
| Female (37)   | 87         | Moderate            | 69.7      |                    |
| <b>Grade</b>  |            |                     |           |                    |
| Elementary (100)  | 88         | Moderate            | 71.5      | 1.980 <sup>b</sup> |
| Middle (31)   | 76         | Moderate            | 67.4      |                    |
| High school (14)  | 99         | Large               | 85.5      |                    |
| <b>Diagnosis</b>  |            |                     |           |                    |
| Developmental disabilities (70)                           | 85         | Moderate            | 68.8      | 1.585 <sup>b</sup> |
| Other disabilities (41)                                   | 91         | Large               | 78.6      |                    |
| No diagnosed disability (34)                              | 90         | Moderate            | 70.5      |                    |
| <b>Classroom setting</b>                                  |            |                     |           |                    |
| General education (47)                                    | 93         | Large               | 72.7      | 0.518 <sup>b</sup> |
| Special education (66)                                    | 85         | Moderate            | 67.5      |                    |
| General and special education (27)                        | 89         | Moderate            | 71.4      |                    |
| <b>Assessment</b>   |            |                     |           |                    |
| <b>FBA method</b>   |            |                     |           |                    |
| Descriptive only (60)                                     | 88         | Moderate            | 72.6      | 0.358 <sup>b</sup> |
| Experimental only (31)                                    | 87         | Moderate            | 68.2      |                    |
| Combination (54)  | 91         | Large               | 73.5      |                    |
| <b>Assessment participants</b>                            |            |                     |           |                    |
| Typical (118)   | 88         | Moderate            | 71.0      | -0.642             |
| Atypical (27)   | 89         | Moderate            | 76.6      |                    |
| <b>Assessment physical context</b>                        |            |                     |           |                    |
| Typical (118)   | 90         | Moderate            | 73.6      | -0.983             |
| Atypical (27)   | 88         | Moderate            | 65.0      |                    |
| <b>Team decision making during assessment</b>             |            |                     |           |                    |
| Yes (46)  | 86         | Moderate            | 75.6      | -0.725             |
| No (99)   | 88         | Moderate            | 70.3      |                    |
| <b>Intervention</b>                                       |            |                     |           |                    |
| <b>Intervention type</b>                                  |            |                     |           |                    |
| Antecedent-based only (33)                                | 96         | Large               | 77.1      | 3.038 <sup>b</sup> |
| Consequence-based only (22)                               | 90         | Moderate            | 77.4      |                    |
| Skills training only (24)                                 | 91         | Large               | 77.7      |                    |
| Multicomponent (66)                                       | 80         | Moderate            | 65.6      |                    |
| <b>Intervention agents</b>                                |            |                     |           |                    |
| Typical (120)   | 88         | Moderate            | 71.2      | -0.546             |
| Atypical (25)   | 90         | Moderate            | 76.1      |                    |
| <b>Intervention physical context</b>                      |            |                     |           |                    |
| Typical (119)   | 88         | Moderate            | 72.6      | -0.368             |
| Atypical (26)   | 88         | Moderate            | 69.3      |                    |
| <b>Team decision making during intervention planning*</b> |            |                     |           |                    |
| Yes (57)  | 100        | Large               | 82.7      | -2.548             |
| No (88)   | 82         | Moderate            | 65.1      |                    |
| <b>Measures social validity</b>                           |            |                     |           |                    |
| Yes (56)  | 88         | Moderate            | 71.9      | -0.015             |
| No (88)   | 88         | Moderate            | 72.0      |                    |
| <b>Length of treatment</b>                                |            |                     |           |                    |
| Long (40)   | 80         | Moderate            | 67.7      | -0.786             |
| Short (105)   | 91         | Large               | 73.6      |                    |

Note: PND = percentage of nonoverlapping data; *n* = number of participants; FBA = functional behavioral assessment. *z* values are derived from Mann-Whitney *U* test.

a. Based on the framework suggested by Scruggs and Mastropieri (1998).

b. Chi-square (Kruskal-Wallis *H* test).

\**p* < .05.

middle school (PND = 76%) students resulted in moderate effect sizes. Although high school students constituted the smallest group, FBA-based interventions applied to this group

resulted in larger effect sizes (PND = 99%). However, a Kruskal-Wallis test indicated no significant differences across grade levels.



In terms of participant diagnosis, slightly fewer than half of the participants (48%) were diagnosed with DD, 28% of the participants were diagnosed with other disabilities (e.g., EBD, LD, ADD or ADHD), and more than a fifth (24%) of the participants carried no disability label. The other disabilities group yielded larger effect sizes for FBA-based interventions (PND = 91%) compared to DD (PND = 85%) and the no diagnosed disability group (PND = 90%), which both yielded moderate effect sizes. However, when the PND scores of the three diagnosis categories were compared, a Kruskal–Wallis test indicated no significant differences across diagnosis categories.

With regard to classroom placement, most participants received primary instruction in self-contained special education settings (47%). However, one third of the participants (34%) received instruction in general education classrooms and the rest of the participants (19%) received instruction in a combination of general and special education classrooms. In terms of intervention effectiveness, FBA-based interventions applied in general education classroom settings (PND = 93%) yielded large effect sizes. FBA-based interventions in special education classroom settings (PND = 85%) and combined general and special education classroom settings (PND = 89%) resulted in moderate effect sizes. However, a Kruskal–Wallis test indicated no significant differences across classroom setting categories.

### Differences Across Assessment Characteristics

With regard to the type of FBA utilized in the studies, descriptive methods only were the most commonly employed (42%), followed by a combination of descriptive and experimental methods (37%) and experimental methods only (21%). Although a combination of descriptive and experimental FBA methods (PND = 91%) yielded large effect sizes, descriptive only (PND = 88%) and experimental only (PND = 87%) obtained slightly lower PND scores within the moderate effectiveness range. A Kruskal–Wallis test indicated no significant difference in intervention effects across the three FBA categories.

A majority of the interventions involved typical assessment participants (81%). In terms of intervention effectiveness, both interventions that involved typical assessment participants (PND = 88%) and those that involved only atypical assessment participants (PND = 89%) obtained moderate effect sizes. A Mann–Whitney test indicated that there was no significant difference in the PND scores across the two assessment participant groups.

In the majority of the cases, assessments were conducted in a typical physical context, which was the participant's natural classroom setting (81%). With regard to intervention effectiveness, both interventions where the assessment was conducted in a typical context (PND = 90%) and atypical

assessment context (PND = 88%) resulted in moderate effect sizes. A Mann–Whitney test indicated no significant difference between the two assessment physical context categories.

Slightly more than a third of the cases involved team decision making during assessment, and the absence of team decision making was noted in 61% of the cases. Intervention cases that involved team decision making during assessment obtained moderate effect sizes (PND = 86%). On the other hand, intervention cases that did not include team decision making during assessment also obtained moderate effect sizes (PND = 88%). A Mann–Whitney test indicated no significant differences in PND scores between these two categories.

### Differences Across Intervention Characteristics

Next, we present intervention effects for each category of intervention characteristic associated with IPBS. In terms of intervention types, more participants received multicomponent interventions (45%), compared to antecedent modifications (23%), skill training (17%), and consequence-based interventions (15%) only. When the four intervention types were compared, the following intervention effects were obtained: antecedent modifications (PND = 96%), skills training (PND = 91%), consequence-based interventions (PND = 90%), and multicomponent interventions (PND = 80%). To summarize, both antecedent modifications and skills training interventions resulted in large effect sizes whereas consequence-based and multicomponent interventions yielded moderate effect sizes. Despite the differences in PND scores, a Kruskal–Wallis test indicated no significant differences among the intervention types.

A large majority of the interventions utilized typical intervention agents (83%). Both typical (PND = 88%) and atypical intervention agent (PND = 90%) categories yielded moderate effect sizes. A Mann–Whitney test indicated that there was no significant difference in PND scores across the two intervention agent groups.

Of the interventions, 82% were implemented in a typical physical context, which was the participant's natural classroom setting. Interventions applied in typical (PND = 88%) and atypical (PND = 88%) physical contexts yielded moderate effect sizes. A Mann–Whitney test indicated no significant differences in scores between the two categories.

Team decision making during intervention planning took place in a minority of the cases (39%). Intervention cases that utilized team decision making during intervention planning (PND = 100%; PND effect = large) obtained a higher PND score compared to when team decision making was absent during intervention planning (PND = 82%; PND effect = moderate). A Mann–Whitney test indicated that the presence of team decision making during intervention planning resulted in statistically significantly higher PND scores ( $z = -2.55, p < .05$ ).

In terms of the measurement of social validity of the interventions, social validity data were collected in only a minority of the cases (39%). Intervention cases that measured social validity (PND = 88%) and those that did not collect social validity data (PND = 88%) obtained moderate effect sizes. When the PND scores of intervention cases that measured social validity were compared to the scores of those that did not collect social validity data, there was no significant difference between these two categories as indicated by a Mann–Whitney test.

Last, with regard to the length of intervention, short interventions (i.e., 20 or fewer data points) were the majority (72%). The median PND scores for short and long intervention were 91% and 80%, respectively. Thus, short interventions yielded large effect sizes whereas long interventions resulted in moderate effect sizes. However, a Mann–Whitney test indicated no significant difference in the PND scores between these two categories.

## Discussion

The primary purpose of this meta-analysis was to quantitatively synthesize research on FBA-based interventions to determine overall effectiveness and the effectiveness of key IPBS features applied in school settings. A secondary purpose was to descriptively analyze school-based FBA-based intervention studies in terms of participant characteristics and IPBS assessment and intervention features. Previous research syntheses that evaluated FBA-based interventions have included school-aged participants in school settings (e.g., Campbell, 2003; Carr et al., 1999; Didden et al., 2006; Harvey et al., 2009; Marquis et al., 2000). However, the findings from those syntheses were not specific to this particular target group. This meta-analysis provides valuable information on the implementation and effectiveness of FBA and IPBS interventions employed exclusively in schools.

The 83 studies identified showed that individualized interventions were applied across a range of disability classifications, including students with no diagnosed disability, grade level, and classroom settings. In addition, the rate of published studies appears to be increasing, with a substantially higher percentage of FBA-based interventions being implemented in schools between 2005 and 2008.

### *Research Question 1: Overall, How Effective Are FBA-Based Interventions Conducted in School Settings for Reducing Problem Behavior, Increasing Alternative or Appropriate Skills, and Facilitating Maintenance and Generalization Outcomes?*

Overall, the results of the meta-analysis showed that FBA-based interventions applied in school settings can effectively

reduce problem behavior of students and increase their use of appropriate skills, with moderate effect sizes for both reduction in problem behavior and increasing appropriate skills. Furthermore, the interventions also yielded effective maintenance results for overall behavior change, with the duration of maintenance ranging from 1 week to up to 2 years. Given the current interest in assessing evidence-based practices in schools (Horner, Carr et al., 2005; Odom et al., 2005), these overall findings for intervention effectiveness are positive. The targeted studies included a range of problem behaviors, many quite severe and most likely exposed to other generic interventions that have been tried and failed. The overall findings for intervention effectiveness provide strong evidence that the needs of students with the most pervasive behavioral challenges can be effectively addressed in typical school settings and by intervention agents (e.g., teachers, paraprofessionals) typical to schools.

When considering specific outcomes emphasized by IPBS, several limitations were noted suggesting areas in need of more empirical investigations. First, although positive maintenance outcomes were found, few studies (20%) assessed maintenance, with only four studies reporting maintenance beyond 2 months past intervention. Although not all investigations lend themselves to an evaluation of maintenance (i.e., some intervention components are better suited than others), this finding is a weakness given that the emphasis of IPBS is on producing long-term sustainable outcomes. Clearly, to claim that IPBS interventions produce durable outcomes in schools, more studies that evaluate maintenance of intervention effects are needed.

Second, even fewer studies (7%) measured generalization, and overall, FBA-based interventions were found to produce large generalization effect sizes. However, these results for generalization effects should be interpreted cautiously given the small number of cases included in the analysis. The problem of inadequate measures of generalization has been noted in other reviews of FBA-based interventions (Carr et al., 1999; Snell et al., 2005), and this problem continues to be evident in the school-based sample. The full evaluation of IPBS interventions requires attention to this critical gap in research. As an artifact of employing interventions in school settings where problem behaviors typically occur, one challenge for researchers will be to find opportunities to evaluate generalization across novel situations. One issue that may curtail generalization assessment is that researchers may find themselves targeting only those situations revealed by FBA to be most problematic. If problematic situations are limited to just one or two scenarios and interventions are applied directly in all, generalization assessment may not be relevant.

Third, only around half of the studies (53%) that focused on reducing problem behavior also measured increases in appropriate skills (e.g., alternative skills, academic work

completion). Because teaching alternative skills is one hallmark of IPBS, the lack of measurement in this area leaves a deficit understanding in how FBA-based interventions can improve prosocial behaviors, particularly alternative skills.

**Research Question 2: Is Intervention Effectiveness Related to Participant Characteristics (e.g., Gender, Disability Label), Grade Level, or Classroom Setting?**

When PND was analyzed according to participant characteristics, grade level, and classroom setting, few differences were found. It is interesting that FBA-based interventions applied to the following categories were found to be highly effective: high school students, students diagnosed with other disabilities (e.g., EBD, ADHD, LD), and students in general education settings. Moderate effect sizes were found for all other participant variable categories. However, none of the comparisons among variable categories were found to be statistically significantly different, suggesting that individualized FBA-based interventions were equally effective for a range of disability categories, classroom settings, and grade levels. This is a welcome finding for schools as it suggests that FBA-based interventions are effective for all students who require individualized interventions regardless of grade or classroom setting.

Descriptively, more evidence for intervention effectiveness exists for certain categories than others. Consistent with Snell et al. (2005), evidence for elementary grade levels, DD, and special education classrooms still predominates. But as the number of school-based studies increased over the past 5 years, there appears to be a change of demographics. Particularly noteworthy are the number of cases falling outside of the predominate categories. A substantial number of cases were diagnosed with other disabilities (e.g., EBD, ADHD, LD) or carried no disability label and were at the middle or high school grade level. It is encouraging that the vast majority of FBA-based intervention studies conducted with students with other or no disabilities was published from 2001 onward. It is more interesting that from 2004 to 2008 there were more FBA-based intervention studies conducted with students with other or no disabilities (71%) than with students with DD. Moreover, more than half of the cases received intervention either in combined general and special education settings or in general education classrooms alone. This suggests a promising trend that evidence is building for nontraditional populations in diverse school settings outside of just special education classrooms. However, when considering one criterion advanced by Horner, Carr et al. (2005) for evidence-based practice (i.e., 20 or more participants across five studies), evidence for high school students and certain specific disability categories (e.g., EBD, ADHD, LD) is insufficient.

**Research Question 3: Is the Effectiveness of FBA-Based Interventions Related to the Incorporation of Key IPBS Features in Assessment, Planning, and Implementation of the Intervention?**

This meta-analysis revealed only one independent variable that resulted in a statistically significant difference among the various assessment and intervention characteristics: The presence of team decision making during intervention planning yielded statistically significantly larger effect sizes when compared to intervention studies where team decision making was absent during intervention planning. This suggests that intervention studies that incorporated input from relevant members during the intervention planning and implementation phase resulted in highly effective interventions, thus lending support to the effectiveness of team decision making, a core IPBS practice. Although Snell et al. (2005) reported only a quarter of the studies in their review involved team decision making, slightly more than a third of the intervention studies included team decision making during intervention planning in this meta-analysis. Although this indicates a positive trend, considering that teaming is one of the key elements of IPBS, coupled with evidence of the effectiveness of interventions in which team decision making took place, current studies are still lacking in terms of incorporating team decision making. Furthermore, when decision making did take place, the teaming process was usually not described clearly in the studies. Future research studies should document the teaming process to allow for replication and for further investigation into the teaming process in school settings.

As for the other assessment and intervention characteristics, all the other variable categories that were closely associated with IPBS yielded moderate effect sizes. This included the following assessment and intervention characteristics: typical assessment and intervention participants, typical assessment and intervention physical context, the presence of team decision making during assessment, multicomponent interventions, and the measurement of social validity. No statistically significant differences were found for these variables. The lack of differences may be attributed to the highly individualized nature of the interventions; each intervention was tailored to address the variables revealed in the pre-intervention FBA. As suggested by other quantitative syntheses comparing FBA-based to non-FBA-based interventions (Campbell, 2003; Carr et al., 1999; Didden et al., 2006; Harvey et al., 2009; Marquis et al., 2000), it may be the case that functional assessment is the predominate influential variable governing intervention effects. In addition, almost all of the FBA-based interventions were implemented by typical intervention agents in typical settings, and Marquis et al. (2000) have reported that these two intervention characteristics

(i.e., typical intervention agents and typical settings) resulted in significantly larger effect sizes. Conceivably, team decision making and the social acceptability of interventions are variables that can strengthen maintenance effects. Unfortunately, an analysis of intervention effects across different outcome measures, such as maintenance and generalization, was not possible given the small sample of cases included in the studies.

Some other interesting patterns are noteworthy for discussion. First, this analysis did not replicate the findings of previous reviews (Campbell, 2003; Didden et al., 2006; Harvey et al., 2009) that found larger statistically significant effect sizes for experimental over descriptive FBA. A key distinction between this and previous reviews is that the focus of the current study was on school-based interventions only where the majority of interventions were carried out by typical intervention agents in the students' typical educational setting. Under such natural settings and circumstances, the use of descriptive or indirect assessments may be as effective as more rigorous experimental manipulations.

Second, with regard to specific intervention characteristics, the findings suggest some positive trends with employing IPBS-related practices in published studies. As previously noted, the vast majority of interventions were carried out in the students' typical classroom settings by intervention agents typical to that setting. Furthermore, consistent with Snell et al. (2005), the majority of interventions were multicomponent, largely composed of antecedent or skills training interventions combined with consequence strategies. Single interventions, involving antecedent, consequence-based, and skills training interventions, were employed with the same relative frequency in current analysis. The use of consequence interventions no longer dominated single interventions as in previous reviews (Campbell, 2003; Carr et al., 1999). A positive trend in the number of studies that measured social validity was also observed. Slightly more than a third of the intervention studies in this meta-analysis reported some form of social validity measurement compared to less than a quarter reported by Snell et al.

On a negative note, although lifestyle change is considered to be an important IPBS outcome (Carr et al., 2002), only one study (Kennedy et al., 2001) included lifestyle intervention in the overall intervention package. The lack of attention to this important feature of IPBS has remained unchanged over the years (Carr et al., 1999; Snell et al., 2005).

### Limitations

The present research synthesis should be interpreted with the following potential limitations in mind. First, one limitation for any review may be the "file drawer problem" (Scargle, 2000). Since published research studies are usually effective and studies that do not result in effective outcomes are

usually neither published nor submitted for publication, all intervention outcomes of published studies would be skewed toward positive results, reducing differences between comparisons and suppressing significant differences. This limitation is somewhat tempered by the fact that in single-participant design studies, a range of differential effects is possible for participants in any one single study.

A second limitation is the use of PND as a measurement of treatment effectiveness. PND does not take into account trends or magnitude of treatment effects because PND calculates only the nonoverlap of baseline and intervention data points. These factors (i.e., trend and magnitude) may be especially helpful when evaluating effectiveness on reducing problem behavior and increasing the use of alternative skills. The suitability of various effect size metrics applied to single-participant research has been extensively debated for years (Jenson, Clark, Kircher, & Kristjansson, 2007; Parker & Brossart, 2003). Although other metrics purport to address the limitations of PND, in reality each presents its own limitations and measures slightly different clinical outcomes (Harvey et al., 2009). Despite its limitations, PND is well suited to the purpose of this study and is a widely accepted metric for evaluating single-case research in special education. For a more sophisticated analysis, future research might consider employing and comparing multiple metrics in assessing the effectiveness of IPBS interventions in schools.

Perhaps because of page length constraints, a third limitation is that some research articles may not have reported in detail team decision making and other information critical to defining IPBS. In short, our analysis was undoubtedly dependent on how clear the authors were when describing intervention characteristics. In addition, the implementation of some key IPBS features occurred along a continuum, yet features were coded as either yes or no. For example, in one study the involvement of a typical intervention agent (e.g., teacher) may be extensive, whereas in another study the typical intervention agent may be only minimally involved. Both studies would be coded as involving typical intervention agents; however, the quality of involvement would differ greatly.

### Summary

This meta-analysis resulted in several promising findings regarding the efficacy and use of FBA and IPBS interventions in school-based research. Team decision making, an important IPBS feature, was found to be highly effective when incorporated during intervention planning and implementation. FBA-based interventions were found to be effective in reducing problem behaviors and increasing appropriate skills across diverse student populations and educational settings, including inclusive classrooms. Furthermore, as FBA-based interventions are being increasingly applied in schools, there

appears to be a concomitant increase in the use of interventions employing key features of IPBS. In general, key features of IPBS yielded positive outcomes for students. At the same time, this meta-analysis revealed a number of deficiencies. Documented support for the efficacy of IPBS interventions in the schools is still emerging. To evaluate the effectiveness of IPBS interventions in its entirety, more examples of extended applications are needed overall, particularly across subgroups within the population of students. Furthermore, research is needed to examine outcomes along multiple measures including generalization, long-term maintenance, use of alternative skills, and consumer satisfaction. Finally, research is needed to evaluate IPBS features overall, either as isolated components or in combination with one another.

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