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Matching Autism Interventions to Goals With Planned Adaptations Using COMPASS

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Abstract

To understand the process by which evidence-based practices (EBPs) move from identification as effective through research establishing empirically validated effects, to being routinely adopted to bring about meaningful impact, we examined the selection/adaptation process within a well-established consultation model, COMPASS, applying two frameworks—the Evidence-Based Practice in Psychology (EBPP) Framework and the Consolidated Framework for Implementation Research (CFIR). The EBPP Framework proposes the equal importance of the EBP, student/family factors, and school/teacher factors in decision-making. CFIR highlights greater understanding of the iterative decision-making process and elucidates how an EBP moves through selection, adaptation, and use. Descriptive analysis of COMPASS intervention plans revealed that five EBPs were selected on average and specific EBPs were based on goal domain. Social goals used the widest variety of EBPs and demonstrated the greatest number of intercorrelations with other EBPs. Goal attainment outcomes were similar across goal domains.

Keywords

autism, CFIR, COMPASS, consultation, coaching, EBP, evidence-based practice in psychology, EBPP, intervention adaptation

The establishment of evidence-based practices (EBPs) for autistic students is a significant step toward improving educational outcomes, evaluating program quality, and prioritizing professional development activities for community practitioners as part of bridging the research-to-practice divide (Cook & Cook, 2013; Steinbrenner et al., 2020; Wong et al., 2015). Although EBPs are interventions that researchers have found to be generally effective for a particular population of individuals, they may often be misapplied (McGrew et al., 2016) or not applied at all (Morrier et al., 2011). EBPs are not meant to be "one size fits all" (Stahmer et al., 2011). Assumptions that selection of any EBP with empirical support for use with autistic individuals will produce better outcomes fail to account for the complex clinical and/or educational decision-making necessary to match an intervention and its delivery to the specific needs of each child and his or her family (Kasari & Smith, 2013; McGrew et al., 2016; Vivanti et al., 2018) and the context for optimal implementation (Barry et al., 2020).

To continue to inform and improve the process by which EBPs move from a designation as effective to routine adoption, we leveraged two existing frameworks as applied to an empirically validated effective consulting model, COMPASS. The Evidence-Based Practice in Psychology (EBPP) Framework (American Psychological Association, Presidential Task Force on Evidence-Based Practice, 2006) and the Consolidated Framework for Implementation Research (CFIR; Damschroder et al., 2009) were used to clarify terminology and explore decision-making by school-based educators tasked with selecting practices that will positively impact the educational needs of autistic students. EBPP proposes a tripartite framework that acknowledges the equal importance of the EBP and of the influences of student/family and school/teacher factors in decision-making regarding which practices to select and make planned adaptations (Kemp, 2016). A foundational driver of the EBPP framework is the acknowledgment that diagnosis alone provides insufficient information to base decisions when selecting which EBPs are optimal for implementation.

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Recognizing that the initial selection of an EBP is only one aspect of the implementation process through which impact is achieved, CFIR builds on the EBPP framework to explicitly highlight the complex interactions of the EBP with the characteristics of the individual receiving the EBP, the individual implementing the EBP, and the context in which the EBP is being delivered (Damschroder et al., 2009). Furthermore, like with EBPP, CFIR calls for greater understanding of the iterative decision-making process through which planning, applying, reflecting, and evaluating become key considerations relative to how an EBP moves from being selected, adopted, and adapted for implementation, to impacting outcomes.

Many years after the initial inception of the EBPP and CFIR frameworks, improving intervention and implementation decision-making for the education of autistic children continues to be a persistent concern (Boyd et al., 2021; Hamrick et al., 2021; Knight et al., 2019). In recent exploratory studies, researchers found that special educators rely primarily on their professional judgment when selecting practices to meet specific needs of autistic students (Knight et al., 2019). Unfortunately, Knight et al., (2019) also found that many of those same educators report believing they are underprepared to select and implement practices designed to address social skills (56%) and communication skills (42%). The complexity of understanding educators' beliefs about practice selection decisions and factors that may constrain use of EBPs with autistic students is further reinforced by Hugh et al. (2021), who examined preschool teachers' selection of social communication interventions. In combination, findings from Knight et al. (2019) and Hugh et al. (2021) exemplify possible constraints on educators' decision-making along with the need for a multifaceted approach to further explore and address the research to practice gap. This gap is amplified by the extreme heterogeneity associated with a diagnosis of autism, especially as children age (Volkmar et al., 2012), and the disparate and often poor post-school outcomes, even when compared with students of similar cognitive abilities (Roux et al., 2013), creating an imperative for researchers. Exploring the process through which particular practitioners select and apply EBPs within particular contexts, with particular individuals, for particular concerns, within particular settings, is necessary work (Kasari & Smith, 2013; McGrew et al., 2016). Unfortunately, research on EBPs is rarely available beyond that of establishing general effectiveness. There is little research exploring the generalizability, appropriateness, core components, acceptable adaptations, and shared elements of EBPs with respect to different contexts, students, or treatment situations such that we may better inform implementation decision-making (Stahmer et al., 2011; Sulek et al., 2019). This gap leaves a significant need for guidance for teachers and parents regarding how best to integrate and apply EBPs within the personalized context of each child (McGrew et al., 2016; Vivanti et al., 2018).

Collaborative Model for Promoting Competence and Success (COMPASS)

Although implementation science frameworks such as EBPP and CFIR are increasingly recognized as providing critical guidance for autism intervention research to improve student educational outcomes (Bauer, 2007; McGrew et al., 2016; Vivanti et al., 2018), systematic study is limited. COMPASS is an exception (Ruble, Dalyrmple & Mcgrew, 2012; Ruble, McGrew & Toland, 2012). As demonstrated now in three randomized controlled trials, children and youth whose teachers were enrolled in COMPASS showed improved Individualized Education Program (IEP) outcomes compared to those receiving standard special education, including when using web-based delivery and with transition age youth with autism (Ruble et al., 2010, 2013, 2018). As called for by both EBPP and CFIR, a systematic and comprehensive planning process is enacted through COMPASS. Planning consists of an initial parent–teacher (and student, when possible) consultation session facilitated by a consultant with a focus on obtaining a shared, holistic understanding of the student's characteristics, needs, and preferences at home and at school from the people who have the most frequent interactions with the student. This ecological assessment is applied to identify three measurable goal areas critical for the development of autistic children and youth—social, communication, and learning skills (National Research Council, 2001) that are measured using *psychometric-equivalence tested goal attainment scaling* (PET-GAS; Ruble, McGrew & Toland, 2012). Following the generation of measurable goals within these domains, intervention plans utilizing EBPs for autism are developed to balance and account for the child's personal and environmental challenges by enhancing personal and environmental supports associated with the specific goal. Thus, the initial COMPASS consultation provides the foundation for an EBPP- and CFIR-informed decision-making process that integrates and applies the personalized context and available educational resources to the selection and adaptation of EBPs to achieve the important pivotal goals consistent with a student's educational program. Furthermore, COMPASS builds in procedures that respond to the barriers associated with use of school-based EBPs as identified in Barry et al.'s (2020) scoping review. That is, intervention plans are generated considering crucial environmental challenges. Specifically, misalignment between EBPs and the student's curriculum, resources, and time are contextual issues to be addressed in goal setting and intervention planning. Reinforcing the substantial need for an empirically informed framework, COMPASS supports the decision-making that comes from the overlapping influences of child/parent

Table 1. Terms and Definitions Regarding Evidence-based Practices.

Term	Definition
Comprehensive treatment model	Conceptually organized packages of practices and components designed to address a broad array of skills and abilities (Odom et al., 2010)
Focused intervention practice	Instructional practices or strategies used to teach specific educational skills and concepts (Odom et al., 2010)
Core features/components	Inclusive of all the implementation components and practice elements of a given evidence-based program that lead to changes in student outcomes (Filter et al., 2022)
Implementation components	Actions associated with an evidence-based program taken by coaches, educators, and administrators that support and prepare for the adoption and delivery of the core practice elements with fidelity (Filter et al., 2022)
Practice elements	The individual observable action associated with an evidence-based program that expected implementers deliver, in isolation or combination, to achieve desired student outcomes (adapted from Sutherland et al., 2019)
Common elements	A focused subset of practice elements that are delivered in a specific combination and order to create an effective teaching sequence (Ruble et al., 2020).
Principles/mechanisms	A process or event through which practice and common elements operate to produce change (adapted from Lewis et al., 2018)

characteristics, teacher preferences, resources, and barriers, as well as the specific EBP (McGrew et al., 2016).

Because autism is extremely heterogeneous, COMPASS is a complex intervention that targets several core areas of social, emotional, and learning skills for autistic students. Thus, it is unusual for one EBP to address all skill deficits adequately and comprehensively, let alone be appropriate for all autistic children. Therefore, within an EBPP-informed framework such as COMPASS, it is important to understand what EBPs are selected in intervention plans generated from parent and teacher input that also account for the challenges and strengths of both child and teacher characteristics. Although the consultant provides a general template for the team to identify the teaching and data collection methods, persons responsible, and materials needed, the educational decision-making necessary for instructional plans varies from child to child and teacher to teacher. Information on what EBPs are reflected in the EBPP-informed intervention plans will help identify both the complexity that goes into instructional decision-making, including what EBPs are commonly used for certain goal domains, and how many EBPs are commonly reflected within those goal domains. Evidence suggests that community treatment providers use a combination of approaches, both evidence-based and non-evidence based, in working with young autistic children (Stahmer et al., 2005). However, little is understood about how interventions are combined and individualized (Stahmer et al., 2011). Understanding the taxonomy of EBPs within an EBPP-informed consultation intervention will provide new information important for training and supporting teachers and consultants as well as shed light on the complexity and use of multiple EBPs.

Taxonomy Informing Decision-Making

Another aspect of COMPASS, and of autism interventions as practiced in "real world" classrooms, is that intervention plans tend to incorporate/extract the important evidence-based (EB) principles from the EBPs. However, there is general confusion about the differences between EB practices and principles (Ruble et al., 2020). Table 1 provides an overview of terms and definitions. For example, principles, such as contingent reinforcement, often cut across several practices (e.g., pivotal response training; applied behavior analysis) and could be classified just as accurately as common elements of best practice (Ruble et al., 2020). Confusingly, although they may be described as separate and individual EBPs (Wong et al., 2015), the identical principle may underlie several EBPs (e.g., prompting and reinforcement have been identified as independent EBPs, but both are also integrated within and included as elements in other EBPs, such as the Picture Exchange Communication System).

Adding to this confusion and general taxonomical fuzziness, many EBPs for autism have been characterized as "focused" because they target an isolated or specific skill associated with autism (Wong et al., 2015). It is often the case, however, that multiple EBPs are usually required for autistic individuals. For example, a social goal of initiating play might involve several "focused EBPs," such as use of a social narrative, peer-mediated instruction, visual supports, prompting, and reinforcement. In addition, planned adaptations may be necessary for the social narrative, visual supports, and prompting strategies to meet the child's comprehension skills. Furthermore, the selection and use of reinforcement procedures must be considered based on the child's preferences and classroom resources. Thus, even within an EBP labeled as

focused, there may be a need for combined use and adaptation to the child's needs and teacher resources.

The purpose of the current study was to answer the following three questions:

RQ1. When COMPASS is used to support decision-making within an EBPP framework, what EBPs are selected and how frequently is each chosen when personalized goals target one of three domains—social skills, communication skills, and learning skills?
RQ2. How similar (i.e., correlated) are the individual EBPs when selected for use within and across targeted domains?
RQ3. Are overall student goal attainment outcomes and responsiveness to the intervention plans similar across targeted domains?

Method

The study data are from a secondary analysis of a randomized controlled trial (RCT) of COMPASS (Ruble et al., 2013). All participants received the COMPASS intervention. To be eligible, all children had to be enrolled in a special education program in a public school located in one U.S. Midwestern or Southern state under the eligibility category of autism. The children ranged in age from 3 to 8 years with a mean age of 6 years ($SD = 1.6$). With respect to gender, 86% of children were male; 80% of the children were White, 6% Black, 2% Asian, 6% other, and 6% unidentified. All had a diagnosis of autism confirmed with the Autism Diagnostic Observation Schedule (ADOS, Lord et al., 2000, 2012) conducted by the researchers ($M = 18.3$, $SD = 3.5$). Assessment of intellectual functioning based on the Differential Abilities Scale (Elliott, 1990) and adaptive behavior based on the Vineland Adaptive Behavior Scales (Sparrow et al., 2005) revealed mean scores of 55.17 ($SD = 20.5$) and 60.5 ($SD = 13.7$), respectively, reflecting moderate levels of cognitive and adaptive behavior severity. The primary classroom placements broke down into three approximately equal-sized groups: about one third of children attended a general education classroom full-time; one third attended general education and special education classrooms part-time; and about one third attended a special education classroom full-time. Teacher mean age was 39.13 ($SD = 11.78$) years. One teacher was male and all were certified teachers. Forty-five percent had a bachelor of arts, 47% a master of arts, and 8% did not indicate the degree earned. Teachers also reported that they have taught for an average of 11.3 years ($SD = 8.2$). They taught autistic students for an average of 5.7 years ($SD + 5.7$) and, on average, taught a total of 6.2 ($SD = 6.9$) autistic students. The consultants were two of the researchers who developed COMPASS and had worked in the field for more than 25 years (Ruble, Dalyrmple & Mcgrew, 2012). One had a master's degree in social work and the other a doctoral degree in school psychology.

Overview of COMPASS

During the initial consultation, a profile of the child's personal and environmental challenges and supports was discussed. The COMPASS profile (publicly available at compassforautism.org) was based on parent and teacher ratings completed independently and then combined for the consultation. Following the discussion, personalized goals for social, communication, and learning skills were identified collaboratively with teacher and parent selection and input with an attempt to focus on goals with a pivotal impact on other important areas of development (Koegel & Koegel, 2006). Next, the goals were shaped into SMART goals (specific, measurable, attainable, realistic, and timely) during the consultation with teacher and parent input. Goals were then converted into goal attainment scales using PET-GAS (Ruble, McGrew & Toland, 2012) prior to the first teacher coaching session. Finally, intervention plans for each of the three goal areas were developed with parent, teacher, and consultant input. Thus, 87 (29 children $\times$ 3 personalized goals) intervention plans were developed through the COMPASS consultation process for later analysis within this study.

Intervention Plan Development

The intervention plans that were evaluated for the presence of EBPs were based on the three focal goals for autistic students targeting social, communication, and learning skills. Each intervention plan was developed with teacher and parent input using a template available in the COMPASS manual (Ruble, Dalrymple & McGrew, 2012) that described the teaching methods for teaching the skill, the person(s) responsible for teaching the skill, the place and time (activity) the skill would be taught, as well as the materials required for implementation. For the teaching methods, the consultant asked open-ended questions to obtain input and ideas from the parent and teacher based on experience with the student, the student's strengths and challenges, and knowledge of EBPs. To help guide the process of developing intervention plans, we used the common elements of teaching sequences (CETS; Ruble et al., 2020). Common elements of teaching sequences guides development of intervention plans using the following features: (a) identification of a developmentally appropriate and meaningful activity designed to target the skill; (b) strategies for obtaining and maintaining student attention throughout instruction; (c) use of prompts and cues that the student understands; (d) time to allow for the student to respond; and (e) use of reinforcement based on student interests.

Analysis of Intervention Plans Procedure

To code which EBPs were included in an intervention plan, an initial codebook (see Appendix S in the online supplemental

materials) providing definitions and examples of 27 EBPs was developed by a doctoral student of school psychology (last author) using descriptions from the National Professional Development Center on Autism Spectrum Disorder report on EBPs (Wong et al., 2014, 2015) and the Autism Focused Intervention Resources and Modules (AFIRM) (https://afirm.fpg.unc.edu/). Once the initial codebook was developed, a second rater (doctoral student research team member) reviewed the definitions and examples for accuracy and clarity. The codebook was refined and then reviewed again by a third rater (first author) before a final version was approved. The final codebook was then used to evaluate all sections of the intervention plan.

The coding process for intervention plans began by first reading the child's COMPASS profile that identified personal and environmental challenges and supports to provide a context for understanding the goal, teaching methods, and behaviors that could interfere with or facilitate the learning process. Second, each goal and instructional method described within the teaching plan was evaluated for the presence of EBPs. When an EBP was explicitly stated in the teaching methods, it was coded as being present (code of 1), such as reference to prompting, reinforcement, or the Picture Exchange Communication System (PECS). When not present, a code of 0 was applied. In addition, if an EBP was listed in the "materials" section of the teaching plan, the EBP was also coded as present. For example, if in the materials section "visual schedule" was listed, the EBP "visual support" was coded. We also evaluated the "who/when/where section" of the teaching plan to identify EBPs. For example, generalization of skills and use of classroom routines representing "naturalistic interventions" would be coded, even if the terminology "naturalistic intervention" was not stated specifically, but the plan included discussion of natural or generalized environments.

For EBPs that required a detailed, multi-step, and systematic approach for implementation, such as functional behavior assessment, functional communication training, PECS, or discrete trial training, the detailed steps of the approach had to be provided within the teaching methods to receive full credit as being present. Thus, we used a narrower and more restrictive definition for these EBPs.

For differential reinforcement and functional communication to be coded, an interfering behavior must have been described in the COMPASS profile or in the instructional plan. For pivotal response training to be coded as present when not explicitly stated, the teaching methods provided must have included instruction pertaining to all of the pivotal areas of child development (motivation, initiation, multiple cues, and self-management) and reinforcement that is specific to the child. For task analysis to be coded when not explicitly stated, the teaching plan must have explicitly stated how the task was being separated into steps. Cognitive behavioral therapy was coded when it was explicitly stated as being utilized or when the goal as stated was aimed at instructing the student to process and understand irrational thoughts for targeted behaviors. Exercise was coded if physical activity was explicitly mentioned and utilized to reduce problem behavior or increase appropriate behavior. Structured play group was coded as present when the goal stated that the group activity was "structured "or a defined activity included multiple peers and adult involvement for guiding the play (see Supplemental Material for codebook).

Two rounds of reliability checks were conducted to establish interrater reliability of the coding of the contents of the intervention plans. In the first round, the primary and secondary coders independently applied the EBP codebook to 20% of the intervention plans, achieving 87% reliability based on percent exact agreement. To further confirm reliability on the use of the codebook, a third coder independently applied the EBP codebook to 50% of the intervention plans that were coded in the first round of reliability testing. Interrater reliability between the three raters was 91%. All three coders obtained consensus for items on which they did not agree.

Measures

Assessment of student goal attainment outcome. To answer the question about whether child goal attainment outcomes differ by goal domain (social, communication, learning skills), PET-GAS was used to assess student goal achievement. Because each child had different goals, different baseline skill levels associated with the goals, and different intervention plans, an idiographic assessment system utilizing PET-GAS was used to measure the amount of progress each student made on the three IEP goals (Ruble et al., 2020). PET-GAS has served as the primary educational outcome assessment approach for our three RCTs of COMPASS (Ruble, McGrew & Tolan, 2012). During the initial goal setting and intervention planning session of COMPASS that includes the parent and teacher, goals related to the three core learning domains of communication (e.g., will independently initiate three requests during lunch), social skills (e.g., will take two turns with an object and a peer during free play), and learning skills (e.g., will independently complete a three-step work activity using visual supports) are identified and translated into an IEP objective. To enhance the quality of the GAS ratings, we applied a protocol for goal writing to ensure goals were (a) of equal difficulty (e.g., goals were selected that were expected to be attainable by most children, but not easy); (b) measurable (e.g., use of clear behavioral descriptions including specific wording concerning duration, frequency, and needed supports); and (c) were rated using equal distances between each goal benchmark across the scale (e.g., an equivalence chart was created for percent accuracy, frequency, number of prompts and level of support needed in performing behaviors). Detailed descriptions are provided in (Ruble, McGrew & Toland, 2012). Each goal

attainment scale used the following 5-point rating scale: −2 = child's present levels of performance, −1 = progress, 0 = expected level of outcome, +1 = somewhat more than expected, +2 = much more than expected. Half-scores were allowed when raters observed skill levels between two benchmarks. A score of zero represented improvement consistent with the actual description of the written IEP objective. PET-GAS post-treatment ratings were based on direct observations from an observer unaware of group assignment. During the observation, teachers demonstrated each of the three targeted teaching objectives during an instructional situation. As recommended, only raw scores were used (MacKay et al., 1996; Schlosser, 2004). Two coders independently coded 39% of the goals. Interrater agreement as measured using the sample intra class correlation for single measures was .82 for social, .86 for communication, and .91 for learning skills goals. Because the intervention plans reflected students who received the COMPASS intervention, all the PET-GAS ratings were coded at the −2 or present levels of performance ratings at the initial consultation. Thus, the final scores were used for data analysis given the lack of variance in the baseline scores.

Reliability of categorization of goal domains. To ensure agreement between goal domain (social, communication, learning skills) across raters, interrater reliability was conducted to ensure consistency in determination of domain for each goal using a coding protocol. The protocol consisted of clear examples for each domain related to social, communication, and learning skills. A primary rater sorted the goals by domain. Then, a secondary rater randomly selected 20% of the goals and independently sorted them. The interrater reliability based on exact agreement was 86%. When there was disagreement, coders discussed and came to agreement.

Data Analysis

To answer the first research question about what EBPs are reflected in COMPASS intervention plans, at what frequency, and by which domains, we examined descriptive statistics on the frequency of each EBP by goal domain. To answer the second question about how similar the EBPs are within and across domains, we conducted Pearson correlations by EBP and domain. We only reported those with $p < .01$ due to the large number of correlations. For the last question about whether different domains result in differences in goal attainment outcomes or responsiveness to the intervention plans, a one-way within-groups analysis of variance was applied.

Results

EBP Selection and Frequency by Goal Domains

Figure 1 shows which EBPs were selected and how frequently within and across 87 COMPASS intervention plans that included goals targeting social skills, communication skills, or learning skills. The EBPs selected most frequently across all domains were prompting and reinforcement. The range in the selection of prompting was 22 to 24 across domains, and the range in selection of reinforcement was 15 to 25 across domains.

For goals targeting the social skill domain, 18 of the 27 EBPs were listed at least once ($M = 5.89$, $SD = 8.17$). Both peer-mediated instruction ($n = 26$) and social skills training ($n = 26$) were the most frequently applied EBPs, followed by prompting ($n = 22$), visual support ($n = 15$), and reinforcement ($n = 15$). The remaining 13 EBPs were described in less than half of the intervention plans and ranged between 1 (picture exchange communication system, differential reinforcement, and self-management) and 10 (structured play group).

For goals targeting the communication skills domain, 19 different EBPs were listed at least once ($M = 5.4$, $SD = 6.25$). Prompting was the most frequently applied ($n = 24$), followed closely by visual support ($n = 16$). Naturalistic intervention and reinforcement ($n = 15$) were tied as the third most frequently applied EBPs. The remaining 15 EBPs were used in less than half of the intervention plans and ranged between one (task analysis, structured play group, self-management, and antecedent-based intervention) and 11 (pivotal response training).

For goals targeting the learning skills domain, 15 different EBPs were listed at least once ($M = 4.51$ $SD = 7.73$). Visual supports were applied most frequently (27), followed by reinforcement (25) and prompting (23). The remaining 12 EBPs were used in less than half of the intervention plans, and their frequencies ranged between one (peer-mediated instruction and intervention, antecedent-based intervention, and self-management) and six (social narratives, time delay, and video modeling).

Relations Between EBPs Selected by Domains

Social skills domain. Results revealed that of the 18 EBPs coded within the social skills domain, 17 correlated with at least one other EBP (i.e., $p < .01$) and are summarized (see Table 2). Analysis of the overlap of EBPs revealed that two EBPs, differential reinforcement and self-management, were associated with the highest number of other EBPs, six and five, respectively. Naturalistic interventions, social skills training, response interruption, and peer-implemented interventions had the next most frequent number of associations with other EBPs, three each. Prompting, peer-mediated instruction, and pivotal response training were associated with two other EBPs. Four final EBPs were associated with one other EBP—social narratives, time delay, video modeling, and visual supports. More than half of the associations were negative, meaning they were less likely to be used together: social skills training with time delay, self-management,

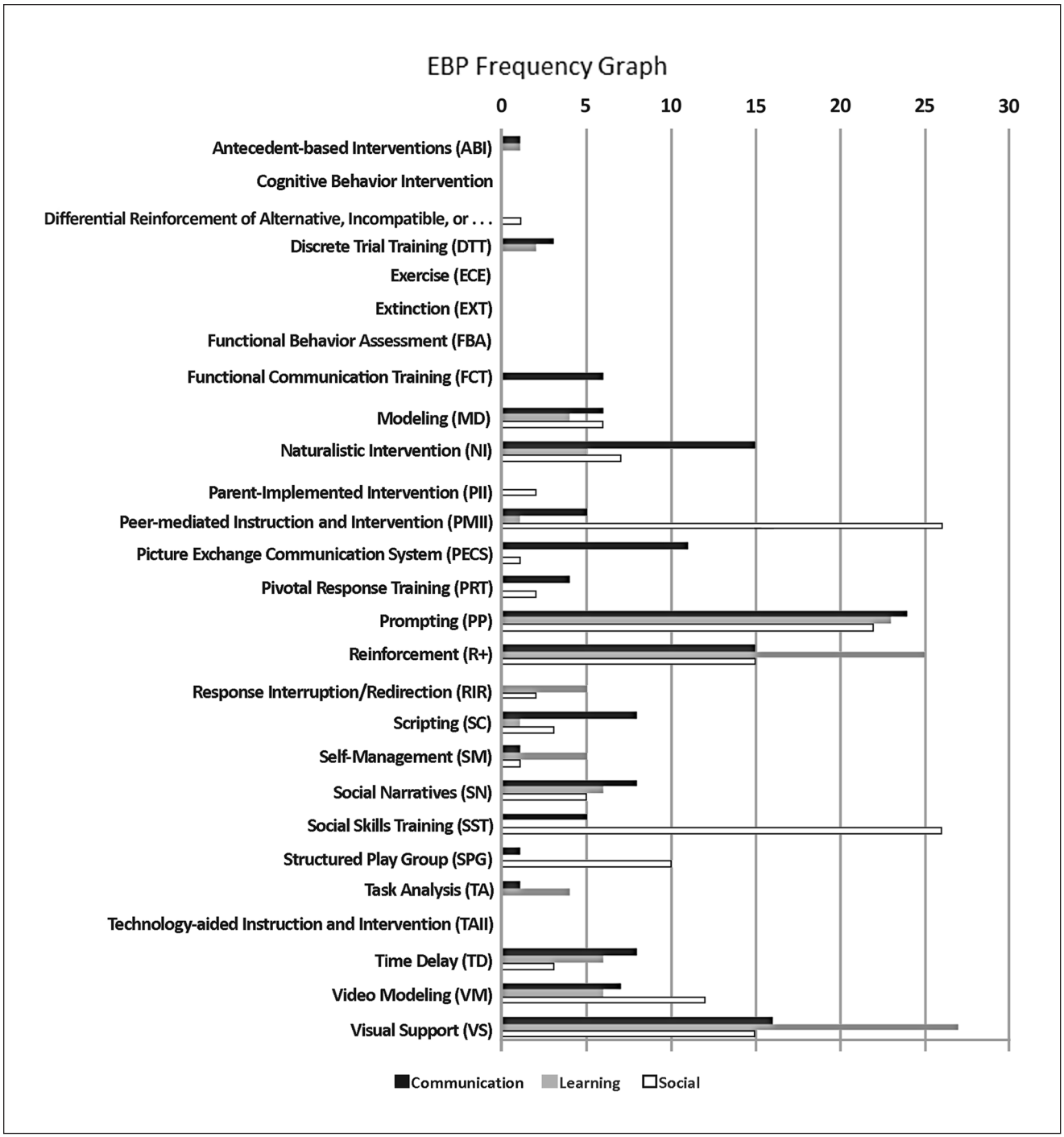

Figure 1. Frequency of evidence-based practices (EBPs) observed in intervention plans by skill domain.

and differential reinforcement; peer-mediated training with differential reinforcement and self-management; response interruption with antecedent-based intervention; and video modeling with prompting. Four EBPs had no overlap with any other domain, modeling, PECS, reinforcement, scripting, and structured play group.

Communication domain. Analysis of the intercorrelations of EBPs applied in the intervention plans with goals targeting the communication domain indicated that of the 19 EBPs used, 13 were significantly correlated with other EBPs and are summarized in Table 3. Social narratives were associated with the most, four other EBPs. Three EBPs, modeling,

Table 2. Intercorrelations Matrix of EBPs for Social Goals.

EBP	DRA/I/O	MD	NI	PII	PMII	PECS	PRT	PP	R+	RIR	SC	SM	SN	SST	SPG	TD	VM
DRA/I/O	—																
MD	–.1	—															
NI	.34**	–.29	—														
PII	.70**	–.14	.48**	—													
PMII	–.56**	–.11	–.07	–.35	—												
PECS	–.04	–.1	–.11	–.05	.06	—											
PRT	–.05	.2	–.15	–.07	.09	–.05	—										
PP	–.34	–.11	.13	–.16	.34	.11	–.48**	—									
R+	.18	–.02	.22	.26	–.33	.18	–.01	.1	—								
RIR	–.69**	–.14	.48**	.46	–.35	–.05	–.07	–.16	.26	—							
SC	–.06	.39	–.19	–.09	.12	–.06	–.09	.19	.1	–.09	—						
SM	1.00**	–1.1	.34	.69**	–.56**	–.04	–.05	–.34	.18	.69**	–.06	—					
SN	.41	.22	–.04	.24	–.15	–.09	.60**	–.38	–.11	.24	.15	.41*	—				
SST	–.56**	–.11	–.34	–.35	.26	.06	.09	.07	–.33	–.35	.12	–.56**	–.15	—			
SPG	–.14	–.01	–.24	–.2	.25	.26	.09	–.27	–.17	–.2	–.01	–.14	–.14	.25	—		
TD	–.06	.11	.07	–.09	.12	–.06	–.09	.19	.33	–.09	–.12	–.06	–.16	–.63**	–.25	—	
VM	.23	–.08	.02	.32	.06	–.16	.32	–.51**	–.03	.05	–.06	.23	.36	.06	.27	–.06	—
VS	.18	–.02	–.10	–.01	.13	–.2	.26	–.38	.03	–.01	.33	.18	.26	.13	.27	–.13	.53**

Note. EBP = evidence-based practices; DRA/I/O = differential reinforcement of alternative, incompatible, or other behavior; MD = modeling; NI = naturalistic intervention; PII = parent-implemented intervention; PMII = peer-mediated instruction and intervention; PECS = Picture Exchange Communication System; PRT = pivotal response training; PP = prompting; R+ = reinforcement; RIR = response interruption/redirection; SC = scripting; SM = self-management; SN = social narratives; SST = social skills training; SPG = structured play group; TD = time delay; VM = video modeling; VS = visual support.
*$p < .01$. **$p < .001$.

reinforcement, and PECS, were associated with two other EBPs. The remaining, eight EBPs, antecedent-based intervention, discrete trial training, functional communication training, parent-implemented intervention, scripting, social skills training, video modeling, and prompting were associated with at least one other EBP. Three intercorrelations were negative—PECS with social narratives and reinforcement and social skills training with video modeling.

Learning skills domain. Analysis of the intercorrelations for the learning skill domain revealed that of the 15 EBPs in intervention plans, eight were significantly associated with one another at $p < .01$ (see Table 4). One EBP, modeling, was associated with the most, three other EBPs. Seven EBPs, antecedent-based intervention, reinforcement, discrete trial training, naturalistic intervention, peer-mediated intervention, scripting, and video modeling were associated with one other EBP. All were positive associations with the exception of reinforcement which was negatively associated with antecedent-based intervention.

Student Goal Attainment Outcomes by Domains

A one-way within-groups analysis was used to examine whether student goal attainment progress was similar across goal domains. Data were analyzed across the three instructional domain groups (social, communication, learning skills). Assumptions of homogeneity of variances were met. The mean GAS scores were .34 ($SD = 1.1$) for the social domain, .73 ($SD = 1.9$) for the communication domain, and .77 ($SD = 1.0$) for the learning domain. There was no significant difference in GAS scores across domains, $F(2, 77) = 1.5$, $p = .296$, indicating that regardless of goal domain, the EBPs applied resulted in similar goal attainment outcomes. In other words, the effectiveness of EBPs within a particular domain (social, communication, and learning skill) was similar irrespective of the individual or combined EBPs selected to address individual learning goals.

Discussion

Stahmer et al. (2011) suggested that to meet the individualized needs of children, a systematic approach for combining intervention strategies may be necessary when multiple interventions are available that have demonstrated efficacy across multiple skill domains. A process for systematically combining EBPs is predicated on the need for a thoughtful decision-making process that accounts for the characteristics of the individual child, the skills being targeted for intervention, the context for intervention, and the characteristics of the intervention to

Table 3. Intercorrelations Matrix of EBPs for Communication Goals.

EBP	ABI	DTT	FCT	MD	NI	PII	PECS	PRT	PP	R+	SC	SM	SN	SST	SPG	TA	TD	VM
ABI	—																	
DTT	.56**	—																
FCT	.37	.11	—															
MD	–.10	.11	–.05	—														
NI	.18	.33	.15	–.02	—													
PII	–.09	–.16	–.23	–.01	–.29	—												
PECS	.24	.20	.13	.40	.04	–.17	—											
PRT	–.08	–.14	.04	.08	.00	–.19	.3	—										
PP	.09	.16	.23	.01	–.26	–.03	.17	.19	—									
R+	–.20	.10	–.19	.49**	.03	.08	–.53**	.00	–.08	—								
SC	–.12	–.21	.07	.26	–.02	.13	–.32	–.03	.54**	.44*	—							
SM	–.04	–.06	.37	.37	–.2	–.09	–.15	.47*	.09	.18	.31	—						
SN	–.12	.04	.64**	.64**	–.18	.13	–.48**	.00	.08	.44	.31	.31	—					
SST	–.09	–.16	–.01	–.01	–.29	.52**	–.17	–.19	.21	.08	.33	–.09	.33	—				
SPG	–.04	–.06	.37	.37	–.2	.41	–.15	–.08	.09	.18	.31	–.03	.31	.41	—			
TA	–.04	–.06	–.10	–.1	.18	–.09	–.15	–.08	.09	.18	.31	–.03	–.12	.41	–.04	—		
TD	–.12	.3	.07	.07	–.02	–.08	–.01	–.03	.28	.29	–.38	–.12	–.04	–.28	–.12	–.12	—	
VM	–.11	.07	.31	.31	.06	–.04	–.44	.04	.26	.22	.19	.34	–.55**	.38	–.11	.34	–.17	—
VS	–.21	–.15	.29	.29	–.18	.23	–.30	–.03	.14	.10	–.06	.17	.40	.04	.17	–.21	.09	.35

Note. EBP = evidence-based practices; ABI = antecedent-based intervention; DTT = discrete trial training; FCT = functional communication training; MD = modeling; NI = naturalistic intervention; PII = parent-implemented intervention; PECS = picture exchange communication system; PRT = pivotal response training; PP = prompting; R+ = reinforcement; SC = scripting; SM = self-management; SN = social narratives; SST = social skills training; SPG = structured play group; TA = task analysis; TD = time delay; VM = video modeling; VS = visual support.
*$p < .01$. **$p < .001$.

Table 4. Intercorrelations Matrix of EBPs for Learning Goals.

EBP	ABI	DTT	MD	NI	PMII	PP	R+	RIR	SC	SM	SN	TA	TD	VM
ABI	—													
DTT	–.05	—												
MD	–.08	–.11	—											
NI	–.09	.60**	.08	—										
PMII	0	–.05	.47**	–.09	—									
PP	.1	.14	–.04	.23	.10	—								
R+	–.47**	.11	–.13	–.08	.08	.04	—							
RIR	.41	.24	.35	.28	–.09	.23	–.35	—						
SC	–.04	–.05	.47**	–.09	–.04	–.37	.08	–.09	—					
SM	–.09	–.12	.35	.03	–.09	–.44	–.35	.03	.41	—				
SN	–.1	–.14	.29	.22	–.10	–.60	.2	–.01	.37	.44	—			
TA	–.08	–.11	–.16	–.18	–.08	–.04	–.13	–.18	–.08	–.18	–.24	—		
TD	.37	.2	.29	–.01	.37	.26	–.29	.22	–.10	–.23	–.05	.04	—	
VM	–.1	–.14	.54**	.22	.37	.05	–.04	.22	–.10	.22	.37	–.20	.16	—
VS	.05	–.46	.11	–.24	.05	–.14	–.11	–.24	.05	.12	.14	.11	.14	.14

Note. EBP = evidence-based practices; ABI = antecedent-based intervention; DTT = discrete trial training; MD = modeling; NI = naturalistic intervention; PMII = peer-mediated instruction and intervention; PP = prompting; R+ = reinforcement; RIR = response interruption/redirection; SC = scripting; SM = self-management; SN = social narratives; TA = task analysis; TD = time delay; VM = video modeling; VS = visual support.
*$p < .01$. **$p < .001$.

optimize impact on outcomes. Frameworks such as EBPP (student and teacher needs and resources) and CFIR (intervention adaptation) are helpful for informing aspects of a decision-making process that could be made more effective, in this case for autistic students. As a first step toward designing a more effective process, this study explored

how the skills targeted for intervention related to which EBPs were selected and how frequently. A subsequent examination of the relation between the selected EBPs relative to the targeted skill domain, as well as any differences in impact on student outcomes, combine to inform new avenues to consider when the goal is to improve intervention-related decision-making.

Based heavily on the principles of EBPP, COMPASS provides a framework to support intervention decision-making and planned adaptations for autistic students. The examination of EBP selection and interrelatedness within COMPASS created a unique opportunity to understand the EBPP framework when applied in a real-world setting. When using COMPASS, teachers expressly individualize, combine, and adapt interventions based on the personal and environmental risk and protective factors of the child. Because a mechanistic one-size-fits-all EBP approach fails to account for the need to implement multiple EBPs or modify EBPs based on the overlapping features of child strengths and preferences and teacher resources and needs, understanding how EBPs are represented in COMPASS and other personalized instructional development interventions (McGrew et al., 2016) facilitates consideration of what is known and not known about the process of systematically selecting, combining, and adapting EBPs.

Decisions to Include EBPs Within Intervention Plans

With respect to the selection of EBPs when using COMPASS to target personalized learning needs, more than half of the 27 EBPs for autism (Wong et al., 2015) were chosen at least once within each of the three goal domains—18 for social skills, 19 for communication, and 15 for learning skills. Although there were some unique EBPs for specific domains, a surprising number of EBPs were used routinely across the three instructional domains. Prompting, reinforcement, and visual supports were chosen most frequently, with more than half of the intervention plans across all three domains including these EBPs. This finding substantiates research from general and specific populations that these EBPs are commonly used and effective teaching methods. For example, of the 27 EBPs (Hume et al., 2022; Steinbrenner et al., 2020; Wong et al., 2015), reinforcement had support from the highest number of reported studies; 43 single case design studies demonstrated effectiveness for students from birth to high school and for a range of domains (e.g., social, communication, behavior, school readiness,; https://afirm.fpg.unc.edu/). Like reinforcement, prompting has also been evaluated in many studies; 32 single case design studies demonstrated effectiveness for students across the age span and for varied learning domains (e.g., communication, social, school readiness). Similarly, visual supports were supported by 18 single case design studies. Like the other two domains, visual supports are effective for students across the age span and across goal areas (social, communication). Furthermore, Morin et al. (2021) analyzed data from the Autism Focused Intervention Resources and Modules (AFIRM; Sam, Cox, et al., 2020) online learning modules of the 27 EBPs. With more than 22,000 users who completed the modules, visual supports and prompting were two of the top three modules accessed most frequently. Thus, it was not surprising that these EBPs, considered foundational, demonstrated the highest prevalence (see AFIRM)

Consistent with the view that there are several available EBPs being selected within and across skill domains, individual teachers are also selecting multiple EBPs for use when addressing an individual goal. Analysis of the number of EBPs by goal revealed that, on average, approximately five different EBPs were identified as necessary for achieving goals outlined in intervention plans. When examined by domain, social skills goals had the highest average number of EBPs, 5.9, followed by communication, 5.4, and learning skills, 4.5. This finding contrasts with efforts of other researchers to train teachers to focus on the use of a single EBP to target a goal. As an example, Sam et al. (2021), conducted one of the largest efficacy studies of a comprehensive program model developed by the National Professional Development Center on Autism Spectrum Disorder with 60 public schools and 486 students. For each student, goals were selected from the IEP and with the assistance of a coach, teachers identified one EBP from the 27 to target the goal (Wong et al., 2015). Although Sam et al. (2021) observed increases in goal attainment with a single EBP, the approach contrasts with this and other studies that demonstrate that a combination of multiple EBPs is more typical (Jung & Sainato, 2013). Furthermore, the selection of multiple EBPs is more representative of the more nuanced planning and adaptation process facilitated by COMPASS in targeting pivotal goals within a comprehensive intervention approach.

It is also interesting that goal attainment outcomes by domain revealed no differences, which suggests that the combination of EBPs used in COMPASS appeared to work equally well across domains. In other words, no particular goal domain operated differently or was advantaged by the combination of EBPs implemented. This also is consistent with the idea that several of the EBPs represent variations of each other or share common evidence-based principles or elements that may be the critical intervention ingredient, a result similar to Wampold and Imel's (2015) analysis of EBPs in psychotherapy. In other words, legitimate interventions tend to produce very similar responses/effectiveness. This assertion was also made by Boyd et al. (2014) based on their finding that outcomes for young autistic children were similar across classrooms implementing one of two

comprehensive high fidelity treatment models for young autistic children (LEAP and TEACCH) or a non-model specific combination of multiple treatment approaches.

The selection of multiple EBPs within domains and for specific learning goals may also be indicative of a robust comprehensive planning process within COMPASS that facilitated greater consideration for the different ways that different EBPs may contribute to impacting outcomes. Specifically, many of the EBPs are interrelated not only because they are often selected together, but because they contain practice elements and principles that seemingly independent EBPs have in common. Although EBPs such as reinforcement, prompting, and visual supports are identified as independent EBPs, in reality, they also represent aspects of other "independent" EBPs that are integral to their use. In other words, EBPs such as reinforcement, prompting, and visual supports also reflect common evidence-based principles undergirding multiple EBPs (e.g., PECS). The overlap between individual EBPs and broad-based principles is an issue that is beginning to be recognized by others. For example, AFIRM identified reinforcement and prompting as foundational practices (Sam & AFIRM Team, 2015; Sam, Savage, et al., 2020; Steinbrenner et al., 2020). Moreover, as further examples, PECS, and social skills training, have elements of all three (i.e., reinforcement, prompting, and visual supports; Griffin et al., 2016; Sam & AFIRM Team, 2016). Finally, antecedent-based interventions are also not mutually exclusive from other EBPs. For example, interventions such as social stories and visual supports are considered to be antecedent interventions. Thus, EBPs are often used in combination. Moving forward, more attention should be given to specifying the practice elements and evidence-based principles that are associated with any given EBP to support more effective decisions about not only what to select, but why, based on the common principles that need to be understood and applied to effectively impact outcomes (Ruble et al., 2020). Ruble et al. (2020) tested the use of common elements of instructional sequences embedded in COMPASS teaching plans and found a direct correlation between the number of elements used and child goal attainment outcomes. Furthermore, coaching improved the use of common elements associated with child engagement and goal attainment outcomes. Our conclusions echo those within the psychotherapy field that common factors not only constitute the active ingredients of most EBPs, but likely explain the greatest amount of variance in clinical outcomes (Wampold & Imel, 2015). Moreover, many "focused" EBPs targeting autism derive from the direct application of well-understood (i.e., common) principles of operant or classical conditioning and within the psychotherapy literature are usually referred to more commonly as behavioral therapy, with the presumption that conditioning principles apply without naming the individual elements as separate EBPs (e.g., contingent feedback, reinforcement schedules, prompting, fading, extinction).

Targeted Domain as a Context for Decision-Making

From a decision-making lens, systematically exploring factors that may create a context for educators to consider inclusion of certain EBPs within intervention plans is consistent with applications of CFIR. Our analysis of the relationships between EBPs by domain revealed that social goals had the highest number of significant associations between EBPs; communication goals had more than half the number of significant associations; followed by learning skill goals. A more detailed analysis of the social EBPs identified two EBPs, differential reinforcement of other behaviors and self-management, as overlapping with the highest number of EBPs, suggesting that these particular EBPs are common across social skills intervention plans. Similarly, analysis of communication EBPs identified social narratives as overlapping with the highest number of EBPs. Finally, for learning skills, one EBP, modeling, was associated with several other EBPs. In sum, social skills intervention plans appear to be more complex and represent a wider range and number of EBPs. This contrasts with a more limited number of EBPs applied to communication and learning skills intervention plans. Although some reports offer explicit links between EBPs and specific learning domains and types of skills (Steinbrenner et al., 2020), our findings might suggest that common elements and complexity of certain plans may actually create a decision-making context for educators that, consistent with CFIR, supports more flexibility and adaptability based on the instructional context.

Giving more explicit attention to the practice elements and evidence-based principles associated with any given EBP may be useful for supporting decision-making about the contexts in which certain EBPs may play a unique role. When examining intervention plans developed within COMPASS, peer-mediated instruction, social skills training, and structured play groups were highly specific to goals within the social skills domain. In contrast, naturalistic intervention, picture exchange communication system, and scripting were highly specific to goals within the communication domain. Finally, the selection of visual supports was highly specific to the learning skills domain. When thinking about the nature of the targeted skills in the instructional plans for these domains, these EBPs make sense conceptually. As mentioned, COMPASS emphasizes the development of core underlying skills that have a pivotal impact on other areas of development for autistic children. Koegel and Koegel (2006) describe pivotal skills as areas of learning that, when targeted, result in collateral

improvements in other, non-taught, areas of development. Self-initiation, as an example of a pivotal area, once learned can support the child with initiation of social greetings, requesting, problem-solving, and turn-taking. Thus, many of the EBPs used for these goal domains emphasized learning strategies that promoted independence and initiation rather than responding.

Analysis of the direction of the associations also shed new light on how EBPs were discordant. For the domain of social skills, differential reinforcement and self-management both were negatively associated with peer-mediated instruction and social skills training. Video modeling was negatively associated with prompting, and time delay was negatively associated with social skills training. For communication, PECS was negatively associated with reinforcement and social narratives. Video modeling was also negatively associated with social narratives. For learning skills, only one set of EBPs was negatively associated with each other: reinforcement and antecedent-based intervention. One explanation for these results comes from the intended scope of the intervention. For example, social skills training and peer-mediated intervention are broad in scope, whereas differential reinforcement and time delay are more narrowly focused. Thus, the use of a broad scope intervention may make the narrow scope treatment less useful or needed. Also, video modeling can be viewed as a kind of prompt in that it provides a visual representation of the skill to be rehearsed or applied. Furthermore, scripting and prompting are focused, but prompting is typically dependent on a person for cueing the student, while scripting, also a prompt, does not rely on a person in its implementation. Because these two "kinds" of prompting differ when applied, it is perhaps not surprising that use of one is related to decreased use of the other. Finally, antecedent-based intervention is temporally sequenced to occur before reinforcement.

Moving From Selection to Use of EBPs in Schools

COMPASS is founded on an EBPP process that promotes matching EBPs to the goals in a naturalistic way rather than limiting intervention plans to a single EBP. In other words, EBPs are selected following careful selection of pivotal and personalized goals informed by the EBPP process. This approach promotes best practice and emphasizes a common elements approach (Stahmer et al., 2011) as decisions are made when selecting EBPs for use. In practice, supporting actual use of EBPs such that positive outcomes are achieved requires further attention. For example, the NPDC professional development model demonstrated success with use of a single EBP (Wong et al., 2015). But it is not clear whether the goals from COMPASS were similar in scope compared with the goals from the NPDC model.

Furthermore, some researchers report that special educators often use a combination of EBPs (Stahmer et al., 2005), which may hinder use of implementation strategies (Proctor et al., 2013), such as fidelity checklists, that are designed to help educators develop deeper knowledge of the elements and principles of singular EBPs. Although the availability of training and fidelity checklists may be useful implementation strategies when a singular EBP is selected, findings from our study reinforce the notion that real-world intervention plans reflect selection of multiple EBPs that overlap across target domains to bring about similar growth in student outcomes. As educators try to make sense of what the essential features are for any given EBP, the sheer number of available fidelity checklists and training supports to be sorted through may be contributing to an unintentionally complex decision-making context for educators. It is possible that these supports may do little to improve the professional judgment used by most educators (Knight et al., 2019) while also contributing to a belief system that constrains educators' decision-making (Hugh et al., 2021). Designing implementation strategies that reflect how educators actually use EBPs, in combined and nuanced ways within the context created by the characteristics of the student, the targeted domains, the intervention, and the educators, may be an important next step to addressing the research to practice gap with the use of comprehensive interventions such as COMPASS.

The structured, consultative process of COMPASS exemplifies what teachers are doing on the ground—examining and adapting the key practices and principles necessary for goal attainment to account for the needs of the student and the resources available to the teacher. Thus, future work that empirically validates the essential components and context for use of singular EBPs, as well as work that informs principled and nuanced uses of common elements across multiple EBPs, and over time, is warranted. Simultaneous work is also needed to address the dissemination and implementation strategies that facilitate the knowledge and belief systems educators will need to become more effective users of EBPs. Suhrheinrich et al. (2021) conducted focus groups with school personnel and identified attitudes, buy-in, knowledge, skills, staffing, and burnout as barriers to overcome in implementation. In addition to teacher factors, Odom et al. (2022) and Suhrheinrich et al. (2021) expanded our understanding by identifying transformational leadership and organizational factors (e.g., support, expectation, structure) as critical for implementation. For decision-making necessary for developing EBPP-informed instructional plans, there is an opportunity for implementation strategies to be developed for in-service and pre-service educators that explicitly describe underlying principles and common elements across EBPs, with needed support and involvement from administrators (Suhrheinrich et al., 2020, 2021). Future research that

explores how implementation strategies based on common elements and underlying principles effective across interventions might enhance contextual alignment, sustained fidelity to essential components over time, and improved impact on student outcomes is warranted.

Limitations

One question left unanswered is the impact of classroom placement on intervention selection. Although this study did not explicitly examine the role of classroom placement, if we use autism severity as a proxy for classroom placement, we can offer some insight from our examination of predictors of child goal attainment outcomes from COMPASS (Ruble & McGrew, 2013). The results showed that although expected child factors such as IQ, adaptive behavior, autism severity, and language level were correlated with goal attainment outcomes, a multivariate analysis revealed that only child engagement during instruction explained the obtained differences in goal attainment. We suspect that while the type of interventions selected may vary based on classroom placement, these findings suggest that the quality of child engagement during instruction with the teacher, not indicators of autism severity or its proxies, such as classroom placement, provides a better explanation for outcomes. Future work that empirically examines organizational features, such as classroom placement, alongside implementation strategies, such as the personalized plan development that promotes contextual alignment to the classroom and follow-up coaching that might enhance decision-making over time, is needed.

Another question that emerges from this study concerns the relative importance of fidelity to the intervention teaching plans as part of evaluating student outcomes. Evaluating individual student outcomes was a secondary interest in this study, and given the complexity of how fidelity is monitored through COMPASS, we reported fidelity of implementation of the teaching plans elsewhere (Ruble et al., 2013). We also describe common elements of high-quality teaching sequences (CETS) in COMPASS intervention plans (Ruble et al., 2020) as an approach to designing implementation strategies based on principles and elements that are shared across multiple EBPs. Results from that work demonstrated that the frequency of use of CETS was not only associated with student engagement and student goal attainment outcomes, but teacher implementation of common elements also increased over time with coaching in association with child goal attainment outcomes. Thus, future research is needed to explore the impact of implementation strategies based on a common elements approach. The degree to which this approach provides a "good enough" structure for the development and implementation of intervention plans and whether implementation outcomes (Proctor et al., 2011) and student outcomes are enhanced by those plans requires further study.

In conclusion, this is one of the first studies to examine the frequency and overlap of EBPs in school-based intervention plans that are based on an EBPP framework. EBPP rests on the assumption that the best outcomes result when science and practice are integrated. Applying an EBP successfully requires selection and often adaptation of the EBP based on child preferences and strengths and teacher resources and needs. The need to select EBPs and adapt them for child characteristics and preferences as well as teacher needs and resources may result in tension between strict adherence to fidelity and the complex decisions involved in applying the EBPP process to improve and optimize outcomes. Future research on the processes involved in teachers' decision-making is necessary for understanding and improving educational outcomes for students with unique needs and for complex learners.

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Supplemental Material

Supplementary material for this article is available on the *Remedial and Special Education* website with the online version of this article.

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