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Randomized evaluation of a web-based tool for designing function-based behavioral intervention plans

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ABSTRACT

Challenging behaviors are prevalent in children with autism and can have a negative impact on a variety of child outcomes. The creation of good-quality behavior intervention plans is critical to decreasing challenging behaviors but little previous research has developed or evaluated practical tools for designing intervention plans. This study consisted of a randomized evaluation of a web-based tool designed to aid clinicians in choosing treatment procedures for inclusion in behavior intervention plans. The effects of the tool were assessed on the inclusion of three types of intervention components that likely contribute to the quality of intervention plans: (1) function-based intervention components, (2) evidence-based intervention components, and (3) non-punishment-based intervention components. Use of the web-based behavior intervention plan builder produced a statistically significant increase in the inclusion of function-based intervention components but no statistically significant effect was observed on the other two measures. Results are discussed in terms of the implications for improving the quality of behavior intervention plans, as well as the dissemination of knowledge of best practices in behavioral intervention.

Challenging behavior has been shown to negatively affect a child's school placement (Allen, 1989), and result in high staff turnover (Felce, Lowe, & Beswick, 1993), abuse (Emerson, McGill, & Mansell, 1994), and the use of psychotropic medication (Matson & Neal, 2009). Although not part of the diagnostic criteria, challenging behavior is common in individuals with autism spectrum disorders (ASD; Matson, Wilkens, & Macken, 2008). The importance of successfully addressing challenging behavior in children with disabilities is widely acknowledged and has resulted in federal mandates, such as the 1997 reauthorization of the Individuals with Disabilities Education Act (IDEA), as well as the 2004 Individuals with Disabilities Education Improvement Act (IDEIA), which included the requirement that educators develop and implement behavior intervention plans (BIPs), which outline the procedures that will be used to manage challenging behavior.

There are many key features of an effective and efficient BIP. First, BIPs should be function-based. An established body of research suggests that successful interventions require the identification of environmental variables associated with challenging behavior (Dunlap et al., 1993) and that function-based behavioral interventions are more effective and efficient (Lalli, Browder, Mace, & Brown, 1993; Umbreit, 1995). Plans that do not include information pertaining to the function of challenging behavior are not only missing important information necessary to be in compliance with the law, but are also devoid of information required to identify appropriate replacement behaviors that should be taught (O'Neill et al., 1997;

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Scott, Liaupsin, & Nelson, 2001; Sugai, Lewis-Palmer, & Hagan, 1999–2000). Second, BIPs should be based primarily on procedures that have been validated in scientific research. Both the No Child Left Behind Act of 2001 and IDEIA (2004) specify the requirement that BIPs be evidence-based (Kraemer, Cook, Browning-Wright, Mayer, & Wallace, 2008). Finally, BIPs should be based on positive reinforcement to the greatest degree possible. All major human service ethical guidelines emphasize the need for minimizing the use of intrusive procedures. For example, section 4.10 of the Behavior Analyst Certification Board Guidelines for Responsible Conduct for Behavior Analysts states that the behavior analyst "always recommends the least restrictive procedures likely to be effective in dealing with a behavior problem" (www.bacb.com).

Procedures that are more likely to be effective also have a higher likelihood of being implemented and maintained (Ingram, Lewis-Palmer, & Sugai, 2005), yet the development of a BIP that addresses challenging behavior appropriately and effectively is a complex and multifaceted task (Killu, 2008). The entire process of conducting a functional behavioral assessment, writing a BIP, and implementing it can be specialized, time-consuming, cumbersome, and impact financial and staff resources (Ingram et al., 2005). One study found that even when BIPs were written by professionals identified as having the most experience and expertise by Special Education Local Plan Area (SELPA) Directors in California, 35% ($N = 244$ plans) were inadequate (Cook et al., 2007). The participants in this study were not necessarily board certified behavior analysts (BCBA) but they had received at least 6 h of training in plan development, had taken at least two courses in applied behavior analysis (ABA), and had attended around 10 trainings on how to manage challenging behavior. Given both this finding along with the fact that courts have now started ruling on essential aspects of plans, it is increasingly important that practitioners develop satisfactory BIPs (Etscheidt, 2006).

Strategies for increasing the quality of BIPs are critical, yet only a small amount of research has investigated methods for doing so. For example, Baker (1998) demonstrated that directly training individuals to develop best-practice behavior support plans can be effective. The development of instruments and tools for increasing the quality of BIPs is another strategy that has been evaluated. In a preliminary investigation, Browning-Wright, Mayer, Cook, Crews, Kraemer, and Gale (2007) evaluated the Behavior Support Plan Quality Evaluation Guide (BSP-QE), an instrument that is used to rate the quality of BIPs. The authors compared its use to training educators in key concepts of positive behavior support (PBS) planning, and found that participants' improvement in knowledge in how to design BIPs was greater when trained to use the BSP-QE than when receiving training in behavioral concepts. In a second investigation, Kraemer et al. (2008) further investigated the effects of training educators to use the BSP-QE and found that the quality of PBS plans was significantly improved.

Given the importance of the BIP design process, it seems that more research is needed on procedures and/or tools that may contribute to the quality of BIPs. The purpose of the current study was to conduct a preliminary evaluation of whether the use of a web-based BIP builder for selecting treatment procedures had an effect on the quality of the BIPs designed. Many dimensions of BIP quality exist but this study examined each treatment component and evaluated the extent to which they were (1) function-based, (2) evidence-based, and (3) punishment-based.

1. Method

1.1. Experimental design and participants

A randomized between-groups design was used. Forty clinicians at a large-scale community-based agency that provides behavioral intervention services to children with autism were included as participants and were randomly assigned to either treatment or control groups. To control for the potential influence of participant professional credentials, pairs of participants who possessed certification as Board Certified Behavior Analysts were randomly assigned one to each group. All participants had little or no prior experience using the BIP builder (all participants had used 0–2 times prior to the study). To control for the possible influence of the number of times participants had used the builder prior to the study, this variable was also equalized in the randomization process. For example, of the first two participants who were enrolled in the study, both of whom possessed the same professional credentials and both of whom had used the BIP builder one time in the past, one was randomly assigned to the treatment group and the other to the control group. In addition, all participants were required to hold a current appointment in a clinical position that involved ongoing design of BIPs for challenging behavior. Participants had roughly the same duration of experience in these clinical positions, with a mean of 5 years in the treatment group (range = 1–13 years) and a mean of 5.3 years in the control group (range = 1–11 years).

1.2. Apparatus

The BIP builder that was evaluated in this study is an interactive web-based tool designed to assist clinicians in selecting treatment components for use in BIPs. Although a stand-alone system in itself, it is also part of Skills®, a larger web-based system of curriculum assessment, treatment planning, and progress tracking (http://www.skillsforautism.com/). The BIP builder was designed to be used by clinicians who already possess sufficient expertise such that they can responsibly design BIPs.

The user begins by designating a target behavior or behaviors and entering an operational definition. The user then chooses a function for the behavior (the client must have already undergone a functional assessment for the target behavior before the user can use the BIP builder). The choices for functions are attention, escape, tangible, and automatic

reinforcement. Based on the function that the user chooses, the BIP builder then asks the user yes/no questions, one at a time. The questions begin with antecedent treatment components, then replacement behavior components, and finish with consequence components. Each question names the treatment component, describes it with a brief paragraph, and asks the user if he/she wants to include the treatment component in their BIP. If the user clicks Yes, then that treatment component is added to the BIP, which is generated later, and the BIP builder presents the next question about a different treatment component. If the user clicks No, then that treatment component is not added to the BIP later, and the BIP builder presents the next question about a different treatment component.

The total number of questions asked per function is between 12 and 18 and varies by function (escape-maintained behavior receives more questions because of the preponderance of different evidence-based treatment components that exist for this function). The total number of questions asked also varies depending on how the questions are answered. For example, one of the questions asks the user to determine whether the behavior is dangerous to the client or others. If the user answers No, for behaviors that are *not* maintained by automatic reinforcement, the user will never then be asked if they want to include response-blocking, because this treatment component would not be function-based. However, if they answer yes, then they *will* be asked if they want to include response-blocking, not for the purpose of reducing the behavior but instead for the purpose of maintaining safety. Table 1 has sample questions from the builder, including the questions for functional communication training for attention, escape, and tangible, as well as the question for differential reinforcement of alternative behavior for automatic reinforcement.

After completing the questions for one function, if the target behavior has more than one function (e.g., attention and escape), then the user answers questions again for each additional function, as the questions are different, based on each different function that the user selects. When the user designates that the target behavior has no more functions to address, then he/she clicks a button that generates the filled-in BIP. The treatment components are automatically populated into three sections: Antecedent treatment components, replacement behaviors, and consequence treatment components. The text describing each treatment component is pasted into a textbox. All textboxes are editable, so that the user can customize them, ensuring that the BIP is tailored to the individual needs of the client. If the user wishes to add additional treatment components, he/she can add additional textboxes with a single mouse click and fill them with typed text. The typical total time for completing the BIP builder ranges from 5 to 30 min, depending on the complexity of the behavior, the number of functions for which questions were answered, the degree of customization the user desires, and the amount of time the user takes to consider each question before answering.

1.3. Dependent variables

Many features and factors are necessary to comprise a good-quality BIP. We did not attempt to compile a comprehensive list of such variables for the purpose of this study and some previous research has been done on that already (Browning-Wright et al., 2007). For the purposes of this study, we identified three features of BIPs for which there is a strong consensus within the ABA community: (1) BIPs should include primarily evidence-based treatment components, (2) BIPs should include treatment components that are based on the function(s) of the target behavior, and (3) BIPs should minimize the use

Table 1
Sample questions included in the behavior intervention plan builder for each function.

Function	Question
Attention	Attention FCT. We will now discuss replacement behaviors, an essential component of any effective behavioral intervention plan. This may include appropriate communication, leisure activities, etc. Intervention plans that do not include replacement behaviors are often considered incomplete. Do you want to teach the individual an appropriate way of asking for the form of attention that is maintaining his/her challenging behavior? Communication is generally considered the best replacement behavior to teach, whenever possible.
Escape	Escape FCT. We will now discuss replacement behavior options for escape-maintained challenging behavior. The two best options for replacement behaviors are (1) communication, and (2) compliance with the task. Both are good options and you are encouraged to select either or both for inclusion in your intervention plan. We will begin by discussing communication. Functional Communication Training (FCT) is a treatment procedure that involves teaching the individual to appropriately ask for what he/she wants instead of engaging in challenging behavior. For escape-maintained behavior, this may include asking for help, asking for a break from work, or asking to change some aspect of the work (different task, different order, different location to complete it in, etc.). The form of communication can be anything, as long as it is easy for the individual to learn (e.g., vocal, sign, picture card). Would you like to include FCT in your intervention plan?
Tangible	Tangible FCT. We will now discuss replacement behaviors, an essential component of any effective behavioral intervention plan. This may include appropriate communication, leisure activities, etc. Intervention plans that do not include replacement behaviors are often considered incomplete. Do you want to teach the individual an appropriate way of asking for the preferred item/activity that is maintaining his/her challenging behavior? Communication is generally considered the best replacement behavior to teach, whenever possible.
Automatic Reinforcement	Attention DRA. It is often a good idea to directly teach the individual how to engage in a leisure activity that may one day turn into an alternative preferred source of automatic reinforcement. Many individuals engage in high rates of automatically reinforced inappropriate behavior because they do not have a large enough repertoire of appropriate play or leisure skills. Directly teaching such a skill is called differential reinforcement of alternative behavior. Would you like to include this in your intervention plan?

of punishment-based procedures, to the greatest extent possible, while still maintaining an effective program that ensures the safety of the client and others. All treatment components included in all BIPs in both the control and experimental groups were scored according to these three variables.

Treatment components were scored as evidence-based if they had been the subject of a significant amount of prior research and have been therefore recommended and used as examples in numerous ABA textbooks and treatment manuals. It was, of course, not possible to conduct a literature review of every single study ever published on the treatment of challenging behavior for this study. Therefore, a relatively conservative approach was taken and only treatments for which considerable research exists and are considered relatively standard practice were scored as evidence-based. An example of a procedure that was scored in many BIPs as evidence-based was functional communication training. An example of a procedure that was not evidence-based was "sensory breaks." The vast majority of procedures that were scored as non-evidence-based in pre and post phases across both groups consisted of procedures which are still considered good standard practice, such as praise for compliance with a task demand.

Treatment components were scored as function-based if the primary mechanism for behavior reduction can be linked directly to the identified function of the behavior. Treatments that may be quite effective but likely work because they "override" the function of behavior, rather than directly addressing it, were scored as non-function-based. An example of a function based treatment component for escape-maintained challenging behavior was teaching the child to ask for a break from work. An example of a non-function-based treatment component for escape-maintained challenging behavior was delivering edible reinforcers contingent on compliance with work, that is to say, offering a competing reinforcer for the desired behavior rather than addressing the actual function of the challenging behavior.

Treatment components were scored as punishment-based if they were consequence procedures wherein something was either removed or presented contingent on behavior, and where the intended effect was to decrease the behavior. An example was the removal of attention or tokens contingent on the behavior. Procedures were not scored as punishment-based if reinforcers that were not already present continued to be absent after the behavior occurred – the latter being exemplary of extinction. It is worth noting that none of the BIPs scored in either group at any time in the study included any physical punishment, harsh aversives, or restraint. Response-blocking was scored as a punishment procedure because it meets the definition; it is a consequence that decreases behavior. Response-blocking is frequently used as a safety procedure, as in blocking one child from hitting another. It is also frequently used as a part of procedures which block and redirect manual stereotypy (e.g., response interruption and redirection). Neither of the above procedures is generally intended as punishment procedures. The former is intended to keep people safe while the latter is intended to disallow automatic reinforcement of stereotypy, as well as redirect the learner to a more appropriate leisure activity. Nevertheless, we took the most conservative approach by simply scoring any reductive consequence other than extinction as punishment, a definition which includes blocking and redirection.

To score each individual treatment component, a team of two Board Certified Behavior Analysts-Doctoral and one Board Certified Behavior Analyst (the three authors of the study), with a combined experience of 42 years in designing and implementing behavioral intervention plans, evaluated and discussed each treatment component until a consensus rating was reached. Similar to how a jury deliberates in a court of law, the scoring team discussed the rationale for why a particular wording of particular treatment component in a BIP should be scored as either present or absent for each of the three dependent variables. Each member of the team described their justification for why a component should be scored in a particular way and the team did not move on to the next component until they reached consensus. The time required for scoring individual components varied a great deal (from approximately 1 min to 10 min), particularly depending on how clearly the treatment components were described in the BIP. The data for each BIP were summarized by dividing the number of treatment components that had a favorable score according to each dependent variable by the total number of treatment components in the BIP, yielding a decimal between 0 and 1 for each of the dependent variables. A score of 0 indicated that none of the treatment components contained in the BIP had a favorable score according to that dependent variable, whereas a score of 1 indicated that all of the treatment components did.

It should be noted that the scoring system used should not be taken to imply that BIPs should always (or even ever) consist entirely of treatment components given a favorable score. For example, many common clinical procedures which are considered ethical and good practice are neither evidence-based nor function-based. For example, if a child has escape-maintained challenging behavior, and the BIP indicates that he/she should be praised for doing his work, this praise is likely neither evidence-based (little or no research has shown that praising compliance reduces escape-maintained challenging behavior), nor function-based (the child wants escape from work, not attention, so giving attention does not address the function). Nevertheless, it is clearly a good idea to give children praise for a job well-done. Therefore, it is important to keep in mind that good quality BIPs should not necessarily be expected to be 100% evidence-based or function-based. Nevertheless, we hypothesized that using the BIP builder would influence clinicians to choose *more* function-based and evidence-based treatment components than they would normally do without it. Therefore, movement in the anticipated direction may be interpreted as a positive finding and it was not expected (nor wanted) that BIPs would be made 100% favorable according to the dependent variables. In a very real sense, there is no such thing as "100% correct" when scoring the quality of a BIP according to these variables. Rather, it is probably reasonable to interpret movement toward more evidence-based, more function-based, and less punishment-based to be a desirable effect.

Table 2
Challenging behaviors in the treatment and control groups.

Topography of challenging behavior	# of participants	
	Treatment group	Control group
Noncompliance	10	7
Physical stereotypy	2	0
Tantrums	2	4
Drooling	1	0
Vocal stereotypy	1	2
Self-Injury	1	0
Negative statements	1	0
Physical aggression	1	3
Elopement	1	2
Physical and vocal stereotypy	0	1
Whining	0	1

1.4. Procedures

All participants in the study were asked to submit one BIP for one behavior for one of their current clients. No guidance was given to the participants regarding what topography or function of behavior to choose, nor which client to choose. The BIPs that were submitted included a wide range of behavior topographies and functions, as depicted in Tables 2 and 3. The ages of the clients ranged significantly, but were roughly equivalent across the two groups, with a mean age of 8.75 years (range = 3–19) in the treatment group and a mean age of 7.75 years (range = 4–10) in the control group. It seems reasonable that due to reactivity, participants would choose to send a BIP that they believed was good-quality, however, this reactivity was likely to be equally distributed across groups. Each BIP was then scored as the pre-test data for that participant. For participants in the control group, the participant was then asked to update their BIP however they see fit over the next 24 h and resubmit it. For participants in the BIP builder group, they were asked to update their BIP using the BIP builder within the next 24 h. No further instructions were given to the participants.

2. Results

At pre-test, the control group showed relatively high scores on all quality measures. The mean score for function-based was 0.84, evidence-based was 0.84, and non-punishment-based was 0.96. The treatment group showed slightly lower pre-test scores in the areas of function-based (mean = 0.78) and evidence-based (mean = 0.78) and similar scores on non-punishment-based (mean = 0.96). At post-test, scores remained the same for the control group and improved in the treatment group for function-based (mean = 0.95), and evidence-based (mean = 0.88), but remained relatively the same for non-punishment-based (mean = 0.93). To evaluate the effects of using the BIP builder on these three outcome scores, the amount of change from pre to post was calculated and used as the dependent variable for each of the three areas measured, respectively. To evaluate if these effects were statistically significant, a MANOVA was conducted. There was a significant group effect for change from pre to post scores on the inclusion of function-based treatment components, $F(1, 38) = 10.35$, $p < 0.01$. There was not a significant effect on the inclusion of evidence-based treatment components, $F(1, 38) = 3.13$, $p = 0.09$. Likewise, there was not a significant effect on the inclusion of non-punishment-based treatment components, $F(1, 38) = 1.31$, $p = 0.26$. Pre and post scores between groups for each of the outcome variables are displayed in Figs. 1–3.

Table 3
Functions of challenging behaviors in the treatment and control groups.

Functions of challenging behavior	# of participants	
	Treatment group	Control group
Escape	12	5
Automatic	4	1
Escape, tangible	2	5
Escape, tangible, attention	1	3
Tangible	1	2
Attention	0	2
Attention, tangible	0	1
Attention, escape	0	1

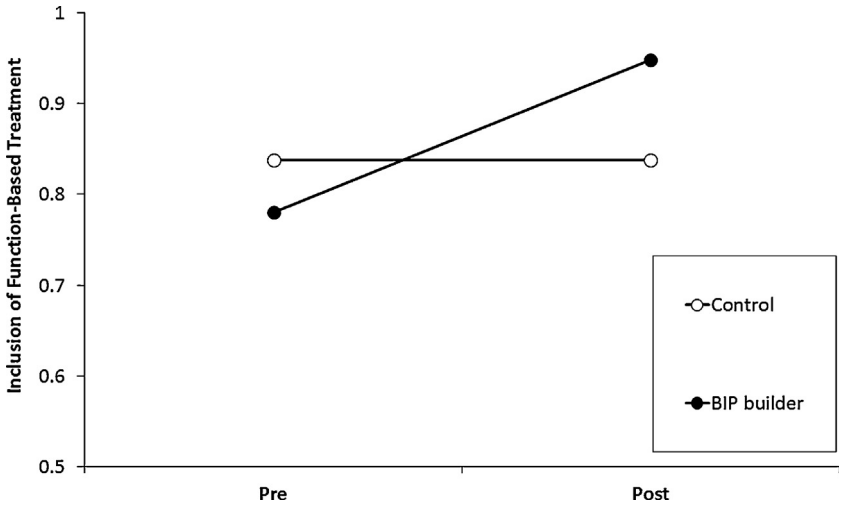

Fig. 1. The proportion of treatment components that were function-based, during pre-test and post-test for the treatment and control groups.

3. Discussion

The results of the current study suggest that the use of a web-based tool for selecting behavioral intervention treatment components may be effective in improving BIPs. The use of a web-based BIP builder produced a substantial increase in the inclusion of function-based behavioral intervention treatment components in the group of participants who used it, relative to the control group. These findings are important because they represent a change in clinician behavior (that of choosing behavioral intervention components) without any training or incentives. It is also worth restating that the participants were never told about how their BIPs were being scored, so the changes in BIPs are likely attributable to the use of the BIP builder tool.

Perhaps the most important implication of the current study is that it demonstrates that a web-based tool may improve the quality of behavioral intervention plans. The desperate need for behavioral intervention services around the globe and the woeful lack of clinicians trained to deliver them necessitate the use of technology to increase efficiency and accessibility. Computers will never be a replacement for expertly trained clinicians but it is hoped that technological innovations may assist by making the spread of evidence-based, top-quality treatment information more rapid and efficient.

The lack of a statistically significant effect of the BIP builder on making BIPs more evidence-based warrants discussion. It is possible that the degree to which the BIP builder encourages the adoption of evidence-based treatment components is not greater than the degree to which such adoption occurs without it. It is possible that the BIP builder simply has no effect on this measure but it is more likely that the effect that it has, if any, is highly influenced by the particular population of

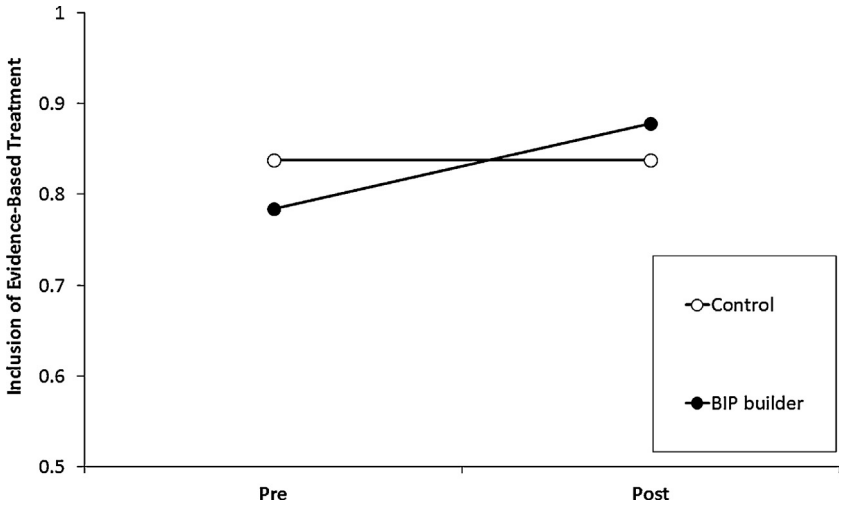

Fig. 2. The proportion of treatment components that were evidence-based, during pre-test and post-test for the treatment and control groups.

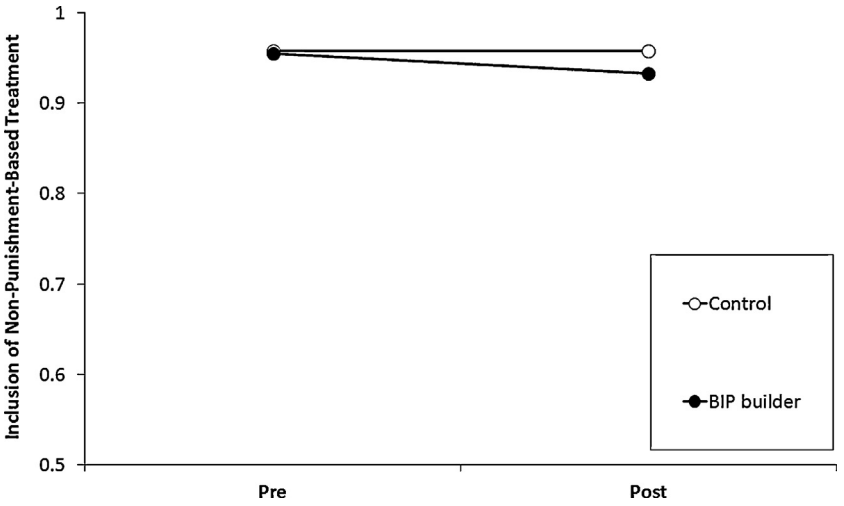

Fig. 3. The proportion of treatment components that were non-punishment-based, during pre-test and post-test for the treatment and control groups.

clinicians who use it. For example, for clinicians who had very little prior training in the use of evidence-based behavioral intervention procedures, the high percentage of evidence-based procedures contained within the BIP builder may encourage a large increase, relative to what such clinicians might normally use. For clinicians who already use a high percentage of evidence-based behavioral intervention treatment components, the content of the BIP builder may not represent an increase, relative to what they normally use when designing BIPs. The participants in the current study had all received substantial prior training in the use of evidence-based behavior intervention treatment components and were already using such components to a high degree, as can be seen from the pre-test data for both groups in Fig. 2. Therefore, it is possible that the study encountered a ceiling effect, in that the BIPs already had a high percentage of evidence-based components.

The lack of an effect of the BIP builder on the inclusion of punishment-based treatment components also warrants discussion. First, it is likely that a ceiling effect was also seen for this measure. A very high percentage of treatment components were non-punishment-based during pre-tests (96%), so it would be difficult for the measure to improve much, if at all. In addition, one particular feature of the BIP builder may have contributed to the inclusion of punishment-based procedures. Specifically, the BIP builder asks the user if the behavior is dangerous to the client or others and if the user answers yes to that question, the BIP builder recommends that the behavior be blocked, in order to keep everyone in the therapeutic environment safe. The user then has the opportunity to answer yes or no. If they answer yes, then response blocking is included in the BIP. For the purposes of this study, response-blocking was always scored as a punishment procedure. There is a case to be made that response blocking may have no effect on the occurrence of the behavior (and therefore cannot technically be punishment), especially when it is used only for safety. However, if it is implemented as a consequence of behavior and the behavior decreases as a result, then it meets the commonly accepted behavioral definition of punishment. In addition, a small amount of research has attempted to address whether response-blocking decreases behavior through punishment or extinction and preliminary results seem to lean toward punishment (Lerman & Iwata, 1996). In any case, if it is punishment, response-blocking is certainly among the least intrusive types, especially when it is implemented for safety. Nevertheless, in the interest of implementing the most conservative measurement system possible, the decision was made to score response-blocking as punishment. It is worth noting that 100% of punishment procedures included in the BIPs that were created using the BIP builder were response blocking – no other more intrusive procedures were included.

Potential limitations of the population used in the current study are worthy of discussion. First, including only one population of clinicians for the study makes it difficult to generalize the results to other populations, but this can be said of virtually all preliminary research – almost by definition, initial studies do not include a representative sample of the entire true population of interest. Nevertheless, the current study included behavioral clinicians who were already experienced in designing BIPs. Inclusion of this population has both strengths and limitations. On one hand, it is limited in the sense that clinicians who most need a tool such as the BIP builder are likely ones who are less trained and less experienced. It is therefore not known how effective the BIP builder would be when used by teachers or other behavior support personnel who do not have substantial prior training in behavioral interventions. On the other hand, the Behavior Analyst Certification Board Practice Guidelines for Autism Spectrum Disorder strongly recommend that behavioral interventions be supervised by expert clinical supervisors who possess substantial prior training (www.bacb.com). Therefore, it is probably neither reasonable nor appropriate to expect untrained clinicians to be able to use a web-based tool in lieu of having top-quality training. It is probably most appropriate for web-based tools

such as the BIP builder to be used either by experienced clinicians (e.g., BCBAs) and/or by those who are working under the supervision and mentorship of such.

It is worth noting that the BIP builder evaluated in this study fulfills only one part (albeit perhaps the most important part) of designing a BIP: selecting treatment components. There are several other crucial phases of designing a top-quality BIP that are not addressed by the BIP builder. For example, good behavior support plans must also consider overall family and systems variables, the availability of sufficient resources and support, parent and child preference, ecological variables, and all relevant cultural factors. In addition, the BIP builder includes only the functions of escape, attention, tangible, and automatic reinforcement. Although these functions are by-far the most common functions identified in research (Hanley, Iwata, & McCord, 2003), other functions have been identified in the literature and are not addressed by the builder. The BIP builder assessed in this study was not designed to address those factors and therefore must be used by an expert in designing BIPs, in conjunction with a careful assessment of the many other relevant factors in addition to treatment component selection.

A final limitation of the current study is that no attempt was made to assess whether BIPs made using the BIP builder were more clinically effective than those made without it. Ultimately, the most important measure of the quality of BIPs is whether they result in a clinically significant decrease in challenging behavior and increase in replacement behaviors. The use of function-based and evidence-based treatment components is considered best-practice and is likely to be effective, nevertheless, future research on web-based intervention planning tools should attempt to evaluate whether the interventions made with those tools are more effective than those made without.

Several directions for future research are apparent. First, the promise of information technology is to make good-quality behavioral intervention more affordable, efficient, and available to a larger population. Very little research, however, has attempted to systematically evaluate how technology can be used to achieve top-quality gains faster, cheaper, or more efficiently. Future research could systematically assess how tools such as the BIP builder allow behavior analysts to design top-quality intervention plans in less time, create more intervention plans in the same amount of time, or how experts may be able to supervise a larger number of lesser-trained clinicians if they are aided with technology which makes clinical supervision more efficient. For example, future research could systematically compare behavioral outcomes for a group of clients whose clinicians were aided by technology to those for a group of clients whose clinicians were not.

In conclusion, although the scope of this study is relatively small, it constitutes an important step in the development and evaluation of technological tools that may be used to improve dissemination of evidence-based treatment for individuals with ASD around the world. The information technology revolution is already a fact of everyday life and the fields of autism and applied behavior analysis cannot afford to wait for the inevitable to happen. If the worldwide demand for autism services is to be met, technological innovations in training and dissemination must be pushed forward and empirically tested.

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