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Using the Prevent-Teach-Reinforce Model with Families of Young Children with ASD

Kacie M. Sears · Kwang-Sun Cho Blair ·
Rose Iovannone · Kimberly Crosland

Abstract This study was conducted to examine the feasibility and potential efficacy of implementing an adapted, family-centered version of the school-based prevent-teach-reinforce (PTR) model. The research included two families who implemented the PTR process for their children in collaboration with the researchers. The adapted PTR was tested using a multiple baseline design across routines to examine changes in child behavior across experimental conditions. Results indicated that the adapted PTR intervention was associated with reduction in child problem behavior and increases in alternative behavior in both target and non-target routines. The results also indicated that the parents were able to implement the behavior intervention plan with fidelity and successfully use the PTR process for a novel routine. The PTR intervention also had high social validity ratings; both self- and novel-rated validity indicated that the PTR intervention was acceptable to both families and the community at large. The data are discussed in terms of the expanding evidence related to the PTR model and the extension to a family context.

Keywords Prevent-teach-reinforce · Family-centered intervention · Positive behavior support · Autism spectrum disorders

K. M. Sears · K. C. Blair (✉) · R. Iovannone · K. Crosland
Department of Child and Family Studies,
College of Behavioral and Community Sciences,
University of South Florida, 13301 Bruce B. Downs Blvd.,
MHC 2113A, Tampa, FL 33612-3807, USA
e-mail: kwangsun@usf.edu

Introduction

Problem behaviors, which are often exhibited by children with autism spectrum disorders (ASD), can be a pervasive challenge to family life. With the increasing numbers of children diagnosed with ASD (Hertz-Picciotto and Delwiche 2009), it is imperative to provide services within many areas encompassing a child's life, especially the area of family functioning where problem behaviors can cause major impairment to family and child quality of life (Lucyshyn et al. 2007; Moes and Frea 2002).

Problem behaviors often develop as a result of environmental issues, lack of reinforcement for desirable behaviors, and communication impairment for both the child and parent (Carr and Durand 1985; Harrower et al. 2000). These problems can occur when parents do not know how to effectively communicate with their child and when the child is unable to communicate wants or needs to their parents (Dunlap et al. 2006; Frea and Hepburn 1999). Because children with ASD spend the majority of their time in the family setting, it is important to equip parents as well as extended family members and siblings with the necessary tools to create a desirable family environment (Meadan et al. 2009). Another important aspect when providing support to children with ASD is early intervention. Families often wait to access intervention concerning problem behavior until the child is older and the problem behavior cannot be 'controlled' by the parents, instead of seeking intervention at the onset (Pavuluri et al. 1996). Therefore, early intervention should be of high priority to reduce problem behavior of children with ASD.

Family-centered behavioral interventions involving family members as an agent of change have received much support in the research literature (Frea and Hepburn 1999; Lucyshyn et al. 2002; Moes and Frea 2002). However, the

design and delivery of appropriate, effective, and feasible family-centered early intervention models for young children with ASD and their families is still a challenge. Despite the fact that the interventions for these children require not only reducing problem behaviors, but also understanding of their interactions within the family system, there is still a lack of empirically validated family-centered intervention models that facilitate family involvement in all aspects of intervention development and implementation (Strain and Schwartz 2009).

Positive behavior support (PBS) is considered an ecological model of family-centered interventions, and is derived from the fundamental concepts of operant learning theories (Carr et al. 2002). The goal of family-centered PBS is to enable families to implement strategies that will result in decreases in problem behavior, increases in appropriate behaviors and improved family and child functioning by promoting effective, meaningful, acceptable, and durable behavior change in the context of family routines (Dunlap and Fox 1999; Lucyshyn et al. 2007).

Prevent-teach-reinforce (PTR) is a model of individualized PBS originally designed for use in classroom settings to meet the need for a standardized model of function-based behavioral intervention subjected to the field's call for rigorous testing with a randomized controlled trial (Iovannone et al. 2009). PTR was systematically evaluated with more than 200 students across five school districts in two states. The results indicated that students who received the PTR intervention showed significantly greater improvements in social skills, behaviors, and academic engagement than did their counterparts who received typical services (Iovannone et al. 2009). The majority of teachers implemented the interventions with a minimum of. 80 fidelity and gave high social validity ratings suggesting that the process addresses a key barrier to effective PBS; that is, teacher resistance to implementing behavior interventions (Scott et al. 2005; Van Acker et al. 2005).

The PTR model includes five steps aligned with the problem-solving process. It is a collaborative team driven process facilitated by a consultant who has expertise in behavioral principles and guides the team through five steps. *Step 1: teaming,* establishes membership and an agreement on how the team will function including methods of gaining consensus and assignment of responsibilities. *Step 2: goal setting,* focuses on identifying and defining the social, behavioral, and academic targets. *Step 3: PTR assessment* (functional assessment), includes direct and indirect observations covering three categories relating to antecedent variables (Prevent), function and replacement variables (Teach), and consequence variables (Reinforce). *Step 4: intervention,* requires the team to select interventions that are matched with the hypothesis and represent each intervention component (i.e., P-T-R). Step 4 includes

a plan for *training and coaching* adults to implement the strategies as intended. Fidelity of support plan implementation is evaluated during this step. *Step 5: evaluation,* uses targeted behavior change data to make decisions about the plan's effectiveness and next steps. The model's manual has been published and provides detailed descriptions of each step as well as tools to be used by teams (see Dunlap et al. 2010).

Although the use of the PTR model was successful in the school setting, there is no research to evaluate the implementation of PTR in family settings. While the five steps of the PTR process apply to the family context, specific strategies to enhance collaborative family-professional relationships need to be added. In addition, the manual and specific PTR tools, such as the PTR functional assessment and PTR intervention checklist (both described in the next section), need to be revised to match the context of family settings and daily family routines. The family-centered, adapted PTR model tested in the current study uses the collaborative, team-driven problem-solving framework to develop function-based intervention plans targeting socially valid behaviors selected by family teams. The process yields behavior support plans comprised of family-selected interventions that can be feasibly implemented with fidelity by typical family members within daily home routines. Our focus was to examine whether the unique feature of the collaborative team-driven PTR process facilitated by a consultant would have the potential to empower families to implement interventions with fidelity and encourage generalization and maintenance of the process into other routines.

Therefore, the purpose of the current research was to examine the feasibility and potential efficacy of adapting the PTR model for use with two families of young children with ASD. It was hypothesized that the family-centered, PTR model would be feasible for implementation in family contexts and result in improved child behavior. Specifically, we evaluated whether: (a) the family members were able to participate in the PTR process to develop a behavior intervention plan that would be implemented with fidelity; (b) the children's problem behavior decreased and appropriate behavior increased across routines; (c) the family members were able to generalize the PTR intervention to a non-trained routine resulting in collateral changes in child target behaviors; and (d) the PTR intervention was rated as acceptable by both participating family members and novel parents.

Method

Participants

Two males with ASD and their families, who were Caucasian middle class, participated in this study. Both were

recruited from a local business providing in-clinic academic services for children with ASD. Inclusion criteria included the following: (a) child between the ages of 3–5, with a diagnosis of ASD or ASD symptoms; (b) child had problem behavior that interfered with family routines; and (c) willingness to participate in the research.

Nicky was a 4 year old male who had been diagnosed with pervasive developmental disorder-not otherwise specific (PDD-NOS) at 33 months of age by a licensed psychiatrist. His standard scores on the Battelle Developmental Inventory II (BDI-2; Newborg 2005) were 80–98 in the adaptive and motor domains. His scores in the cognitive, personal/social, and communication domains were 69–71. For 1 year prior to this study, Nicky had been receiving verbal behavior therapy that focused on teaching him manding for reinforcers as well as physical therapy from a private health insurance provider. He was able to make a variety of sounds, such as mama, dada, and tee tee, but no formal words. He fluently used 6 signs for different toys. At the time of the study, Nicky attended a public preschool half time, where he received special education services. Nicky frequently engaged in several problem behaviors across family routines which thus far had been resistant to the therapeutic and educational services. Nicky lived with his parents and his 6-year-old sister. His parents did not have experience with PBS, but implemented verbal behavior intervention strategies at home to teach Nicky to mand for reinforcers.

Michael was a 6-year-old male who had been diagnosed with autism at 18 months of age by a licensed psychiatrist. When he was assessed at age three by the school district to receive early childhood special education services, the standard score on the Vineland II (Sparrow et al. 2005) was 86 in the communication domain. Scores in the other domains were 78 in daily living abilities, 65 in socialization, 79 in motor skills, and 73 in adaptive behavior. Michael had also been receiving verbal behavior therapy in his home since the age of 18 months. Michael frequently engaged in tantrums and repetitive stereotypic behavior. Michael lived with his parents and an 8-year-old brother. His parents were not experienced with PBS, but as with Nicky's parents, they implemented verbal behavior intervention strategies at home to teach Michael language skills.

Setting

This study took place primarily in the home setting of each family. The specific routines that Nicky's family selected for intervention included bathroom, independent play, and mealtime. The bathroom and play routines for Nicky occurred in the afternoon right after he arrived home from school. The mealtime routines occurred in the morning and at lunchtime. The target routines selected by Michael's

family included car riding and the morning routine. The car ride routine for Michael occurred when the family took him shopping, to his grandparent's house, and to the public pool.

PTR Adaptation

The authors adapted the PTR model by revising worksheets and process steps included in the PTR manual. Specific behaviors, antecedents, and settings, which were tailored to school settings, were changed so that they incorporated home-based options for young children. For example, the menu of interventions worksheet had *curricular modifications* as one possible *prevent* strategy. This strategy was replaced with the strategy of *family routine changes*. In addition, the model was streamlined by reducing the number of meetings required prior to developing interventions. These and other practical changes were addressed in order to attend to the differences between caregiver use in the family context and school personnel use in the classroom context.

Measures

Fidelity

Family implementation fidelity was measured to assess the extent to which a parent and/or second caregiver implemented the behavior support plans as designed. Implementation fidelity was calculated as a percentage based on the number of correct intervention steps implemented divided by the total number of intervention steps that were applicable for each routine. Plans developed for Nicky contained 13 steps for the potty routine, 6 steps for the independent play routine, and 6 steps for the mealtime routine. The plans for Michael contained 9 steps for the car routine and 8 steps for the morning routine. A sample fidelity checklist with a breakdown of steps is shown in Table 1.

Problem Behavior

The problem behavior for Nicky was identified as inappropriate chewing which was defined as chewing his shirt or other non-food items. Problem behaviors for Michael included repetition and tantrums. Repetition was defined as repeating questions or phrases. Tantrum behavior was defined as occurrence of a chain of behavior including kicking family members with any part of his foot, hitting family members using an open or closed fist, screaming in a high-pitched tone above the normal vocal level, crying, and stomping by lifting the foot off the floor and returning it to the floor in a forceful manner. Percentage of intervals was measured for Nicky's inappropriate chewing and

Table 1 Sample PTR implementation fidelity checklist. Routine: Potty, Child: Nicky

Task analysis of interventions	Demo #1		Demo #2	
Prevent steps				
1. No T.V.	Yes	No	Yes	No
2. 5–10 min of No T.V. on to self-initiate	Yes	No	Yes	No
3. Taken to sign say "1st potty, then Little Einstein"	Yes	No	Yes	No
4. Physically prompt him to hand you the potty picture	Yes	No	Yes	No
Teach steps				
1. Nicky goes or is physically guided to the bathroom	Yes	No	Yes	No
2. Stand blocking the exit	Yes	No	Yes	No
3. Head/eye gesture to the pictures	Yes	No	Yes	No
4. Given 10 s to self-initiate step	Yes	No	Yes	No
5. Physically prompted after 10 s	Yes	No	Yes	No
6. Repeat for each step	Yes	No	Yes	No
Reinforce steps				No
1. Reinforce self- initiation of bathroom routine or expressing bathroom needs with gestures with a high amount of praise	Yes	No	Yes	No
2. Reinforce completion of each step with verbal praise	Yes	No	Yes	No
3. Reinforce completion of routine with preferred T.V. Show	Yes	No	Yes	No
Total correct steps				
Percentage of correct steps				

Michael's tantrums. For Michael's repetition, rate per minute was measured.

Appropriate Behavior

The appropriate behaviors to be increased for Nicky included (a) independent completion of bathroom steps without the need for any prompts from caregivers and (b) eating unfamiliar food or non-preferred food that had either never been eaten before or had previously been associated with refusal. Measurement included percentage of bathroom steps completed independently and the number of bites of unfamiliar food. Appropriate behavior selected for Michael was following directions (e.g., complying with a family member's or caregiver's request to eat independently) and was measured as percentage of intervals.

Social Validity

Two types of social validity, self-ratings and naïve parent ratings, were assessed in this study. Self-rated social validity was assessed during the follow-up phase with parents using an adapted 15-item treatment acceptability

rating form-revised (TARF-R; Reimers and Wacker 1988) designed to measure the acceptability and effectiveness of the plan and the ability to design a plan without the researcher. Novel parents also rated the intervention acceptability of child behavior, parent behavior, and implementation using a 5 point Likert scale. Three parents who did not have any previous knowledge of Nicky and Mike's families and who had children with ASD were selected as novel raters. They were recruited from the same local clinic where the participating families were recruited. The raters viewed 2–4 min randomly selected video clips (one from baseline and one from intervention) taken during Nicky's mealtime routine and video clips taken during Michael's morning routine. The scale items were adapted from the social validity measure by Buschbacher et al. (2004).

Procedural Integrity

To ensure the researcher delivered the PTR process as planned, researcher (first author) procedural integrity was assessed by audio taping each session with team members and having an independent observer (a graduate student in Applied Behavior Analysis) use an integrity checklist to score adherence to procedures. The checklist, adapted from PTR, listed 15 steps required for facilitating a team and used a yes/no scoring format. Procedural integrity of the researcher was scored at 100 % across both families indicating that all PTR steps were correctly delivered in each meeting. IOA for procedural integrity, assessed by using a point-by-point method (item by item), was 100 % for families across sessions.

Data Collection and Inter-observer Agreement

We observed child target behaviors using a 10-second partial interval recording system or an event recording system except for Nicky's bathroom routine behavior. His behavior during the bathroom routine was recorded using a task analysis worksheet indicating the prompt hierarchy. We scored the number of steps completed independently without any prompts or with minimum verbal or visual prompts. All other routines for both children were video-taped by families for later scoring. Data were collected during approximately 10-min sessions except for Nicky's bathroom routine. During the later sessions of intervention and follow-up, Nicky completed the bathroom routine in <10 min and data were collected for 5 min in several sessions. Fifty percent of the sessions were assessed for IOA. The mean IOAs were 100 % across participants, routines, phases, and target behaviors except the IOAs for Michael's behaviors during morning routine, which averaged between 93 and 97 %. IOA for Michael's problem

behavior was 93–100 % in baseline and 82–100 % in intervention. IOA for Michael's appropriate behavior was 87–100 % in baseline and 72–100 % in intervention.

Experimental Design

The feasibility of using the PTR intervention in home settings was tested using a concurrent multiple baseline design across routines for each family. The family team identified which routines were problematic and implemented the intervention staggered across routines.

PTR Intervention Procedures

General Procedures

The general procedures of the PTR intervention are described below, followed by specifics of the collaborative PTR process and intervention strategies for each family, follow-up, and generalization.

PTR Initial Meeting An initial team meeting lasting 2 h was conducted in each family's home, which covered Step 1 (teaming) and 2 (goal setting) of the PTR process. During the meeting, the researcher guided the family in identifying problematic routines in need of intervention and selecting and defining target behaviors. The team members used the PTR *goal setting* worksheet to identify the short-term and long-term goals for the child to achieve in the areas of behavioral, social, and independent functioning.

Baseline Data Collection After the initial meeting, we collected baseline data on the child's target behaviors and baseline levels of the family's use of intervention steps or strategies for a period of 1–2 weeks. We asked families to engage in the problematic routines by interacting with their child as they would normally (see below for each family's typical interactions with their child during each target routine before intervention). This phase was conducted with each family until a stable level of data was achieved across child target behaviors and in family fidelity across routines. Observation sessions were 5–15 min, depending on the target routine.

Functional Assessment and Behavior Intervention Planning Following baseline data collection, the team members participated in the second meeting, which covered Steps 3 (functional assessment) and 4 (intervention development) of the PTR process. A separate 3 h meeting was held for each routine so that the intervention would be staggered across the routines. The teams used the PTR *functional assessment* form to identify the antecedents, consequences, and functions for each problem behavior.

The researcher summarized the assessment results and determined hypothesized functions of behaviors using the *PTR assessment organization table* worksheet. The team reached consensus on the hypothesis and then completed the *PTR intervention checklist* to select behavior interventions from each of three categories (Prevent, Teach, Reinforce) that were feasible for implementation and best matched the hypothesis.

Family Training After the intervention plan was developed by task analyzing each strategy into steps, the researcher (first author) provided approximately 30 min of training to the parents on the implementation steps using verbal and written instructions, modeling, rehearsal, and feedback. The training occurred separately for each family. Using the PTR Fidelity Checklist developed for each family, the researcher scored each family member on their percentage of correct performance of intervention steps. The researcher and family practiced implementing the steps until each family member was able to perform the steps with 90 % accuracy.

Intervention Plan Implementation and Evaluation Upon completion of training, the family members began implementation of the behavior plan in each target routine. Additional coaching sessions were scheduled if implementation scores of any implementer fell below 80 % during the initial phase of intervention. No coaching sessions were required for Nicky's parents because their fidelity scores never fell below 80 % except in the generalization routine. The researcher provided two 15-min in-situ coaching sessions to Michael's mother during the morning routine to prompt and model how to withdraw reinforcement when the tantrum behavior occurred and to discuss and role play on prompting Michael to take medicine. The teams participated in ongoing evaluation of the effectiveness of the intervention; the researcher briefly reviewed with each child's parents the video recorded data on child target behavior on a weekly basis and discussed the child's progress and their implementation of the intervention plan. Intervention phases ended when each family's primary interventionist demonstrated that they could implement plans with fidelity scores above 80 % and when a stable improvement was seen in each child's behaviors. Data were collected 1–2 times per week.

PTR Process and Intervention Strategies for Each Family

The following are specifics of the PTR process conducted for each family and intervention strategies developed to address each child's problem behavior and to promote new replacement skills within the context of natural family routines.

Nicky During the first meeting, Nicky's family identified three routines that posed problems; potty, independent play, and mealtime. During the bathroom routine, Nicky would often void in his pull-up and then remove it. As a result, the parents would either physically prompt him to go to the bathroom before he toileted in his pull-up or take him to the bathroom to put on a new pull up. In addition, his parents had to provide full physical prompts to have Nicky complete all of the bathroom routine steps. During the independent play routine (generally television viewing, but also toy play), Nicky would put non-edible objects such as his shirt or other toys in his mouth and chew on them. Parents would verbally reprimand him and remove the item, which often led to not requiring Nicky to wear shirts while at home. During mealtime, the identified problem behavior was spitting out food after one bite or refusing to eat non-preferred or unfamiliar food. This resulted in the family ceasing feeding attempts. Of the three routines, bathroom and independent play were targeted for intervention, and the mealtime was selected for generalization evaluation.

Nicky's family determined that the function of Nicky's problem behavior during the bathroom routine was access to tangibles. Nicky's family hypothesized that when Nicky had access to preferred activities (T.V. or computer) he was more likely to void outside of the bathroom, which gave him continued access to the preferred reinforcers. They also hypothesized that Nicky's chewing behavior was maintained by automatic reinforcement. They found that when Nicky was playing alone, he was more likely to chew on his shirt and other items in order to gain the automatic reinforcement associated with the act of chewing.

The team decided that for the bathroom routine the most helpful *Prevent* strategy would be an *environmental support* that would make it less relevant for Nicky to not comply with bathroom routine steps. Specifically, the team developed a first/then visual board depicting a photograph of the bathroom and a photograph of the T.V. to signal to him that going to the potty first would be followed by access to the T.V. The team selected a *communicative behavior* and *independent skills* from the *Teach* component. They designed an intervention to teach Nicky to initiate a request to potty by use of the potty photograph included in his *prevent* intervention. Pictures were taken of each potty routine step to use as visual prompts to teach him to go through the steps independently. For the *Reinforce* component the team selected *discontinue reinforcement of the problem behavior* and *reinforce the replacement behavior*. This involved withholding access to the T.V. as a reinforcer until Nicky had successfully completed all steps of the bathroom routine.

The team repeated this intervention development process for each routine selected. After interventions were selected and agreed upon, a concrete plan was designed which included task analyzed intervention strategy steps. The steps were developed with active family input so that the intervention plan would be feasible for the family to implement. Both of Nicky's parents implemented the intervention across routines. The interventions for the bathroom and the play routines were implemented for a period of 6 weeks.

Michael Michael's family identified two problematic routines; riding in the car to preferred destinations and the morning routine. They reported that during car rides he would repeatedly say the same phrase and question about the destination (e.g., "we're going to market, we're going to market, mom, we're going to market; when can we go to market mom?"). Family members would respond by saying "yes, we're on our way," or "we're going right now, I've already told you we're going to the market." During the morning routine, Michael would often kick and scream when asked to comply with morning activities including getting dressed, brushing hair, eating breakfast, taking medicine, brushing teeth, and putting on shoes. The family would continue to deliver verbal demands to comply with activities and would try to "get him out of the bad mood" by tickling or chasing, eventually reverting to yelling, holding him down if he was kicking excessively, or leaving him alone and trying again a few minutes later. The team determined that repetitions in the car occurred to gain attention and tantrums during the morning routine functioned to delay the onset of less preferred activities and to gain attention from adults and his sibling.

For the car ride routine, Michael's team selected the *prevent* intervention, *provide alternative items* (e.g., books, toys, music, and videos) that would engage Michael in different activities making it unnecessary for repetitions. Parents also felt that excitement about destinations contributed to the attention gaining behavior. Therefore, they selected a *functional prosocial behavior,* verbalizing appropriate statements about destinations, from the *Teach* strategies. It was also planned that engagement in alternative activities and appropriate prosocial statements would be reinforced with attention by delivering verbal praise and conversation. For the morning routine, the team selected *environmental supports* as the *Prevent* strategy, focusing on using a timer to signal transitions. The *Teach* intervention was to provide physical prompts to instruct Michael to follow directions and engage in the required tasks. For the *Reinforce* component, parents chose *discontinue reinforcement of problem behavior* and selected to extinguish tantrum behavior and reinforce with praise when Michael followed the routine steps. In addition, the team opted to provide verbal praise contingent upon Michael following directions and engaging in preferred interactions (tickles and spinning).

Follow-up

Two weeks following the intervention phase, four follow-up data points were collected for a period of 2 weeks during Nicky's bathroom routine. The researcher took four probes of child target behaviors and family implementation fidelity. No follow-up probe data were collected for Michael due to his family's vacation and time constraints.

Generalization

During the first team meeting session, Nicky's parents were interested in participating in the generalization evaluation. As a result, the parents spent an additional 2 h designing an intervention plan for the generalization mealtime routine immediately after they completed the initial intervention plan developed under the guidance of the researcher. They independently followed the PTR steps of assessment and intervention planning, using the worksheets to design their own intervention for mealtime. The purpose of the generalization evaluation was to determine if the family could successfully apply the PTR steps independently. During this phase, the researcher only provided input when asked by the family for specific suggestions (e.g., developing intervention steps) and provided no coaching of the plan. Nicky's target replacement behavior during mealtime routines was accepting unfamiliar or non-preferred food (e.g., apples, hamburger, carrots, and eggs). The family hypothesized that Nicky's refusing or spitting food out was maintained by escape from food demands or non-preferred food. Strategies selected to teach Nicky to eat unfamiliar or non-preferred food were using *sibling modeling*, *providing choices*, and *reinforcing* each bite of non-preferred or unfamiliar food with preferred food. Generalization data were collected across baseline and intervention phases.

Results

Fidelity

As shown in Fig. 1, Nicky's family's baseline implementation of intervention steps was 0–10 % across routines. Once the PTR intervention was introduced, the implementation of intervention steps immediately increased. His mother's fidelity averaged 92 % for the bathroom routine and 100 % for the play routine. In follow-up, his mother implemented the intervention steps correctly 100 % of the time during the bathroom routine. Nicky's father's fidelity data also showed <10 % of implementation across routines in baseline, but his implementation of intervention steps immediately increased to an average of 90 % across routines in intervention, demonstrating high levels of fidelity.

During the mealtime routine in which family generalization of intervention was assessed, fidelity averaged 0 % in baseline and 82 % in intervention; however, there was some variability in fidelity for both parents during the mealtime routine. As shown in Fig. 2, average intervention steps implemented for Michael's mother in baseline was 0 % for the car routine and 2 % for the morning routine. Fidelity increased during intervention to 89 % for the car routine and 88 % for the morning routine.

Child Behaviors

As shown in Fig. 1, Nicky was able to complete only 14 % of the steps in the bathroom routine independently on average during baseline. After the behavior plan was implemented, his independent step completion increased to 53.3 % across the last four sessions, demonstrating an upward trend. For the independent play routine, Nicky engaged in chewing his shirt or other objects an average of 93 % of intervals (range 71–100 %) during baseline. During intervention, chewing inappropriate items decreased to an average of 3 % of intervals per session, demonstrating immediate change. During the baseline phase of the generalization routine, Nicky did not take any bites of unfamiliar or non-preferred food. However, during intervention his bites of unfamiliar or non-preferred food increased to 3 bites per meal on average (range 0–9 bites). Michael's repetitive behavior during car rides occurred an average of 3.3 times per minute in baseline and decreased to an average of .04 times per minute during intervention. Tantrum behavior in the morning routine occurred an average of 75 % of intervals during baseline, and decreased to an average of 19 % during intervention. Following directions occurred an average of 25 % during baseline and increased to 81 % during intervention. The intervention resulted in immediate changes in target behaviors across routines and there was no overlap in data between baseline and treatment conditions.

Social Validity

The results of social validity ratings indicated that both families rated the PTR intervention as having high levels of social validity. Overall ratings for Nicky's parents were a mean of 4.3 for the independent play routine and 4.5 for the mealtime routine. Michael's parents rated a mean of 4.6 for car riding and 4.5 for the morning routine. All of the following items received ratings of 4 or 5, indicating a high level of acceptability and satisfaction: acceptability of the PTR intervention plan, willingness to carry out the plan, confidence that the intervention was effective in changing behavior, intervention will result in permanent improvement in the child's appropriate behaviors, degree to which

Fig. 1 Percentage of family implementation fidelity and percentage of intervals, percentage of steps completed, and number of bites for Nicky's target behaviors across routines and phases
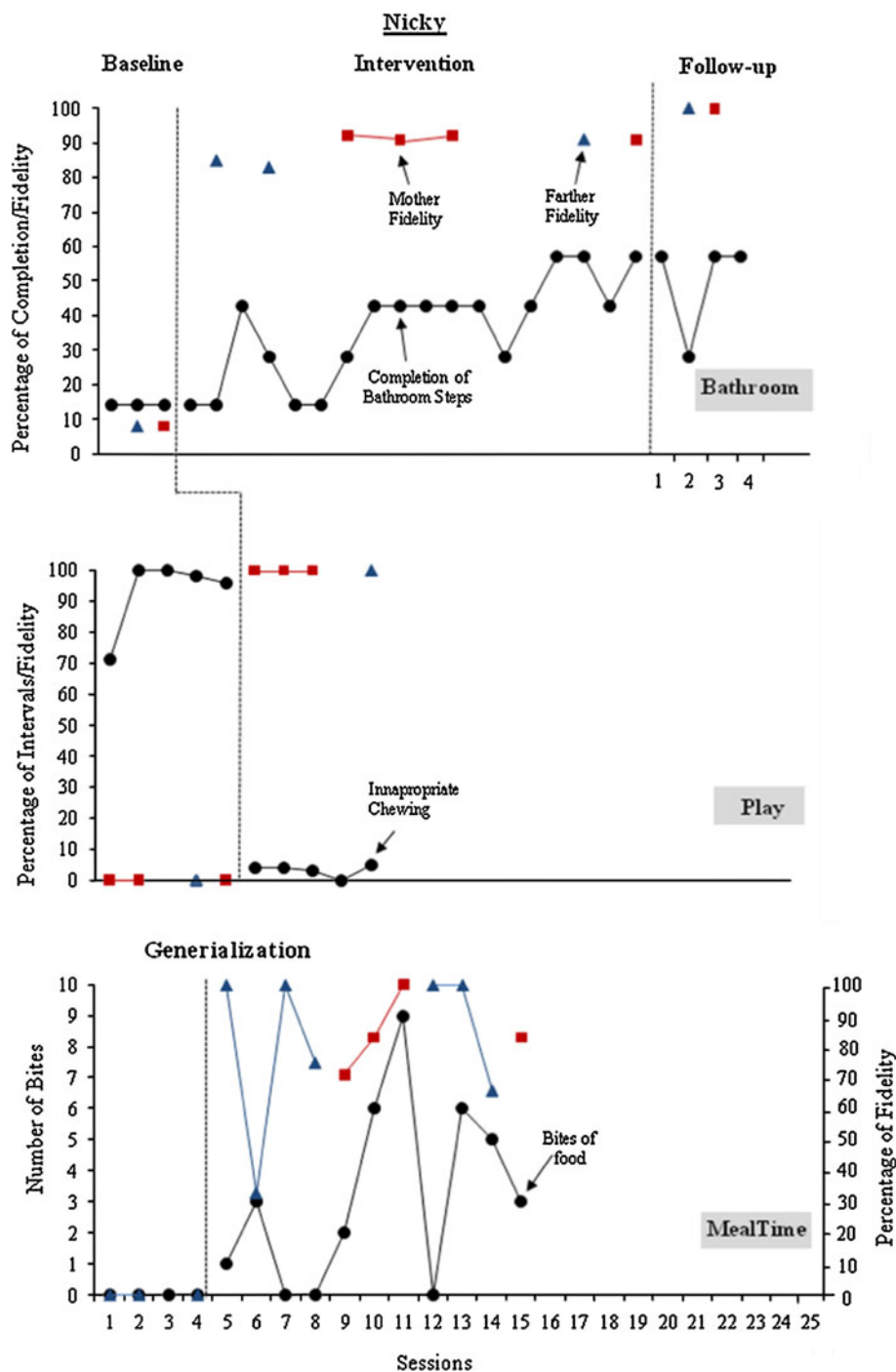

parents liked the intervention procedures, likelihood that the parents will continue the intervention, willingness to change the routine in order to carry out the plan, and the extent to which intervention fits within the routines and team's goal. The social validity ratings given by novel parents viewing video segments of baseline and intervention sessions showed low scores at baseline, but higher scores at intervention. Overall mean ratings by the naïve

observers across children and routines were 1.3 in baseline and 4.7 in intervention, indicating that the children's behaviors were acceptable in target routines, the children participated appropriately in the routines, the strategies used by the family members were effective in the routines and practical for families to implement, and both the children and family members appeared to be comfortable with how the routines were going.

Fig. 2 Percentage of mother implementation fidelity and percentage of intervals and number of repetitions for Michael's target behaviors across routines and phases
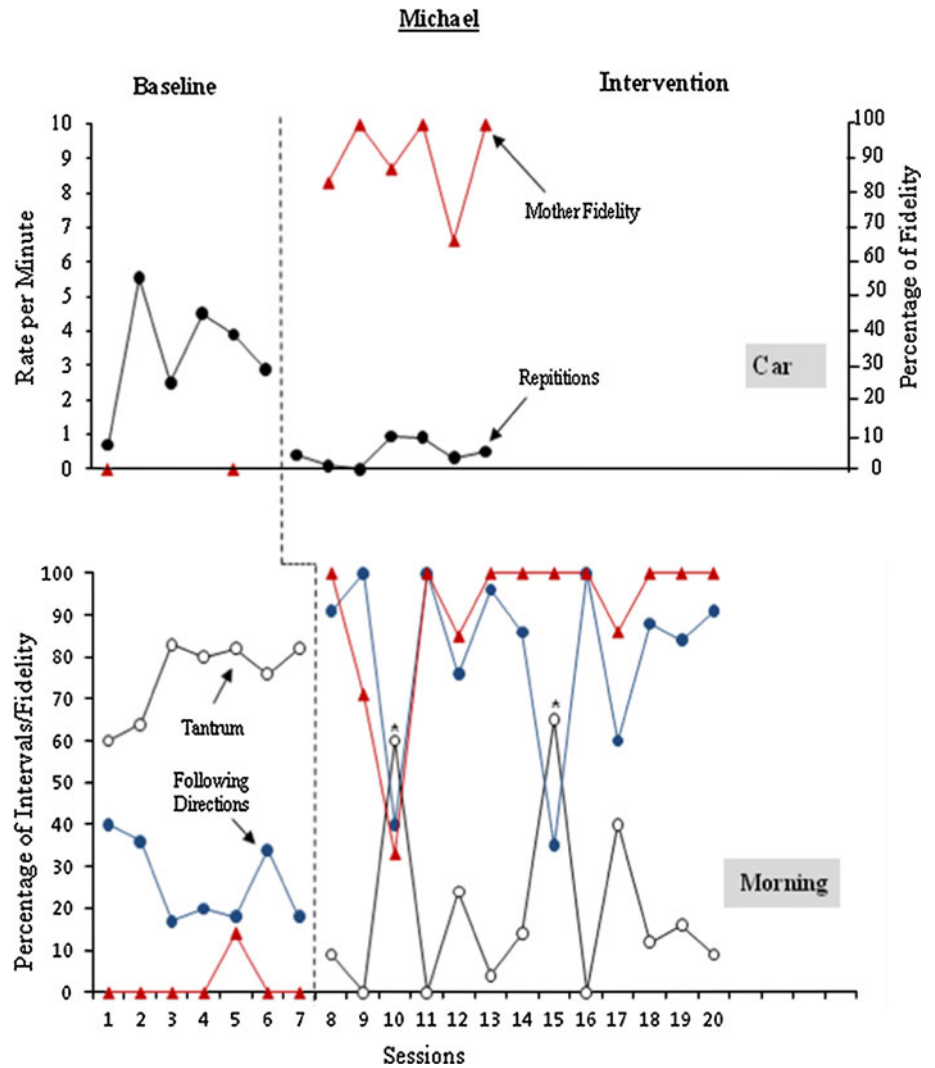
Discussion

This study assessed the feasibility of implementing an adapted PTR model for use in home settings with families of young children with ASD. The results suggested that the school-based PTR model is adaptable and can be successfully implemented with families of children with ASD. This research showed that two families of children with ASD were able to successfully create and implement behavior plans with fidelity across routines in collaboration with the researcher. The families' implementation of the PTR intervention positively affected the two children's behaviors. Both children's problem behaviors were dramatically reduced and appropriate behaviors increased during intervention. The PTR intervention also had high social validity ratings; both self- and novel-rated validity indicated that the PTR intervention was acceptable to both families and the community at large. This suggests that a

manualized family-centered intervention based on the PTR model may be helpful for family service providers.

The school-based PTR model was adapted to home settings, by revising the worksheets and reducing the number of meetings. The initial meetings with each family lasted about 1.5 h, and subsequent meetings during which behavior plans were developed and family training was conducted lasted a maximum of 3 h. The behavior planning and training were done in the same meeting, and parents generally had 100 % fidelity after rehearsal and feedback. Although the behavior plans created with the researcher were successful in reducing the children's problem behaviors and teaching their appropriate behaviors, the family who participated in the generalization assessment (Nicky's parents) was able to independently develop and implement an intervention plan using the information acquired through initial plan development. Their implementation of the generalization plan resulted in collateral

effects by increasing the child's acceptance of non-preferred food.

However, the family's implementation fidelity during the generalization routine was lower than those during the first two target routines, which indicates that lower fidelity resulted in less improvement of child behavior. This suggests that parents may be able to design effective intervention plans using intervention options with which they are familiar, but they may not be able to correctly implement the plans with fidelity without specific training or coaching support. Fidelity data showed that it was sometimes difficult for Nicky's parent to wait until Nicky ate unfamiliar or non-preferred food after a choice between two unfamiliar or non-preferred foods was given and to refrain from reinforcing Nicky's food refusal. This was also seen in research by Rosales et al. (2010) who assessed the skills of implementing a picture exchange system with caregivers who had only written instruction and were then given behavior skills training. The results of the current study suggest that generalization promotion may be needed in order to facilitate families' successful implementation of the PTR intervention with fidelity during non-trained routines (Blair et al. 2011; Lucyshyn et al. 2007).

A few studies found that parents could generalize specific PBS or function-based intervention strategies that had been previously taught (Blair et al. 2011; Lucyshyn et al. 2007; Moes and Frea 2002), but thus far the current study is the only research that attempted to examine if parents could successfully generate and implement their own behavior plan. Further research should look at how much experience creating behavior plans parents may need before being able to not only generalize strategies previously learned but to develop and implement specific plans with fidelity. An alternative solution to generalization promotion may be to consider looking at the adequacy of the intervention created by the parents. It is possible that the intervention strategies themselves were not necessarily strategies that would have been included had there been professional help. The families were familiar with verbal behavior therapy which might have impacted their overall high fidelity scores in the generalization routine. However, considering the fact that verbal behavior strategies are not collaborative, team driven, nor based on a functional behavior assessment, it is likely that the impact of the families' experience with the verbal behavior therapy was minimal. The process and intervention used in the generalization routine of this study were quite different from strategies of teaching mands of which the families were already familiar.

This study extends the literature on PBS and function-based intervention by providing evidence of positive outcomes of the family-centered process for children. The results suggest that family-centered intervention is essential in supporting children with ASD who have problem behavior. This study demonstrates that behavior support using a PBS approach (PTR) can have powerful effects on outcomes for young children with ASD when intervention is implemented in multiple routines. A collaborative problem solving process that involves team building to reduce problem behavior and increase alternative skills in multiple family contexts could enhance children's long term success (Lucyshyn et al. 2007).

One important implication of the findings of the current study for future research and practice is that all relevant family members should collaborate in the entire behavior support process. Nicky's entire family, including his mother, father and sister, participated in this study. Nicky's 6-year-old sister participated in the modeling procedures, promoting and demonstrating appropriate eating during the mealtime routine. Involving a sibling in the process of implementing the intervention was both practical and valuable in increasing the effectiveness of the intervention. However, rather than involving all of the family members in the implementation of intervention in all routines, it is more practical for family contexts to determine the team member who will be primarily responsible for each intervention in each routine. For example, Nicky's father mostly implemented the intervention plan during mealtime because he was responsible to feed Nicky and was identified as the main implementer during that routine. This resulted in fewer data points when it came to assessing the mother's fidelity data for that routine. This was also seen with Michael's family. Michael regularly went to preferred locations with his mother and not with his father, so data on Michael's repetitive behavior was only collected with one caregiver. Therefore, as stressed in the PTR model, it is imperative to design an intervention plan that has high contextual fit and social validity.

Another interesting occurrence concerning Michael's behavior was the spike in tantrum behavior during the morning routine task of taking medicine in sessions 10 and 15. It became apparent that Michael responded well to the intervention strategies during all tasks except the task of taking medicine. This may have been due to the taste of the medicine, which was a combination of fish oil, vitamins, minerals, and frozen orange juice concentrate (which was supposed to cut the fish oil flavor). The increases in tantrum behaviors during this specific task suggest that potential setting events for problem behavior should be identified during the functional assessment to develop an effective behavior intervention plan.

One limitation of this study was the amount of data collected during intervention due to families' inconsistent video recording. Recorded session durations were too short, or the number of sessions requested was simply not recorded, which lead to an insufficient number of data

points to demonstrate a strong experimental control. Another limitation of this study is that it involved only two families and thus the results should be interpreted with caution. Two families are two few to make conclusions regarding the utility of the family-centered PTR model. Research that includes a larger sample will be necessary to provide further validation of the adapted PTR model. In addition, only one of the families participated in the follow-up probe and generalization; thus, it may be difficult to determine whether the family-based PTR model can promote maintenance of behavior change after the intervention has been terminated, and whether the families can generalize the intervention to novel settings with minimum support.

A third limitation is that both families were implementing verbal behavior interventions prior to PTR. It is possible that the families were continuing these interventions while doing PTR and this may have impacted the positive outcomes. However, both families volunteered for the study due to persistent behavior problems that were interfering with family routines and were resistant to previous interventions. In addition, the verbal behavior therapy was not addressing the specific problem behaviors targeted for each child. For Nicky, verbal behavior therapy consisted of teaching him to mand for reinforcement. The PTR intervention taught him to use a communicative replacement behavior (i.e., a picture card to hand to the parents when needing to use the bathroom) which is more directly related to replacing the target problem behavior. Similarly, Michael's verbal behavior aimed to increase language skills but did not have the specificity of teaching him to make appropriate social comments during the problematic car riding routine. Baseline performance of both children indicated that the specific target behaviors were occurring at higher rates when PTR was not implemented, presumably while verbal behavior was implemented. Finally, when the researcher was present, there were no verbal or observational indications from the families that they were using verbal behavior strategies for the specific targeted problem behaviors. However, future research may want to consider how to specifically control this so that the results can be interpreted with accuracy.

Despite its limitations, this research is consistent overall with the original PTR research (Dunlap et al. 2010; Iovannone et al. 2009) and provides initial support showing that the PTR method is highly adaptable in addressing problem behavior in young children with ASD and promoting alternative behaviors in home settings. In conclusion, this study suggests that adapting the PTR model for use within family contexts is important to address problem behaviors with families of children having ASD and other disabilities. The PTR components are comprehensive and include worksheets and possible strategies that encourage family participation which could be helpful for providers who truly want to create plans that have high contextual fit and social validity.

References

Blair, K. C., Lee, I., Cho, S., & Dunlap, G. (2011). Positive behavior support through family-school collaboration for young children with autism. *Topics in Early Childhood Special Education, 31*, 22–36.

Buschbacher, P., Fox, L., & Clarke, S. (2004). Recapturing desired family routines: A parent-professional behavioral collaboration. *Research and Practice for Persons with Severe Disabilities, 29*, 25–39.

Carr, E. G., & Durand, V. M. (1985). Reducing behavior problems through functional communication training. *Journal of Applied Behavior Analysis, 18*, 111–126.

Carr, E. G., Dunlap, G., Horner, R. H., Koegel, R. L., Turnbull, A. P., Sailor, W., et al. (2002). Positive behavior support: Evolution of an Applied Science. *Journal of Positive Behavior Intervention, 4*, 4–16.

Dunlap, G., Ester, T., Langhans, S., & Fox, L. (2006). Functional communication training with toddlers in home environments. *Journal of Early Intervention, 29*, 81–97.

Dunlap, G., & Fox, L. (1999). A demonstration of behavior support for young children with autism. *Journal of Positive Behavior Interventions, 1*, 77–887.

Dunlap, G., Iovannone, R., Kincaid, D., Wilson, K., Christiansen, K., Strain, P., & English, C. (2010). Prevent-Teach-Reinforce:A school based model of positive behavior support. Baltimore, MD: Paul H. Brookes.

Frea, W. D., & Hepburn, S. L. (1999). Teaching parents of children with autism to perform functional assessments to plan interventions for extremely disruptive behaviors. *Journal of Positive Behavior Interventions, 1*, 112–116.

Harrower, J. K., Fox, L., Dunlap, G., & Kincaid, D. (2000). Functional assessment and comprehensive early intervention. *Exceptionality, 8*, 189–204.

Hertz-Picciotto, I., & Delwiche, L. (2009). The rise in autism and the role of age at diagnosis. *Epidemiology, 20*, 84–90.

Iovannone, R., Greenbaum, P. E., Wang, W., Kincaid, D., Dunlap, G., & Strain, P. (2009). Randomized controlled trial of the prevent-teach-reinforce (PTR) tertiary intervention for students with problem behaviors: Preliminary outcomes. *Journal of Emotional and Behavioral Disorders, 17*, 197–212.

Lucyshyn, J. M., Albin, R. W., Horner, R. H., Mann, J. C., Mann, J. A., & Wadsworth, G. (2007). Family implementation of positive behavior support for a child with autism: Longitudinal, single-case, experimental, and descriptive replication and extension. *Journal of Positive Behavior Interventions, 9*, 131–150.

Lucyshyn, J. M., Kayser, A. T., Irvin, L. K., & Blumberg, E. R. (2002). Functional assessment and positive behavior support at home with families: Defining effective and contextually appropriate behavior support plans. In J. M. Lucyshyn & G. Dunlap (Eds.), *Families and positive behavior support: Addressing problem behavior in family contexts*. Baltimore: Paul H. Brookes.

Meadan, H., Ostrosky, M. M., Zaghlawan, H., & Yu, S. Y. (2009). Promoting the social and communicative behavior of young

children with A: A review of parent-implemented intervention studies. *Topics in Early Childhood Special Education, 29,* 90–104.

Moes, D. R., & Frea, W. D. (2002). Contextualized behavioral support in early intervention for children with autism and their families. *Journal of Autism and Developmental Disorders, 32,* 519–533.

Newborg, J. (2005). *Battelle developmental inventory* (2nd ed.). Itasca, IL: Riverside.

Pavuluri, M. N., Luk, S. L., & McGee, R. (1996). Help-seeking for behavior problems by parents of preschool children: a community study. *Journal of the American Academy of Child and Adolescent Psychiatry*, 35,215–222.

Reimers, T. M., & Wacker, D. P. (1988). Parents' ratings of the acceptability of behavioral treatment recommendations made in an outpatient clinic: A preliminary analysis of the influence of treatment effectiveness. *Behavioral Disorders, 14,* 7–15.

Rosales, R., Stone, K., & Rehfeldt, R. A. (2010). The effects of behavioral skills training on implementation of the picture exchange communication system. *Journal of Applied Behavior Analysis, 42,* 541–549.

Scott, T. M., Mclntyre, J., Liaupsin, C., Nelson, C. M., Conroy, M., & Payne, L. D. (2005). An examination of the relation between functional behavior assessment and selected intervention strategies with school-based teams. *Journal of Positive Behavior Interventions, 7,* 205–215.

Sparrow, S. S., Cicchetti, D. V., & Balla, D. A. (2005). *Vineland adaptive behavior scales* (2nd ed.). Circle Pine, MN: AGS Publishing.

Strain, P. S., & Schwartz, I. (2009). Positive behavior support and early intervention for young children with autism: Case studies on the efficacy of proactive treatment of problem behavior. In W. Sailor, G. Dunlap, G. Sugai, & R. Horner (Eds.), *Handbook of positive behavior support* (pp. 107–124). New York: Springer.

Van Acker, R., Boreson, L., Gable, R. A., & Potterotn, T. (2005). Are we on the right course? Lessons learned about current FBA/BIP practices in schools. *Journal of Behavioral Education, 14,* 35–36.