


Classroom Pivotal Response Teaching: Teacher Training Outcomes of a Community Efficacy Trial

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Abstract

Classroom Pivotal Response Teaching (CPRT) is a naturalistic behavioral intervention for students with autism spectrum disorder (ASD) that was systematically adapted for teacher use. In this study, the authors evaluate outcomes of a large randomized trial training teachers ($n = 126$) to use CPRT. Training involved 12 hours of small group sessions and additional 1:1 coaching in each teacher's classroom. Overall, CPRT fidelity was significantly higher at the end of the training year relative to the observation year ($B = 0.24, p = .001$) and teachers report using CPRT an average of 47 minutes per day. Moderator analyses indicate that training, teacher, and classroom- and school-level characteristics affected CPRT fidelity. Teachers report high overall satisfaction ($M = 4.37, SD = 0.45$; 1-5 Likert-type scale) and confidence in their ability to use CPRT with their students ($M = 4.2, SD = 0.57$). In this study, the authors indicate the acceptability and feasibility of the CPRT training protocol and adds to the limited number of school-based randomized controlled trials (RCTs) evaluating interventions for students with ASD.

Keywords

autism spectrum disorder, teacher training, pivotal response training, implementation

Effective education for students with autism spectrum disorder (ASD) has become a significant challenge for public schools in recent years, with the increasing numbers of students served for ASD. The most recent estimates from the Centers for Disease Control indicate that 1 in 59 children have ASD (Baio et al., 2018). The number of children with ASD served by schools has grown sixfold across the past two decades, from 93,000 in 2000 to 576,000 in 2015 (Kena et al., 2015). The annual cost in the United States is estimated to be US\$268 billion currently and is set to reach US\$461 billion by 2025 (Leigh & Du, 2015). ASD-related education funding in the United States increased from less than 0.1% of the total special education budget in 1995 to 6.1%

in 2005 and continues to rise (Kena et al., 2015). This has strained educational resources as this system is largely responsible for targeting the wide range of needs that interfere with a child's ability to benefit from general education, including improving learning skills, such as attention and engagement, and core symptoms of ASD. Ensuring that teachers supporting students with ASD are prepared to meet

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these needs using effective instructional practices is imperative.

Despite the existence of multiple evidence-based practices (EBPs) available for students with ASD (e.g., Wong et al., 2015) these practices are not being well-integrated into school-based programming where the majority of children are served (Brookman-Fraze et al., 2009; Kena et al., 2015). This is in part due to the majority of EBPs having been designed for use in one-on-one or highly controlled settings and their efficacy being established under these conditions. Teachers attempting to use these programs in classrooms report barriers related to staffing, training, and the fit of the model for their teaching setting and for a broad range of students with heterogeneous learning needs (Cochran-Smith & Lytle, 1999; Stahmer, Collings, & Palinkas, 2005). The limited information available on classroom use of EBPs for ASD is varied, but teachers consistently report high levels of adaptation to improve flexibility and fit to educational contexts and student needs (Stahmer, Suhrheinrich, Reed, & Schreibman, 2012).

Pivotal Response Training

One intervention for students with ASD is Pivotal Response Training (PRT), which has been consistently identified as an EBP in multiple systematic reviews (National Autism Center, 2009, 2015; Wong et al., 2015). PRT is a naturalistic behavioral intervention designed based on a series of studies identifying important treatment components. The “pivotal” responses targeted in PRT are *motivation*, *initiation*, and *responsivity to multiple cues* (i.e., increasing breadth of attention). When using PRT, the provider attempts to maximize the student’s motivation by using the student’s preferred materials, varying the level of difficulty of tasks, and providing consistent and direct reinforcement. A series of learning trials are used to target the student’s goals, with the provider gaining the student’s attention, delivering a cue/opportunity to respond, and providing a contingent consequence following the student’s response to the cue. Using PRT as an instructional tool has been linked with multiple

positive outcomes for students with ASD, including increasing verbalizations and contingent language use (Koegel, Koegel, Hurley, & Frea, 1992; Koegel, O’Dell, & Dunlap, 1988) and concomitant decreases in inappropriate and disruptive behaviors (Koegel, Koegel, & Surratt, 1992; Mohammadzaheri, Koegel, Rezaei, & Bakhshi, 2015). PRT is also effective for improving a variety of language skills, including speech imitation, labeling and question asking (Koegel, Camarata, Valdez-Menchaca, & Koegel, 1998; Verschuur, Huskens, Verhoeven, & Didden, 2017), spontaneous speech (Laski, Charlop, & Schreibman, 1988), conversation (Koegel et al., 1998), and rapid acquisition of functional speech in previously nonverbal children (Sze, Koegel, Brookman-Fraze, & Koegel, 2003). PRT has also been used to address social deficits in ASD, including joint attention (Pierce & Schreibman, 1995; Rocha, Schreibman, & Stahmer, 2007; Whalen & Schreibman, 2003), social initiation and interactions with peers (Brock, Dueker, & Barczak, 2018; Koegel, Koegel, Harrower, & Carter, 1999; Pierce & Schreibman, 1997), and spontaneous, creative object play (Humphries, 2003; Levy, Mandell, Merhar, Ittenbach, & Pinto-Martin, 2003; Stahmer, 1995). PRT also increases generalization and maintenance of behavior changes in children with ASD (Humphries, 2003; Schreibman, Kaneko, & Koegel, 1991).

While PRT clearly has a strong evidence base and has been shown to be efficacious, very limited research to date has examined PRT’s use in the context of school settings. Two recent school-based randomized trials found that the PRT approach was associated with significantly greater improvement in a child’s targeted goals as compared with more structured behavioral interventions (Mohammadzaheri, Koegel, Rezaee, & Rafiee, 2014; Mohammadzaheri et al., 2015). Two further randomized trials have explored the impact of PRT as part of a manualized program (the Strategies for Teaching based on Autism Research, or STAR program; Arick, Krug, Loos, & Falco, 2004) that also includes Discrete Trial Training (DTT) and teaching within functional routines (Mandell et al.,

2013; Young, Falco, & Hanita, 2016). Across both studies, results indicate that being the most difficult of the strategies to learn, PRT was associated with positive student outcomes (i.e., gains in cognitive ability that were not observed with DTT and teaching within functional routines; Pellecchia et al., 2015). The positive associations with gains, despite teacher difficulty with implementation, suggest that PRT is an effective intervention in the classroom context and improving implementation should be targeted to further improve outcomes. Additional work indicates slightly improved teacher fidelity outcomes when teachers are trained in a systematic way by a research team as compared with clinical staff (Suhrheinrich et al., 2013). Finally, studies of teacher use of PRT outside targeted research-based training efforts indicate that teachers modify the protocol (Stahmer et al., 2005) or omit specific components of PRT (Suhrheinrich, Stahmer, & Schreibman, 2006). Thus, the limited evidence of how teachers implement PRT in the classroom to date indicates significant amounts of modification and low to moderate fidelity overall.

These findings are not completely unexpected, as research suggests a unidirectional method of translation of EBPs from research to practice is not likely to be effective. For example, research in other areas of child psychotherapy indicates that child outcomes may not be as positive when EBPs developed in research settings are used in the community (Garland et al., 2010; Silverman, Kurtines & Hoagwood, 2004; Weisz, Donenberg, Han, & Weiss, 1995). The growing field of implementation science provides additional theory and contextual supports to understanding how to best integrate EBPs into school-based services. Implementation science is the study of methods to promote the uptake of research findings into routine clinical or educational services. As implementation science theory and literature suggests, to promote significant outcomes for students with ASD, we must not only select an appropriate EBP but also use effective implementation strategies and contextual supports to ensure the EBP's use and sustainment in the intended setting (McIner-

ney, Zumeta, Gandhi, & Gersten, 2014; Metz, Naoom, Halle, & Bartley, 2015). For example, limited consideration of community service settings during intervention development likely results in a high degree of provider adaptation to improve applicability and fit to specific settings. This is consistent with teachers' adaptation of practices for students with ASD that were developed in highly controlled research settings. A key consideration in implementation science, then, is the intervention itself and the fit to the educational context. One step toward improved student outcomes is development or adaptation of interventions in collaboration with end users (teachers and other school staff) to ensure fit, feasibility, and fidelity of use.

Adaptation of PRT

Based on the importance of intervention fit, PRT has been systematically adapted for the school context to create Classroom Pivotal Response Teaching, or CPRT (Stahmer, Suhrheinrich, & Rieth, 2016). A mixed-methods approach (Creswell & Garrett, 2008; Teddlie, Tashakkori, & Johnson, 2008) was used to collaboratively examine ways to adapt PRT for classroom use that would maintain the integrity of the intervention while increasing feasibility of use for teachers. This process involved examination of qualitative data from focus group findings to identify themes for implementation and adaptation (Stahmer et al., 2012), and quantitative data, in the form of direct observational ratings, to determine the extent to which teachers were implementing PRT with fidelity (Suhrheinrich, 2011; Suhrheinrich et al., 2013). Convergence of results was obtained by examining the relationship between teachers' reported difficulty with PRT components in the qualitative data and observed difficulty in the quantitative results, to develop recommendations for adaptations. Adaptations were then subjected to confirmatory testing using controlled, single-subject design methodology (Reed, Stahmer, Suhrheinrich, & Schreibman, 2013; Rieth et al., 2014; Rieth, Stahmer, Schreibman, & Suhrheinrich, 2015). Thus, the resulting modifications to

PRT were the result of systematic mixed-methods evaluation of both intervention components and teacher use in classroom programs as well as input from teachers through focus groups and a community advisory board.

The modified intervention protocol is titled CPRT to reflect the adapted technology of PRT. A manual along with accompanying training materials to support CPRT use in the classroom was developed in partnership with an advisory board of teachers and school administrators (Stahmer et al., 2012). Although the components of the CPRT are very similar to those of PRT, some terms, recommended application of components, and guidance for differentiation based on student and setting factors have been adapted (see Stahmer et al., 2012, for more details). Specific modifications included in the manual are (a) recommending that conditional discrimination training only be conducted with students with a cognitive age above 3 years who exhibit challenges with discrimination and/or generalization of skills, (b) emphasizing the use of multiple examples and varied materials/instructions rather than conditional discrimination training, (c) describing methods of using a token system and other creative ways to provide direct reinforcement during group activities, (d) providing strategies for differential use of turns based on language level and target skills, and (e) providing examples and recommendations for using CPRT with groups of students. Newly incorporated resources include (a) information about Applied Behavior Analysis (ABA), (b) theory behind each CPRT component, (c) examples of how to target Individualized Education Program (IEP) goals using CPRT, (d) data collection materials, (e) paraprofessional training materials, and (f) materials to facilitate communication about CPRT and student progress between teachers and parents.

An initial pilot study using a single-subject design indicated modest but discernible increases in rate of language acquisition for children receiving the intervention delivered by their teachers in the classroom and participating teachers rated CPRT highly (Stahmer et al., 2016). All 20 participating teachers met

fidelity of implementation in the full protocol during at least one classroom lesson. Eighty-five percent of teachers reported being very satisfied with the CPRT training, materials, and procedures, and 82% reported continued use of CPRT at a 3-month follow-up.

Expanding upon these initial findings, the current article systematically examines outcomes of classroom teachers participating in a large, randomized wait-list controlled trial of CPRT. This work was guided by three primary research questions:

Research Question 1: Do teachers learn and use CPRT?

Research Question 2: Do teachers sustain use of CPRT after training has ended?

Research Question 3: What factors moderate teacher use of CPRT?

Method

This project examined the effectiveness of CPRT training on teacher use of the intervention in the classroom, using a randomized, wait-list controlled trial across classrooms. Classrooms were randomized to one of three training cohorts: Classrooms in Cohort A received CPRT training in Year 1. Classrooms in Cohort B were observed in Year 1 and received CPRT training in Year 2. Classrooms in Cohort C were observed in Year 2 and received CPRT training in Year 3. Serving as the comparison group, classrooms assigned to Cohorts B and C represented current ASD services as usual during the years they were observed (Years 1 and 2, respectively). The wait-list control design offers methodological benefits over a standard randomized trial by increasing the sample size of teachers receiving CPRT training. As recommended by Hedges & Rhoades (2010), an independent consultant randomized participants at the classroom level (instead of the school or district level) to increase efficiency and statistical power.

Participants

Participants were recruited from public school districts in Southern California. Inclusion criteria for districts specified that they served

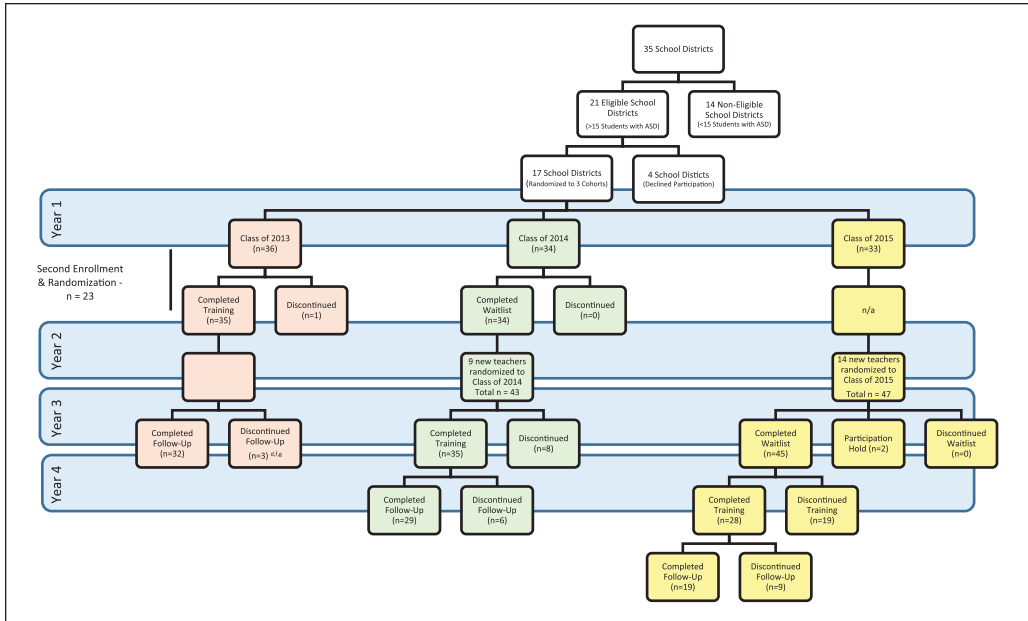


Figure 1. Consort diagram.

Note. Overall, $N = 79$ teachers were observed for Current ASD Services (control) group, $N = 98$ teachers were observed for training group, and $N = 80$ teachers were observed for follow-up group. The overall attrition was 22% through the end of the training year and 34% through the end of the follow-up year. The reasons for attrition included (a) not appropriate for study ($n = 1$), (b) personal reasons ($n = 8$), (c) maternity leave ($n = 3$), (d) moved ($n = 4$), (e) too busy ($n = 4$), (f) no longer serving students with ASD ($n = 11$), and (g) unresponsive/no reason provided ($n = 12$). ASD = autism spectrum disorder.

at least 15 students, ages 3 to 10, with an educational classification of autism. Of the 35 school districts in San Diego County, 21 districts were eligible; administrators from 17 districts agreed to participation.

Teachers. Inclusion criteria for teachers specified that teachers had not received prior training in CPRT and were serving at least two students with an educational classification of autism. School district staff were asked to share study information with eligible teachers. Research staff met with interested teachers to explain the study and training process, and 126 teachers consented to participation. Although recruitment materials and participation criteria did not specifically target special education teachers, all teacher participants reported special education as their primary job description. Participating teachers worked in self-contained, inclusion and resource programs. After initial enrollment in the study

during Year 1, each teacher was randomly assigned to Cohort A ($n = 36$), B ($n = 34$), or C ($n = 33$). Due to additional teacher interest and to meet project enrollment goals, an additional 23 teachers were enrolled in Year 2 of the study and randomly assigned to Cohort B ($n = 9$) or C ($n = 14$). Figure 1 presents a consort diagram of teacher participants across the 4 years of the project, and Table 1 describes the demographic characteristics of participating teachers.

Students. Each participating teacher had a goal of enrolling two target students in his or her classroom with whom he or she would practice CPRT strategies during training and for data collection. Inclusion criteria for students included being between 3 and 12 years of age, enrollment in a participating teachers' classroom, and receiving services under the educational classification of autism. A total of 318 students participated. Students

Table 1. Teacher Demographics ($N = 106$).

	<i>n</i> (%)
Sex	
Female	99 (93)
Male	7 (7)
Age	
18-30	40%
31-50	43%
51+	16%
Ethnicity	
Hispanic	19 (18)
Non-Hispanic	82 (82)
Race	
Asian American/Pacific Islander	5 (5)
Caucasian/White	86 (81)
Native American	1 (1)
Filipino/a American	2 (2)
Other	8 (8)
Mixed	4 (4)
Highest level of education	
High school/GED	1 (1)
Bachelor's degree	40 (38)
Master's degree	65 (61)
Years of special education experience	
0-5	36 (34)
6-10	30 (28)
11-20	34 (32)
21+	5 (5)
Years of ASD experience	
0-5	35 (33)
6-10	34 (32)
11-20	33 (31)
21+	4 (4)

Note. A total of 106 enrolled teachers completed a demographics questionnaire (93% completion rate). Percentages are taken from teachers with available demographics data. GED = General Educational Development; ASD = autism spectrum disorder.

participated for as long as they remained enrolled in a participating teachers' classroom. A complete description of the student population and student outcomes is in preparation. In summary, participating students had a mean age of 6.28 ($r = 3$ -12 years) and were predominantly male (85%). Race/ethnicity was reported by parents and reflects the diversity of the large, urban, Southern

California region in which the study took place (43.7% Hispanic/Latinx, 33.7% Non-Hispanic/Latinx White, 22.6% Non-Hispanic/Latinx—Other). Upon enrollment, students were assessed by the research team to determine ASD severity using the Autism Diagnostic Observation Schedule—Second Edition (Lord, DiLavore, Risi, Gotham, & Bishop, 2012) and cognitive level, using the Mullen Scales for Early Learning (Mullen, 1995) or Differential Ability Scales (Elliott, 2007). The cognitive assessment was selected based on the student's age and developmental level. The mean ADOS-2 severity score (1-10 scale) was 7.14 ($SD = 1.83$). The mean standard score ($M = 100$, $SD = 15$) across both cognitive assessments was 67.52 ($SD = 20.59$).

CPRT coaches. Trained CPRT coaches were part of the research team, and they facilitated the training process with all teachers, including both group didactic sessions and individual coaching. Coaching staff included seven experienced teachers and clinicians with a master's or doctoral degree in psychology or education and at least 10 years of experience working with children with ASD. Four of the coaches were classroom teachers prior to joining the research team. Coaches were supervised by a licensed clinical psychologist with extensive expertise in ASD intervention and training providers, and they received systematic training in how to deliver the CPRT training protocol. Specifically, coaches independently reviewed the CPRT manual and scripted training presentations, practiced giving each training presentation to a live audience, received feedback from the clinical supervisor and other coaching staff, and achieved reliability in assessing fidelity and providing coaching. Throughout the project, coaches met as a group with their supervisor at least bimonthly throughout the study to review procedures and discuss any coaching or training challenges. Training protocol fidelity was assessed throughout the project (see below).

Procedures

CPRT training procedures. The CPRT training plan was developed based on current knowledge of adult learning theory, effective teacher professional development, and data from our pilot project (Darling-Hammond, Hylar, & Gardner, 2017; Odom, 2009; Stahmer et al., 2016). Specifically, this involved incorporation of active-learning and practice-based instructional strategies, modeling of CPRT components, and ongoing coaching throughout the school year with data-based feedback on fidelity of the intervention. Within each training Cohort (A, B, and C), smaller training groups were formed within a district, or by combining participants from districts in close geographic proximity, to provide training in collaborative groups. CPRT coaches conducted a total of 30 training groups, with an average of three to four participants each ($M = 3.37$; range = 2-6), across the three training cohorts. Initial training involved 12 hours of didactic, interactive lecture with each group, typically delivered 2 hours per week over 6 weeks (with some slight variability based on district schedules). The group training protocol, including content and activities, is described in Table 2. The majority of training groups met after school ($n = 20$, 67%) or during district-supported professional development time on student early release days ($n = 7$, 23%); however, one district chose to hold trainings during the school day and provided substitute coverage for participant teachers ($n = 3$, 10%). If a participating teacher was unable to attend a group training session, a prerecorded, narrated PowerPoint presentation of the training content was provided for independent study.

After the first 6 hours of group training (three sessions), teachers began to receive individualized, in-classroom coaching on their use of CPRT. Coaching appointments were scheduled once per week during the school day until the teacher met coach-rated mastery criteria (see Teacher Fidelity of CPRT, below, for full description of mastery criteria). During each coaching appointment,

coaches evaluated fidelity of CPRT using the CPRT Assessment (see *Teacher fidelity of CPRT*) and provided structured feedback of the results using a standardized format. Coaches also rated the teachers' engagement in the coaching process, though these scores were not shared directly with the teacher. Upon successfully maintaining mastery criteria over two sequential visits, scheduled coaching faded from weekly, to biweekly, and then monthly, for the duration of the school year. During the year following CPRT training, teachers received two coaching sessions to promote maintenance of skills, scheduled at their convenience. These follow-up coaching sessions followed the same format. Some variation in frequency of coaching occurred based on teacher and school schedules.

Fidelity of training procedures. Coach adherence to the CPRT training protocol was evaluated through a detailed checklist for each training session. Coaches completed self-checks for 91% of a total 176 training sessions and the fidelity ratings indicate high percentages of adherence to training procedures ($M = 90\%$ adherence, $SD = 17\%$). A clinical supervisor also observed each coach during one or more training sessions each training year (after the coach had been trained to fidelity) and completed the session protocol checklist to assess fidelity and provide delivery feedback. Supervisor ratings indicated high fidelity across coaches and demonstrated similar adherence to coaches' self-ratings ($M = 86\%$ adherence, $SD = 16\%$).

Data collection procedures. Data were collected for each teacher upon study enrollment and throughout observation, training, and follow-up years. Teacher-completed measures were distributed via email with an embedded individualized survey link. Teachers also had the option to complete measures using printed documents or by phone interview, if preferred. Research team-administered measures were completed through live observation or video observation of classroom activities. At the

Table 2. Training Protocol Table.

Session	Workshop topic (2 hours each)	Coaching (30 minutes)
1	Learning your ABCs—An introduction to behavioral principles as the foundation for CPRT	—
2	The components of CPRT	—
3	Using CPRT with groups	—
4	Using CPRT to target student goals	Coaching
5	Integrating CPRT into your classroom	Coaching
6	Sharing CPRT with paraprofessionals and parents	Coaching
		Ongoing coaching

Note. CPRT = Classroom Pivotal Response Teaching.

beginning of each school year, teachers were asked to identify two activities to be followed across the year. These two teacher-selected activities were the focus of all in-classroom observations for the purpose of fidelity data collection and coaching appointments. Video recordings were collected during these classroom activities 4 times during control and training years and 2 times during the post-training follow-up year. Table 3 outlines the measures and data collection methods utilized across the study.

Measures

Outcome measures. Outcome measures were selected to address the primary research aims. Measures aligned with the first research question, “Do teachers learn and use CPRT?” include teacher participation and engagement in training and coaching, teacher satisfaction with CPRT, teacher fidelity of CPRT, and teacher report of CPRT use. Measures aligned with the second research question “Do teachers sustain use of CPRT after training has ended?” include teacher engagement in coaching and teacher sustainment of use reports. All outcome measures are described below.

Teacher participation and engagement in training and coaching. Attendance was recorded for all training and coaching sessions. During each coaching appointment, the coach evaluated the teachers’ use of CPRT components, using the CPRT Assessment (used and analyzed as described in *Teacher fidelity of CPRT* below), and recorded whether the teacher met

or failed to meet fidelity criteria, defined as earning a 4 or 5 on each of the CPRT components rated (see Table 4 for CPRT Components). The coach also gauged the teachers’ engagement in the coaching process using a three-item Likert-type-scale ratings (1 = *low* to 3 = *high*). The coach’s perception of the teacher’s enthusiasm for coaching, willingness to take feedback, and integration of feedback from the previous coaching session into current CPRT use were documented. Strategies for calibrating coding or teacher engagement were discussed during weekly clinical team supervision; however, interrater reliability was not formally calculated. For analysis of the coaching engagement measure, the scores for each item were averaged across all coaching sessions for an individual teacher to provide one score per item for each teacher across the year.

Teacher satisfaction with CPRT/training. A satisfaction questionnaire was completed by teachers at the end of the training to address satisfaction with the training process as well as general issues of comprehension of the intervention, areas of difficulty in applying CPRT in the classroom, and perceived effectiveness of CPRT for students. Ratings were completed on a Likert-type scale (1 = *very dissatisfied/not at all*, 3 = *neutral*, 5 = *very satisfied/to a great extent*). An average across all items on the questionnaire was used in analyses.

Teacher fidelity of CPRT. The CPRT Assessment and CPRT fidelity definitions were developed to evaluate fidelity of teacher use

Table 3. Measures and Data Collection Methods.

Variable	Title of measure	Data collection method and timing
Outcome measures		
Teacher engagement in coaching	Coach's evaluation of teacher engagement	Researcher evaluated, during all coaching appointments
Teacher satisfaction with CPRT	Satisfaction Questionnaire	Teacher report, collected at end of training year
Teacher fidelity of CPRT	CPRT Assessment	Researcher evaluated, during all coaching appointments and 4 times across the year (video/ blind coding)
Teacher use of CPRT	Report of use	Teacher report, collected monthly
Predictor/moderator measures		
Teacher knowledge	Teacher Knowledge of Research-Based Practices for ASD	Teacher report, collected at intake
Overall classroom quality	Professional Development Assessment	Researcher evaluated, beginning and end of school year
Implementation climate	Program Implementation Climate Scales	Teacher report, collected after training completion

Note. CPRT = Classroom Pivotal Response Teaching; ASD = autism spectrum disorder.

of CPRT components. These materials were adapted from the CPRT Assessment included in the CPRT manual and pilot evaluation (Stahmer et al., 2012, 2016). The form and definitions were developed for use by CPRT coaches and research assistants. The CPRT fidelity evaluation form included 13 items (see Table 4 for CPRT components). Items were rated on a 1 to 5 Likert-type scale (1 = *teacher correctly implements the component less than 30% of the observation*, 2 = *teacher correctly implements the component approximately 30%-49% of the observation*, 3 = *teacher correctly implements the component 50%-79% of the observation*, 4 = *teacher implements the component correctly 80% of the observation*, and 5 = *teacher implements the component correctly through the entire observation [100% of opportunities]*). The current measure addresses both adherence to (i.e., the degree to which proscribed procedures are utilized) as well as quality (i.e., skill used in delivery) of teachers' CPRT use with students (Sanetti & Kratochwill, 2009; Schoenwald et al., 2011). Please contact the first author for the full CPRT Assessment and fidelity coding definitions.

Research assistants naive to participant training condition evaluated fidelity of CPRT from classroom video recordings. Activities from the teachers' first and last observation for each year were scored for fidelity ($n = 1,038$). This typically corresponded to approximately one observation from September to November and one from March to May in a given year. All coders met a reliability criterion of 80% agreement with coding keys across two separate video recordings prior to beginning independent coding. Ongoing agreement was evaluated throughout the coding process. Coders with two consecutive videos below 80% agreement received a didactic review of components for which they were having difficulty and were required to code two reliability videos at 80% agreement or above again before further independent coding. A total of 33% of all video samples ($n = 354$) were evaluated by two independent coders. Intraclass correlation coefficients (ICCs) were calculated to assess interrater reliability. ICCs ranged from .67 to .89 across components, with a mean of .81. Items with an ICC below .7 were not considered reliable and were dropped from further analyses (contingent consequences and varied

Table 4. CPRT Components and Descriptions.

	CPRT component	Description
Antecedent components	Incorporates choice	The teacher provides specific choices to the student, either within or between activities.
	Follows student interest	The teacher responds to student interest within the context of the lesson, activity, or learning objective and adjusts activities accordingly.
	Incorporates preferred materials	The teacher sets up appealing activities or uses personalized, interesting, or unusual materials in the learning activities.
	Takes or facilitates turns	The teacher or a student models a related play, academic or communication skill <i>at or just above</i> the students' level.
	Presents opportunities (maintenance/acquisition)	The teacher clearly <i>intersperses</i> tasks that are easy with tasks that are difficult for the students.
	Gains attention before cue	The student is attending to the teacher <i>before</i> the teacher presents a cue.
	Provide clear cues	A clear cue indicates to the students how they should respond and is at or slightly above the students' response level.
	Requires responding exemplars	The teacher uses multiple exemplars to target the same learning goal. An exemplar is a teaching material or tool related to a learning goal or concept.
	Provides varied cues	The teacher alters the type or form of the instruction or opportunity to respond related to each learning goal.
Consequence components	Provides contingent consequences	The teacher provides immediate, appropriate feedback to the student based on their response (correct, incorrect, or attempt).
	Provides reinforcement	The teacher rewards the student for appropriate responding and behavior with something other than praise.
	Provides direct reinforcement	The teacher uses rewards that are directly related to the teaching activity and/or the behaviors required.
	Reinforces goal-directed attempts	The teacher should provide reinforcement after most of the students' reasonable, goal-directed attempts.

Note. CPRT = Classroom Pivotal Response Teaching.

cues). The remaining codes exhibited fair to good ICCs according to accepted standards (Cicchetti, 1994).

Teacher report of CPRT use. Teacher report of use of CPRT was evaluated through an online monthly survey where teachers were asked to report on how many days per week they utilized CPRT, as well as to estimate how many minutes per day. Teachers were specifically asked to report these values for the prior week. An average number of days per week

and minutes per day across all teacher reports collected after the conclusion of didactic training were used in analyses.

Teacher sustainment of use of CPRT. Teacher sustainment of use of CPRT was evaluated through an online survey administered 18 months after completion of training for each cohort. Teachers were asked to indicate agreement on a 5-point Likert-type scale (1 = *strongly disagree* to 5 = *strongly agree*) to statements related to their individual ongoing

use of CPRT, as well as ongoing use of CPRT in their school. Average scores across items ($n = 16$ related to schools, $n = 9$ related to individuals) were used in analyses.

Predictor/moderator measures. To address the third research question “What factors moderate teacher use of CPRT?” the following measures were collected and analyzed to reveal possible relationships with primary outcomes.

Demographics. Participant self-reported demographic information, including personal characteristics, teaching experience, education, and professional training were collected using an 8-item questionnaire.

Teacher knowledge regarding research-based practices. Teachers completed a 64-item questionnaire at baseline to self-assess their knowledge regarding research-based practices for students with ASD. This questionnaire was adapted from Williams, Fan, and Goodman (2011). Ratings were completed on a 4-point Likert-type scale (1 = *not knowledgeable* to 4 = *highly knowledgeable*). In addition to total score (averaged across all items), items judged to be related directly to CPRT (referred to as CPRT Knowledge score) were averaged and used in analyses. These CPRT-specific items included ensuring student attention before providing an instruction; providing clear, developmentally appropriate instructions; using multiple examples of materials and instructions; using varying levels of task difficulty; identifying and using natural consequences; embedding choices within routines; reinforcing goal-directed attempts; and using preferred materials within academic tasks.

Overall classroom quality. The quality of the classroom for supporting students with ASD was evaluated using the Professional Development Assessment (PDA; Boyd et al., 2014; National Professional Development Center [NPDC] on Autism, 2008). The PDA includes a 2-hour observation, a 30-minute teacher interview, and an educational records review (i.e., review of IEPs for two students with ASD, as well as lesson planning documents, if

available). The PDA was completed by CPRT coaches in the fall and spring of each school year. Training in PDA administration and scoring was completed using materials developed by Boyd and colleagues (2014), and reliability was attained for each assessor across one video-recorded observation and one in vivo PDA prior to independent administration. At the time of PDA completion, coaches were blind to the training status of teachers' classrooms they assessed (i.e., in fall, coaches did not know which teachers would receive training that year or which teachers were part of the observation group; in spring, no coach was sent to the classroom of teachers they had trained personally).

The PDA includes 54 items across seven domains: Teaming, Classroom Structure, Classroom Environment, Curriculum, Social/Peer Relationships, Management of Challenging Behavior, and Instructional Climate. Item ratings were completed on a Likert-type scale (1 = *minimal/no implementation* to 5 = *full implementation*). Individual items scores were averaged within each of the seven domains for analyses. In addition, individual items that are most aligned with the components of CPRT were identified by CPRT developers for additional analysis (PDA CPRT score). These included the use of clear and developmentally appropriate instructions, varied types of opportunities to respond, the use of natural/direct reinforcement, opportunities for students to make choices, provision of contingent consequences, opportunities to generalize skills in/with multiple settings/people, the use of individualized reinforcers, and incorporation of student interests and strengths in learning activities.

Classroom implementation climate. The Program Implementation Climate Scales (PICS) is a 47-item measure that captures teachers' perceptions of the extent to which the use of CPRT is feasible and expected, supported, and rewarded by colleagues and supervisors. The original measure of implementation climate (Klein, Conn, & Sorra, 2001) was systematically adapted by Kratz and colleagues (2019) to evaluate perceived implementation in autism

support classrooms. The PICS includes several subscales including ease of use, stress associated with program use, training quality and accessibility, support, communication, and rewards. All items were rated on 5-point Likert-type scales (1 = not *true* to 5 = *true*) with some items reverse coded. To weight each of these domains equally, scaled scores were averaged to create an overall perceived implementation climate score. Cronbach's alpha for the perceived implementation climate scales as rated by teachers was .76. Teachers completed this scale at the end of the training year.

Data Analysis

Initial analysis of teacher fidelity included calculating mean scores across all components and the percentage of components for which the mastery criterion was met for each individual observation. Additional data consolidation involved aggregating components (averaging scores) by common features to simplify analysis. CPRT components related to delivering cues for student responding were grouped as Antecedent variables, and variables related to delivering feedback following student responding were grouped as Consequence variables (see Table 4).

All analyses utilized teacher's highest fidelity score (within each grouping of components: Overall, Antecedent, and Consequence) at each time point (beginning or end of the school year). To account for the nested structure of the data, multilevel models (nested by teacher) were used to predict teacher fidelity at the end of each school year based on training status (Observation, Training, and Follow-Up). Moderator analyses were conducted to evaluate predictive value of teacher and classroom variables on the change in teachers' fidelity scores from the beginning to end of the school year. Each potential moderator was used as a predictor variable in separate models.

Results

Participants

Analyses examined the 126 participating teachers, with some variation in the number of

participants based on completion/availability of individual measures examined (all tables specify the number of teachers included). Of these teachers, 98 participated through the end of their training year (78%) and 80 participated in follow-up data collection (63% of total, 82% of those who participated in training; see Figure 1 for full consort diagram, including reasons for attrition).

Teacher Participation, Engagement, and Satisfaction

On average, teachers demonstrated high participation in training sessions, with teachers attending an average of 5.79/six group training sessions (range = 4-6 sessions). Coaching appointment attendance was more variable, with 65% of appointments kept as originally scheduled. The remaining 35% of appointments were canceled by the teacher; all canceled appointments were rescheduled as soon as possible based on teacher availability. Teachers participated in an average of seven coaching sessions (range = 2-13). A total of 76% of teachers met fidelity criteria during at least one coaching session, according to the coaches' in-person ratings of CPRT Fidelity. Among teachers who met the coach-rated fidelity criteria, it took 4.4 coaching sessions on average to pass ($SD = 2.76$, range = 1-12). Teacher engagement was high during individual coaching sessions. With a maximum code of 3, average coaches' ratings of engagement were 2.77 ($SD = 0.36$) for teachers' enthusiasm for coaching, 2.87 ($SD = 0.24$) for their willingness to take feedback, and 2.55 ($SD = 0.41$) for incorporation of previous feedback. Engagement was rated for 100% of teachers who participated in training ($n = 98$). During the follow-up year, 91% of teachers who completed training participated in coaching sessions. Teacher engagement in coaching maintained during the follow-up year, with the exception of incorporation of previous feedback, which was rated lower by coaches ($M = 1.93$; $SD = 0.68$; see Table 5).

In terms of satisfaction, the average score on the Satisfaction Questionnaire after training was 4.37 ($SD = 0.45$; 1-5 Likert-type scale), indicating high teacher satisfaction

Table 5. Teacher Engagement in Coaching, $n = 98$ Teachers.

Item	Training year	Follow-up year
Teacher enthusiasm for coaching	2.77 (0.36)	2.72 (0.42)
Willingness to receive feedback	2.87 (0.24)	2.88 (0.37)
Incorporates previous feedback	2.55 (0.41)	1.93 (0.68)

with the training experience. Scores were collected from 84% of teachers who completed training ($n = 82$). Teachers indicated they felt confident in their ability to use CPRT with their students ($M = 4.2$, $SD = 0.57$) as well as their ability to use CPRT in groups effectively ($M = 4.18$, $SD = 0.74$).

Teacher Fidelity of CPRT

Teacher fidelity was defined as their score averaged across the 11 CPRT components examined at the end of each school year (i.e., Overall, Antecedent, and Consequence). Figure 2 shows the mean scores for overall fidelity to CPRT and for each component group during the observation (control), training, and follow-up years. Fidelity scores were available for a total of 114 teachers (90%). Overall, CPRT fidelity was significantly higher at the end of the training year relative to the observation year ($B = 0.24$, $p = .001$). Teachers passed a higher percentage of components during the training year (64%) than the observation year (57%; $B = 0.06$, $p = .009$); however, these changes did not maintain during the follow-up year, with lower overall fidelity compared with the training year (55%; $B = 0.04$, $p = .045$).

When examining the different groups of CPRT strategies, there is variable fidelity across CPRT components prior to participating in training, with teachers, on average, demonstrating higher proficiency using Antecedent strategies and lower proficiency using Consequence strategies (see Figure 2). Teachers improved fidelity from observation to training for Antecedent strategies ($B = 0.17$, $p = .022$) and Consequence strategies ($B = 0.46$, $p = .018$). The changes in fidelity, however, were maintained during the follow-up year compared with the training year only for the Consequence strategies ($B = 0.52$, $p = .01$).

Teacher Report of Use

A total of 73 teachers (74% of trained teachers) completed at least one CPRT Report of Use measure after didactic training was complete (range = 1-5 reports, five possible). Across all reports, teachers reported using CPRT an average of 47 minutes per day ($SD = 36$, range = 15-240), 3 days per week ($SD = 1.1$, range = 1-5).

Sustainment of CPRT

Fifty-seven teachers ($n = 58\%$ of trained teachers) completed a sustainment survey 18 months after participating in training. On a 1 to 5 scale, teachers rated their individual sustainment of CPRT at an average of 3.8 ($SD = 0.58$) and their school's sustainment of CPRT at an average of 1.4 ($SD = 0.7$).

Moderators of Teacher Fidelity

Results demonstrated that CPRT training, teacher, and classroom- and school-level characteristics affected CPRT fidelity after training. The number of coaching visits received was associated with higher overall CPRT fidelity ($r = .15$, $p = .03$) and higher percentage of components passed ($r = .18$, $p = .00$). Teacher knowledge at intake was also related to fidelity outcomes. Both teacher knowledge of research-based practices for ASD generally, and teacher knowledge of CPRT practices specifically, were associated with overall CPRT fidelity ($r = .19$, $p = .03$; $r = .20$, $p = .02$, respectively) and percentage of CPRT components passed ($r = .15$, $p = .05$; $r = .17$, $p = .02$, respectively). Overall, classroom quality as measured by the PDA was associated with higher percentage of components passed ($r = .54$, $p = .05$). In addition, higher scores on the Classroom Environment domain on the PDA

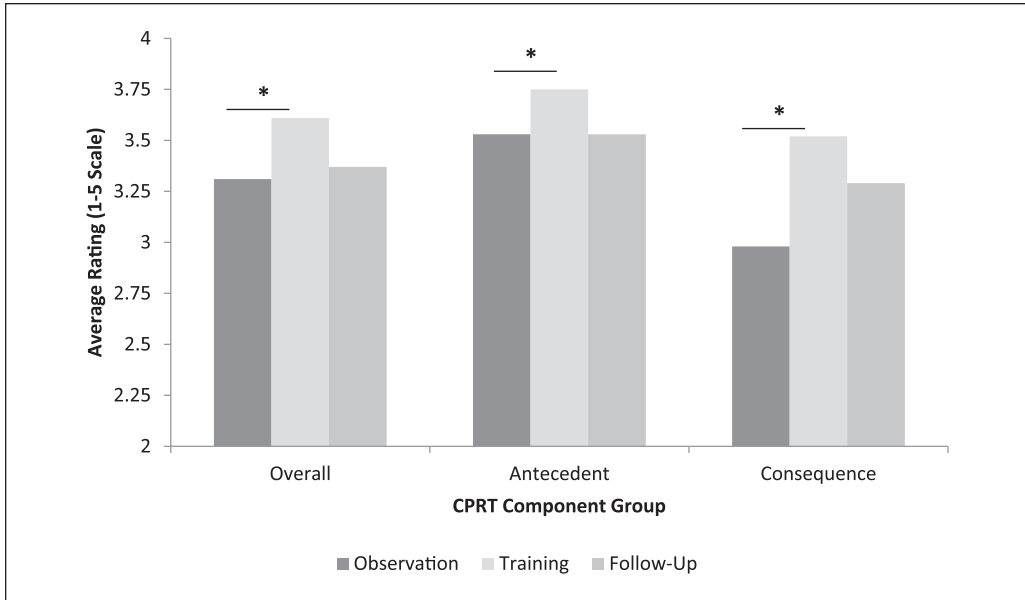


Figure 2. CPRT fidelity of intervention by component group and condition.
 Note. CPRT = Classroom Pivotal Response Teaching.

were associated with higher overall CPRT fidelity ($r = .36, p = .02$) and higher percentage of components passed ($r = .58; p = .04$). Finally, teacher ratings of program implementation climate were associated with higher overall CPRT fidelity after training ($r = .38, p = .00$).

Generalization

The end of the school year PDA scores were compared across groups to evaluate change in CPRT-focused components, or those assessment items most related to individual CPRT components (identified above). Outcomes indicate marginally significant findings with higher PDA CPRT scores for teachers in their training year as compared with those in the observation year ($B = 1.41, p = .099$). This marginal difference maintained with teachers in the follow-up year also, demonstrating higher scores than those in the observation year ($B = 1.39, p = .077$).

Discussion

In this study, we evaluated teacher outcomes associated with training in a collaboratively

adapted EBP for students with ASD. Participants received small-group training and one-on-one coaching in CPRT. Teachers reported high engagement and satisfaction with CPRT training, and observational data indicated that teachers learned and accurately implemented CPRT following training, although a majority of these improvements did not sustain during the follow-up year. Several variables, including higher prior knowledge and experience with EBPs and CPRT, as well as higher scores of classroom environment and quality, were associated with higher CPRT fidelity following training. Overall, findings of teacher satisfaction and fidelity with CPRT indicate support for the feasibility of the intervention in schools.

Teachers demonstrated higher average fidelity of CPRT during the training year, as compared with the observation year, indicating moderate support of the training model utilized and the feasibility of the intervention for community use. Importantly, teacher fidelity of CPRT was measured in multiple ways, including both adherence and quality. The measurement of quality within the context of adherence is important to assure that students are not only exposed to prescribed CPRT

components but that they also receive a quality dose of indicated strategies to optimally promote student outcomes (Schoenwald et al., 2011). Consistent with prior work (Stahmer et al., 2016; Suhrheinrich, 2015), increases in fidelity during the training year also varied across components, with the Consequence strategies showing the lowest average score during the observation year and the most growth from observation to training years. Similar variability in the sustainment of CPRT components was observed, with the largest retention of gains during the follow-up year with the Consequence strategies. These strategies had the largest room for growth compared with the initial high levels of fidelity for other components, signaling that training was effective in improving an area of need for teachers to better match the overall moderate to high general quality of strategies seen across other CPRT components. The observed variability in fidelity points to key targets for additional training regarding teachers' use of certain strategies and highlights potential methods to individualize and enhance teacher training.

Although teacher fidelity of CPRT indicates moderate to high levels of accuracy during the implementation year, sustainment of fidelity in the year following training was substantially lower. This finding is disappointing but not completely unexpected, as previous research has also demonstrated teacher lack of sustainment following successful outcomes associated with initial training. For example, data suggest that teachers demonstrate limited fidelity despite comprehensive, supportive training and observed gains in child outcomes (Mandell et al., 2013; Pellecchia et al., 2015), especially in the case of multicomponent interventions that require clinical judgment such as CPRT or PRT (Stahmer et al., 2015). In addition, we now have a better understanding of factors related to sustainment of practice as the field of implementation science has provided a growing body of literature on how plans and supports for sustainment of practice must be integrated in the planning stages, prior to active implementation (McInerney et al., 2014). Specifically, theory and models

from this field highlight the key role of inner and outer context factors, such as provider experience and background, known to be related to providers' ability to maintain and generalize use of EBP over time and with new students who weren't part of initial training efforts (Aarons, Hurlburt, & Horwitz, 2011) and supported within the educational professional development literature (Darling-Hammond et al., 2017; Desimone, 2009; Wenner & Campbell, 2017). The importance of considering inner and outer context is further exemplified in our results identifying prior EBP knowledge and experience or use and ongoing consultation following training as key modifiers of teacher fidelity, which have been known to facilitate EBP attitudes and adoption following training (Barnett et al., 2017; Darling-Hammond et al., 2017; Desimone, 2009; Reding, Chorpita, Lau, & Innes-Gomberg, 2014). This points to the possibility that some prerequisite understanding of ASD and level of classroom quality might be necessary prior to learning a complex EBP. Recommendations might include preservice training in these areas or additional training for teachers with less experience in this area before embarking on lengthy EBP training.

Our findings indicating high levels of satisfaction and sustained engagement with the adapted intervention and the training procedures also speak to the importance of considering key inner and outer factors in implementation efforts. Teacher support for and satisfaction with CPRT may be high because PRT was systematically adapted with teacher partners and based on qualitative and quantitative data from teachers. The high level of satisfaction is encouraging and adds to the existing implementation science literature (e.g., Aarons et al., 2011; Chambers & Norton, 2016), underscoring the importance of creation or adaptation of context-specific EBPs to better promote both the "fit" and resulting use of EBPs in community settings. Our results indicating the benefit of a positive implementation climate on teachers' ability to accurately learn and use are also consistent with this broader literature and highlight the benefit of targeting multiple key contextual

factors, such as implementation climate and intervention fit to best promote teachers' willingness and ability to adopt an EBP (e.g., Darling-Hammond et al., 2017). Consistent with the broader emphasis on leadership and teacher leadership (McCormick, Capella, O'Connor, & McClowry, 2015; Wenner & Campbell, 2017), these findings suggest that education leaders play a part in the success of EBP adoptions and specific training for leaders in how to support teachers may be necessary for effective implementation and sustainment. It will be important to continue to examine the impact of these key implementation determinates, especially in the context of further efforts to evaluate the effectiveness of EBPs for ASD such as CPRT within real-world, community settings.

Several limitations were present in the current study. The most significant limitation is the primary focus of the larger study on the efficacy of CPRT, such that the current training procedures were highly controlled and facilitated by trained research staff. Thus, the effectiveness of the CPRT training and intervention has yet to be fully examined, especially in the context of ongoing support or facilitation from community-based personnel. The classrooms and students included in this efficacy trial, however, were highly variable and likely representative of broader publicly funded schools. Teachers in the current study agreed to participate in a research study and thus may not be representative of the broader population of teachers serving students with ASD. For example, their willingness to participate in the current study may reflect higher experience with or openness to EBPs relative to other teachers.

Despite these limitations, the current findings have important implications for classroom-based ASD interventions. This study adds to the limited number of school-based randomized controlled trials (RCTs) evaluating interventions for students with ASD. The focus of this article was identifying teacher-related training outcomes and factors that were related to teacher learning and use. We plan to conduct additional analyses of how teacher fidelity of CPRT affects student outcomes to

more fully evaluate the efficacy of the adapted protocol. Future work should address these limitations and evaluate the effectiveness of CPRT when independently supported by district personnel.

Declaration of Conflicting Interests

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