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Implementation fidelity and common elements of high quality teaching sequences for students with autism spectrum disorder in COMPASS

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ABSTRACT

Background: Evidence-based educational instruction includes teaching elements common across different approaches as well as specific elements of the chosen evidence-based practice. We were interested in evaluating the use and impact of common elements of teaching. Specifically, we adopted a model of elements of high quality teaching sequences and developed and tested an instructional quality index to capture evidence-based features within teaching sequences (Grisham-Brown & Ruble, 2014).

Method: The current investigation examined 29 special education teachers who received a consultation intervention called the Collaborative Model for Promoting Competence and Success (Ruble, Dalrymple, & McGrew, 2012; Ruble, McGrew, & Toland, 2012) that results in personalized teaching plans for young students with ASD and embeds elements of evidence-based teacher coaching of self-reflection and performance-based feedback. We analyzed the teaching plans to understand which of the common elements were present, and if teachers demonstrated improved performance after coaching.

Results: Analysis of the use of common elements during the first and fourth coaching session demonstrated that all teachers showed improvement. Most importantly, the use of common elements correlated with student goal attainment outcomes.

Conclusions: These results suggest that common elements of teaching sequences which we view as core features of teaching quality, can be improved as a result of coaching, and most importantly, are associated with students' educational outcomes.

1. Introduction

Special education teachers must be prepared to educate and implement evidence-based practices (EBPs) for academic, behavioral, and social emotional concerns for students with a wide variety of needs and disabilities, including children and youth with autism spectrum disorder (ASD; IDEA, 2004). However, for ASD alone, the National Professional Development Center (NPDC) has identified 27 EBPs (Wong et al., 2015). Given the sheer number of EBPs for ASD, it is not surprising that research suggests a research-to-practice gap (2009b, Foster, 2014; McGrew, Ruble, & Smith, 2016; Odom, 2009a; Suhrheinrich, Dickson, Rieth, Lau, & Stahmer, 2017). Implementation science helps shed light on the reasons for the gap in research and practice for teaching students with ASD that

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includes the characteristics of the intervention, contextual factors, and the implementation process (Damschroder et al., 2009; Kasari & Smith, 2013). Characteristics of the intervention are particularly compelling because interventions that are too complex and multi-faceted present barriers that contribute to the gap; on the other hand, understanding the core components that underlie an interventions success can facilitate implementation (Damschroder et al., 2009; Rycroft-Malone et al., 2002).

Another reason offered for the gap may be due to student characteristics. ASD is one of the most heterogeneous developmental disorders and adapting EBPs to the developmental and behavioral characteristics of students with ASD is complex and requires clinical decision-making (McGrew et al., 2016). For example, a child who does not read will not be able to respond to a social narrative without adaptations of how the social narrative is presented. Further, a child who does not understand abstract pictures may require tangible objects when learning to initiate communication with the picture exchange system.

Our work has involved the development and testing of consultation as an implementation strategy for embedding EBPs derived from the individual education programs (IEPs) of children with ASD into classroom activities and routines. The Collaborative Model for Promoting Competence and Success (Ruble, Dalrymple et al., 2012; Ruble, McGrew et al., 2012) for ASD provides the process by which personalized educational and clinical decision making occurs within an evidence-based practice in psychology (EBPP) frame (McGrew et al., 2016). While professional development training that emphasizes EBPs is necessary and important, it is insufficient because high quality clinical and educational decision-making requires an ecological approach for personalizing EBPs to the specific situation of a student, and bridging the child's and teacher's strengths, preferences, and resources and allowing adaptation of the EBP from the intersection of the three.

COMPASS is manualized (Ruble, McGrew et al., 2012) and has been tested in three randomized controlled trials (RCTs) with effect sizes ranging from 1.1–2.1 (Cohen's d) (Ruble, Dalrymple, & McGrew, 2010; Ruble, McGrew, Toland, Dalrymple, & Jung, 2013, 2018). COMPASS begins with a 3 h parent-teacher consultation. For high school, students are encouraged to attend as well. During this session, a profile of the student's strengths/preferences, frustrations/fears, self-management, problem behaviors, social and communication skills, sensory issues and preferences, and learning skills is reviewed using summaries provided by the parent and teacher. The consultant facilitates discussion of these areas noting concerns described at home and school and goal areas that have the potential for leveraging other areas of development (Koegel & Koegel, 2006). After obtaining a shared understanding of the student at home and school, the pivotal areas of social, communication, and learning skills are targeted for goal setting (see Table 1 for examples). Once the goal is identified, a measurable objective is developed for the goal. Next highly individualized intervention plans are developed for each objective that considers the student's personal and environmental challenges and supports that will facilitate learning or create barriers if not addressed. After this initial consultation, the consultant provides four, 1 h teacher coaching sessions for the remainder of the school year, occurring about every 6 weeks. During coaching, goal attainment scaling is used to monitor student progress and performance feedback is provided to the teacher through videotape review of implementation of teaching plans. In all, the consultant spends fewer than 10 h with the teacher over the school year.

Although COMPASS is highly successful for improving the IEP outcomes in core areas of social, communication, and learning skills for students with ASD, the RCTs were conducted by the developers. Thus, there is a need to demonstrate the effectiveness of COMPASS when implemented by community-based consultants. However, a challenge with broad implementation of COMPASS in schools is its complexity. For dissemination of COMPASS to occur widely, it is necessary to ensure implementation fidelity when training community-based consultants. Consultation is a multi-tiered intervention that requires fidelity assessment at two levels – the consultant level and the teacher level. Dunst, Trivette and Raab (2013) offer a framework that captures consultation fidelity well. Their framework explicates the different levels. Consultant fidelity at the implementation practice level should be associated with teacher fidelity at the intervention practice level, which should be associated with the practice outcome (e.g., student IEP goal

Table 1
Examples of Goals by Domain.

Social
During structured play time, Student will independently imitate an adult/peer action with at least 5 objects 5 times a day for each over a two week period.
During recess, social skills, and specials, Student will take 5 turns with a peer with peer prompts once a day 4 out of 5 days.
Follow group rules of turn taking while waiting his turn in line at the cafeteria or at recess and waiting to be called on during math for 1 min independently and without calling out or cutting in line to be in the front 2 times per day for 2 weeks
Communication
When presented with an activity that requires assistance or is desired, student will independently - without adult verbal cues – using visual cues and gestures only - initiate requesting asking for help or asking for objects, activities, 4 times a day for two weeks.
With peers in a structured group, student will engage in conversational turn-taking through 4 turns (back and forth as 1 turn) with peer(s), staying on topic with visual prompts 4 of 5 opportunities in a 1 week period.
When offered a nonpreferred item, student will say "no" by tapping/giving a "no" card 4/5 trials over 1 week.
Learning
When presented with a familiar work activity, student will complete the work task when presented with a model with one verbal prompt once a day for two weeks.
When presented with a task menu from which to select a work task, student will start and complete three 2 – 3 min tasks each day without aggression with adult verbal cues across 2 weeks.
When given a familiar task, student will start the task with one specific cue from an adult and visual cues, to complete the task with the adult more than 5 feet away from him 4/5 opportunities for 2 weeks.

attainment). Using serial mediation with COMPASS fidelity and outcome data, Wong, Ruble, McGrew and Yu (2018) identified the indirect impact of COMPASS on student IEP goal attainment outcomes through teaching fidelity and child engagement.

For the current study, we wanted to understand how best to assess implementation practice fidelity for one of the key activities of COMPASS – the development and implementation of the personalized intervention plans. While the consultant helps guide the development of the intervention plans during the initial consultation, the teacher is responsible for implementing the plans. Thus, such a measure could assist both tiers- fidelity of the implementation practice and fidelity of the intervention practice. Our method began with a review of the COMPASS intervention plans. We took a theoretical-empirical approach influenced by empirically validated interventions, theory, observation, and practice for ASD. Schreibman and colleagues (2015) comprehensive review of evidence-based naturalistic developmental behavioral interventions (NDBI) for children with ASD was used as a reference because it best encapsulates the empirically supported elements selected for review in the COMPASS interventions as implemented by teachers: observation of teachers using (a) a three-part contingency (antecedent-response-consequence); (b) child initiated teaching episodes; (c) environmental arrangement to support cueing; (d) reinforcement for enhancing motivation; and (e) use of prompting and prompt fading during the instructional situation. We then used these general features and developed a fidelity measure that would allow for a more objective way to assess the quality of teaching plans. As mentioned, the goal for this measure was to assist with training and evaluating community consultants trained in COMPASS, and thus, was specific to this project. However, the information learned offers generalizable knowledge for implementation science researchers.

2. Present study

Five primary research questions guided our study: (a) What is the variation in the fidelity to the common elements across teachers and goals? (b) Are these elements viewed and used as a sequence? That is, do the elements tend to occur together (i.e., correlated) or are they independent (i.e., use of one element does not necessarily predict use of the other elements)? (c) Does adherence or fidelity to the elements improve with coaching and is this improvement consistent across different teachers? (d) Is adherence to the use of the elements related to other measures of teaching quality (student engagement)? and (e) Is adherence to the elements related to student goal attainment outcomes, both in terms of overall adherence and with respect to individual elements (that is, are certain elements particularly important in relationship to outcomes)?

3. Methods

3.1. Participants

The data for the current study were derived from a sample of teachers who participated in a randomized controlled trial (RCT) of COMPASS (Ruble et al., 2013). Thus, the data represent a secondary analysis of the parent RCT. Data from 29 special education teachers who were randomized into the COMPASS condition were selected for analysis. All were the primary teacher who oversaw the special education program of a student with ASD between ages 3–8 from public schools located in two Midwestern states. All but one teacher was female and all teachers had their teaching certification for special education.

3.2. Measures

Three measures were used for evaluating common elements, child engagement, and child goal attainment outcomes (Table 2).

3.2.1. Common elements of teaching sequences (CETS)

An instructional fidelity measure that captures common elements of teaching sequences (CETS; Grisham-Brown & Ruble, 2014) was developed as an index measure (Table 3) that taps into teacher ability to set up a developmentally appropriate and meaningful activity designed to target the skill, obtain and maintain student attention throughout instruction, provide clear prompts and cues that the student understands, allows for time to respond, and provides reinforcement (Grisham-Brown & Ruble, 2014). We prioritized usability, feasibility, and overall ease-of-use of the measure so that the tool can be used in applied settings proficiently and with future implementation and dissemination in mind (Ruble & McGrew, 2013). Thus, all the items were rated using global ratings of overall use of elements based on observation from videotape using a dichotomous scale (1 = No; 2 = Yes) with the exception of item number 2, which was rated on a 3-point Likert-type response scale (1 = Poor; 2 = Somewhat; 3 = Good) but recoded so that 3 = 2; 2 = 1.5; and 1 = 1 for equal weighting with other items. Each item of the index is addressed individually because a teacher may demonstrate one of the common elements, but not others. The total score represents the degree to which the teacher demonstrated the CETS as a whole.

Five raters were involved in the coding process. One coder was responsible for all the videos within one goal domain (i.e., social, communication, or learning; see Table 1 for examples of goals). The following four steps occurred for reliability training. First, before watching the video, the rater read the COMPASS report, teaching plan, and coaching session summary report to obtain a comprehensive understanding of the teaching plan, including information about the child's verbal comprehension and expression. Second, the rater watched the video and determined the number of teaching sequences provided. Third, the rater identified the start of the teaching sequence which was defined by a set of activities that began when the teacher /peer made a request or the environment was set up with the expectation for the child to initiate or respond and ended when the child responded (with or without teacher assistance) or a task was clearly completed. If the teacher provided additional support for the child to respond, the sequence

Table 2
Table of Measures and Paired *t*-test Comparisons.

Measure	Definition	Coaching 1 Mean (SD)	Coaching 2 Mean (SD)	t
Common Elements of Teaching Sequences (CETS)	A 6-item instructional fidelity index measure that captures common elements of high quality teaching sequences.	1.8 (.15)	2.1 (.12)	−8.4***
Autism Engagement Rating Scale (AERS)	A 6-item observational measure of global child engagement during instruction	13.7 (2.2)	15.7 (1.7)	−5.6***
Psychometric Equivalence-Tested Goal Attainment Scaling (PET-GAS)	An idiographic and objective assessment of student IEP progress	−2.0 (0)	0.54 (.87)	−15.7***

Note: ***p < .001.

Table 3
Common Elements of Teaching Sequences (CETS).

Item	Response Format
1. Child participated in meaningful goal-directed activity (yes/no)	1 = No 2 = Yes
2. Teacher / environment solicits the student's attention at the start and throughout the teaching sequence (poor/somewhat/good)	1 = Poor 2 = Somewhat 3 = Good
3. Teacher / peer makes initial request, or environment is set up clearly, in format the child can understand (yes/no)	1 = No 2 = Yes
4. Teacher / peer provides sufficient time (3–5 s) for the student to perform the target skill after the initial request (yes/no)	1 = No 2 = Yes
5. Teacher / peer provides sufficient time (3–5 s) following each prompt to perform the target skill is provided (yes/no)	1 = No 2 = Yes
6. Teacher provides clear reinforcement for completing the skill	1 = No 2 = Yes

continued. For example, if the teacher gave the child three pictures from which to choose an activity, and the child did not respond, and the teacher reduced the number of pictures from 3 to 2 and then the child responded, the teaching sequence ended. If instead the teacher took the child's hand and placed it on a picture, then the sequence ended. Finally, the raters practiced coding and compared codes to other observers. Areas of agreement and disagreement were discussed. Notes were made on the areas and reasons for disagreement and how the raters came to consensus. This process of practice coding was completed until there was agreement for 80 % of items coded. After establishing agreement with coding, the primary rater randomly selected at least 20 % of the videos for reliability checking by a secondary rater from the remaining videos. This process was repeated for each goal area. Overall, at least 20 % of the videos within each of the three domains were independently coded by two trained raters. The reliability of the coding decisions for the CETS was measured using Holsti (1969) coefficient of reliability (CR), Cohen's (1960) kappa (*k*), and Spearman's rho. CR was used for the reliability of all items. *Kappa* was used for all items except item two because coefficient *k* works best for categorical items but not for ordinal and interval items. Spearman's rho (ρ) was used to measure the reliability of item two between the two coders because of the ordinal nature of item two. The overall CR across all items and coders was 93.93 %, which is nearly perfect according to the Landis and Koch (1977) standard. The *kappa* values were 1, 0.85, .83, .82, and 0.96 for item one, three, four, five, and six respectively. The inter-rater reliability for item two was $\rho = .81$. Applying the Landis and Koch (1977)'s standard, the overall inter-rater reliability scores using the Cohen's kappa and Spearman's rho were in the range of almost perfect. These results indicate that the CETS had sufficient inter-rater reliability. We describe each element of CETS next.

3.2.1.1. Meaningful activity. The first common element asks whether the child participated in a meaningful activity. An activity is meaningful if it is consistent with a student's teaching plan which includes use of the child's strengths, preferences, and interests, aligned to set the occasion for the targeted skill, and promotes skill acquisition of the targeted behavior (Division for Early Childhood (2014); Marshall & Goodall, 2015; Ruble, McGrew et al., 2012; Schreibman et al., 2015). For example, if the skill was initiating a request for help, and the activity that the teacher set up involved sabotage so that the child needed to ask for help to complete the activity, this would be judged a meaningful activity. Recall that the teaching plans assessed in the study were developed as part of the COMPASS intervention that is designed specifically to develop personalized intervention plans that take into account the EBPP framework described earlier. Further, the notion of embedding instruction into ongoing classrooms and routines has been associated with skill acquisition, maintenance and generalization (Snyder et al., 2015).

3.2.1.2. Attention. The second common element is the maintenance of student attention with the learning task. Attention, as an essential component in learning (Kruschke, 2005; Reynolds, 1992; Wolery, Ault, & Doyle, 1992), is associated with different domains, such as early word acquisition (Smith, Colunga, & Yoshida, 2010), reading (Hidi, 1995; LaBerge & Samuels, 1974), and social development (Mundy & Newell, 2007), and is maintained when the practitioner has designed the young child's learning environment to increase access and participation (Division for Early Childhood, 2014). The role of teachers in helping students with ASD attend to the learning task is especially critical because children with autism exhibit significant attention problems (Mayes & Calhoun, 2007).

3.2.1.3. Prompting. Prompting is a common element embedded within many different EBPs and is also listed independently as one of the 27 focused interventions (Sam, 2015; Swain, Lane, & Gast, 2014) and can take many forms, including verbal, gestural, and environmental (Mesibov & Shea, 2010). Requesting and providing information / instructions clearly about how to perform a target behavior, in accordance to the students' level of functioning, is a critical element of teaching students with disabilities in general (Grisham-Brown & Hemmeter, 2017; Wolery et al., 1992) and for students with ASD in particular. To help rate the prompt for the child, the rater reviewed, in advance of scoring the video, the child's consultation report and teaching plans that described the child's abilities and skills.

3.2.1.4. Wait time. The fourth common element, wait time, assesses whether the teacher allows sufficient time for the student to process and respond after an initial request. Wait time influences (a) length and correctness of students' responses, (b) frequency of

student initiations, and (c) scores on academic achievement tests (Llewellyn, 2012; Stahl, 1994). Two items within the CETS assess this feature. The first item concerns wait time (at least three seconds) for the student to respond after an initial request; the second item assesses continued use of wait time after follow-up prompts. An initial request is defined as the first teaching command or cue that asks students to perform a certain behavior or complete a particular task. Wait-time is considered an effective practice when teaching Common Core State Standards to students with disabilities (National Center State Collaborative, 2013). For students with ASD, wait time is especially important because of difficulty responding due to issues of receptive communication (Weismer, Lord, & Esler, 2010), overselectivity of attention (Kelly, Leader, & Reed, 2015), interference from distractions (Murphy, Foxe, Peters, & Molholm, 2014), and risk for developing prompt dependence (Milley & Machalicek, 2012).

3.2.1.5. Reinforcement. The final assessed feature of an effective teaching sequence is reinforcement. Reinforcement is defined as an action or process that increases the possibility of the occurrence of the behavior (Cooper & Heward, 2007; Schramm, 2011). Reinforcement is an effective teaching strategy in the field of special education for teaching students with disabilities a variety of skills (Lysakowski & Walberg, 1981).

3.2.2. Student engagement

The Autism Engagement Rating Scale (AERS; Ruble & Robson, 2007; Ruble, Dalrymple et al., 2010; Ruble & McGrew, 2013) is an observational measure of global child engagement during an activity and serves as an additional measure of overall intervention quality. The scale was originally developed for measuring the quality of interaction between children with autism and their caregivers. In the present study, the AERS was used to assess the overall quality of the child's engagement with his/her teacher in learning through six domains of child behavior during an instructional activity: (a) cooperation; (b) functional use of objects; (c) productivity; (d) independence; (e) consistency between the child's and the teacher's goals; and (f) attention to the activity. Each domain includes one question. All the items were rated using a 5-point Likert scale (1–3, with −0.5 midpoints). The summed score of the items was used to represent the overall quality of the child engagement. The AERS has good psychometric properties (see Ruble & Robson, 2007; Ruble & McGrew, 2013; Wong, Ruble, Yu, & McGrew, 2017) with high internal consistency ($\alpha = .86$) and inter-rater reliability ($r = 0.88$, $p < .01$).

3.2.3. Student goal attainment outcomes (PET-GAS)

Psychometrically Equivalence Tested Goal Attainment Scaling (PET-GAS; Ruble, Dalrymple et al., 2010; Ruble, McGrew et al., 2012) was used as an objective assessment of student IEP progress. PET-GAS as an idiographic outcome measure is ideal when assessing individualized student outcomes where students have different starting baseline levels of skill, diverse teaching targets, and varied teaching plans as opposed to a standardized measure of IEP progress that fails to capture the need for an individualized approach. PET-GAS is based on a 5-point scale (−2 = child's present levels of performance, −1 = progress, 0 = expected level of outcome, +1 = somewhat more than expected, +2 = much more than expected). Half-scores are allowed when the status of behaviors fell between two benchmarks. For instance, a score of zero represents improvement consistent with the written IEP objective (i.e., the expected goal). In the current study, PET-GAS scores were based on direct observation of child progress toward IEP goals (ICC = .90–.99) from a blinded rater (i.e., who was unaware of group assignment) (Ruble et al., 2013.

3.2.4. Procedure

As part of the COMPASS coaching protocol, teachers were asked to provide a videotape demonstrating implementation of the teaching plans with the student. Each teacher-student video was intended to capture instruction for the three goal domains targeted by COMPASS: social, communication, and learning skills derived from the initial consultation and applied during the coaching sessions. The lengths of the videos varied from 31 s to 21 min depending on the target skills. For instance, a video that captured instruction on making social greetings of a child saying "hi" and "bye" to teachers was short compared to a segment that captured a child instruction on developing independent work skills, such as completing an assignment from start to finish. The first video was submitted approximately 4–6 weeks following the initial COMPASS consultation that occurred within the first two months of the school year. The last video was obtained in March or April of the same school year. Several analyses were conducted to evaluate the videotape samples and understand more about teachers' use of CETS. We were interested both in the cross-sectional relationships between study variables and in change across time and, thus, selected data from the first and fourth coaching sessions for analysis. After videos were coded for use of each element of CETS for the first and last coaching sessions, inter-rater reliability was calculated.

For the first question: What is the variation in the fidelity to the use of the common elements across teachers and across goals, we calculated the number of elements observed across teachers, goals, using descriptive statistics. To answer the question whether common elements are used together as a sequence, we examined the internal consistency of the CETs and conducted inter-item correlations. For the question about whether adherence to the common elements improves with coaching across teachers and goals, we conducted paired *t*-tests to identify changes in the use of common elements from Coaching 1 and 4. For the question of whether adherence is correlated with measures of student engagement and student goal attainment outcomes, we correlated the overall mean score of the use of common elements with child engagement and student goal attainment outcomes using Pearson's correlation coefficient.

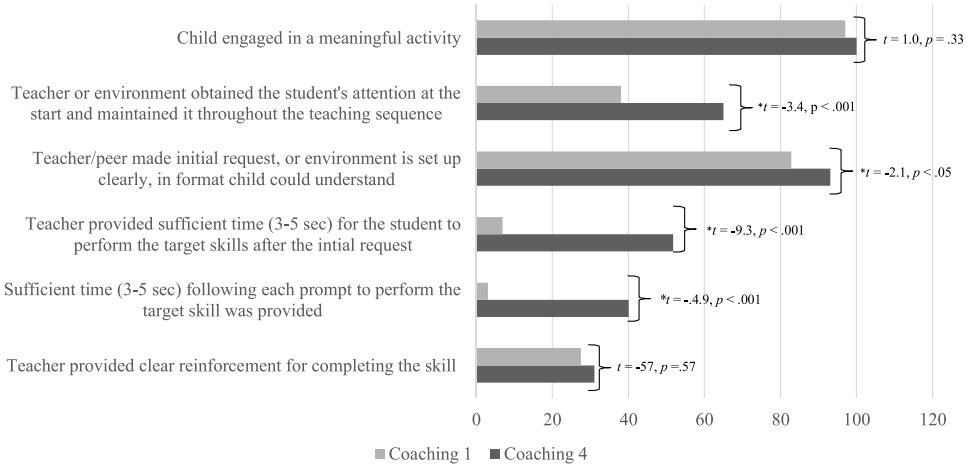

Fig. 1. Percentages of teachers who demonstrated the element. The * indicates a significant *t* test between paired samples.

4. Results

4.1. Variability in use of common elements across teachers and goals

The first question about the variation of the fidelity to the use of common elements across teachers and goals revealed both areas of strength and difficulty at baseline (see Fig. 1). Across teachers, the ability to successfully set up a meaningful activity that targets the skill (97 %) and provide a clear initial request or instructional environment (83 %) were areas of strength; however, successful demonstration of the other elements was observed in less than 40 % of the baseline videos. The poorest results were observed for two areas: allowing sufficient time to perform the skill after the initial prompt (7 %) and following each prompt (3 %). Providing clear reinforcement was also noted infrequently (28 %). A little over a third of the videos revealed evidence that the teacher was obtaining the students attention and maintaining it throughout the instructional activity (38 %).

4.2. Use of common elements as a sequence

To answer the second question about whether common elements are implemented together in a sequence, analysis of the internal consistency and intercorrelations are provided. For internal consistency, results based on Kuder-Richardson Formula 20 for coaching 1 and coaching 4 were .47 and .22, respectively, indicating low internal consistency. Table 4 shows the results of the intercorrelation matrix for coaching 1 and coaching 4. For coaching 1, none of the items were correlated with an adjacent item in the sequence. But item 2, obtaining and maintaining the child's attention was correlated with item 4, providing wait time after the initial request ($r = .38, p < .05$) and item 5, after follow-up requests ($r = .36, p < .05$). Also, item 3, providing a clear cue correlated with item 6, providing reinforcement ($r = .45, p < .05$). The intercorrelations were similar for coaching 4 with no evidence of elements being used together or sequentially. Similar to coaching 1 results, obtaining and maintaining the child's attention correlated with providing time to respond after the first cue ($r = .39, p < .05$).

4.3. Improvement in use of common elements after coaching overall and by goal

Changes in the presence of the common elements from the first to the final coaching session were significant for four of the six elements (Fig. 1). By the final coaching session, teachers were more likely to be maintaining student attention ($t = -3.4$, $df = 28$, $p < .001$), providing clear initial requests ($t = -2.1$, $df = 28$, $p = .05$), and allowing at least 3 s for students to respond to the initial requests ($t = -9.3$, $df = 28$, $p < .001$) and the follow-up prompts ($t = -4.90$, $df = 24$, $p < .001$). The two areas that did not improve were setting up a meaningful activity that targets the skill and providing clear reinforcement for skill completion. However, for the former element, scores were near 100 % at coaching 1 and at 100 % for coaching 2 leaving no room for improvement.

Using a paired *t* test, teaching fidelity overall, using summed CETS scores, improved from the baseline to the final coaching session ($t = -8.5$, $df = 28$, $p < .01$). Similar improvement in total CETS scores was observed for each goal type (communication: $t = -4.58$, $df = 21$, $p < .01$; social: $t = -5.07$, $df = 22$, $p < .01$; learning: $t = -4.37$, $df = 25$, $p < .01$).

4.4. Association between common elements, student engagement, and IEP goal attainment outcomes and changes from coaching 1 to coaching 4

For the last two research questions on the relationship between adherence to common elements and student engagement and outcomes, analyses revealed that CETS ratings correlated with engagement at coaching 1 ($r = .69, p < .01$) and also at coaching 4 (*r*

Table 4
Intercorrelations Between Common Elements Items, Engagement (AERS), and Student Outcomes (PET-GAS).

	Activity	Attention	Request	First Wait	Wait	Reinforce
Activity	- / -					
Attention	.09 / -	-				
Request	-.07 / -	.17 / .23	-			
First Wait	.00 / -	.38* / .39*	-.00 / .19	-		
Wait	-.05 / -	.36 / .09	-.05 / .21	.34 / .29	-	
Reinforce	.29 / -	.06 / .12	.45* / .11	-.01 / -.11	-.02 / -.12	-
AERS – 1[1]	.02 / -	.48* / .05	.12 / .25	.16 / .40*	.45* / .27	.15 / -.15
AERS – 4[2]	.20 / -	.56** / .37	.07 / .01	.30 / .59**	.31 / .21	.05 / -.25
PET-GAS	.03 / -	.2 / .12	-.09 / -.22	.15 / .17	.24 / -.03	.03 / -.27

Note: Upper diagonal represents coaching 1; lower diagonal represents coaching 4.
[1]Student engagement at coaching session 1.
[2]Student engagement at coaching session 4.

Table 5
Associations Between Common Elements (CETS), Engagement (AERS), and Student Outcomes (PET-GAS).

	Common Elements (CETS)		Autism Engagement Rating Scale (AERS)	
	Coaching 1	Coaching 4	Coaching 1	Coaching 4
Autism Engagement Rating Scale (AERS)	.69**	.61*		
Student Goal Attainment Outcomes (PET-GAS)	.56**	.61**	.26	.47*

Note. * p < .01, ** p < .001.

= .61, $p < .01$), and with student goal attainment scores at coaching 1 ($r = .56$, $p < .01$) and coaching 4 ($r = .61$, $p < .01$) (see Table 5). Analysis of the association between individual elements and outcomes revealed no significant findings. Further, paired *t*-test comparisons (Table 2) demonstrated improved mean scores for the CETS (t = −8,4, p < .001), the AERS (t = −5.6, p < .001), and the PET-GAS (r = −15.7, p < .001).

5. Discussion

The primary aim of this study was to identify whether the CETS was a sensitive approach for assessing implementation fidelity. The CETS provides a structure of key intervention elements and a means to assess fidelity or the degree to which educational plans reflect naturalistic interventions as implemented so that the child is involved in meaningful activities, with clear instruction, and effective prompting and reinforcement procedures.

We tested the CETS with real examples of COMPASS intervention plans implemented by special education teachers. Teacher behaviors that were used frequently or infrequently were identified such as meaningful instruction associated with the target skill, teacher prompting, wait time, and reinforcement. In addition, we wanted to understand the variation in implementation of common elements across teachers and goal areas, if CETS is viewed as a sequence of skills or as separate and independent factors, whether teachers would show improvement between two time points on each element following a COMPASS coaching intervention and explored the CETS in relation to a measure of student engagement and student goal attainment outcomes.

Clear areas of strength in the fidelity to common elements were observed for both coaching sessions across teachers and goal domains. Ability to set up a meaningful instructional sessions that targeted the skill and provided a request that was in a format understood by the child were observed in over 80 % across teachers and \ goal domains. But because these teachers received COMPASS that targeted the development of an EBP-informed goal setting and intervention development activity, scores were at ceiling at baseline and remained there at the final coaching session. Further, across teachers and goal domains, consistent areas of weakness were also noted. Ability to allow sufficient response time was infrequently implemented at coaching 1. Similarly, only about a quarter of teachers provided reinforcement. Similar to these findings, in a study of evaluating teachers' ability to implement the EBP, pivotal response training, Suhrheinrich et al. (2017) also observed a need for teachers to have additional training in reinforcement.

The areas of strength and challenges were similar when analyzed by goal domain, with the exception of one element - obtaining and maintaining student attention for social skills. About 40 % of goals in social skills demonstrated this element, whereas about 75 % of goals for communication and learning skills demonstrated this element. We observed during coaching sessions that teachers often had a difficult time developing a teaching plan for social skills, especially for objectives that required the student to learn to initiate a skill, such as asking for a turn and playing a game with a peer. Often teachers were better able to generate plans that were based on adult-directed instruction. But teaching plans based on skills of child-initiation were challenging. Nevertheless, the findings indicate areas that teachers would benefit from further training such as allowing time for the child to respond and providing clear reinforcement.

The findings that the CETS is not internally consistent or intercorrelated at the item level suggests that teachers may use certain elements but tend not to view them or use them together or in a sequence. Teachers' use of systematic and explicit instruction with fidelity is clearly a gap. Although COMPASS coaching sessions were designed to support teachers with the implementation of teaching plans, these findings identify specific behaviors that require more intensive instruction and support during coaching.

Significant improvement in overall adherence to CETS was observed from the first to the last coaching session within COMPASS. The coaching sessions featured serial performance feedback of intervention fidelity and corrective suggestions for improvement. Areas of strength were teachers' ability to improve in maintaining student attention, wait time, and follow-up prompts. Because all the teachers received COMPASS, scores were high at time 1 and maintained at time 2 (over 90 %). For the other area that failed to show improvement, reinforcement, scores were less than 40 % at time 1 and 2. The findings suggest that coaching sessions should provide greater emphasis on fidelity for the use of reinforcement. Nevertheless, the findings demonstrate that COMPASS coaching is sensitive to the features within the CETS and can potentially lead to increased use of teaching behaviors associated with recommended practices for teaching students with autism (e.g., increased time to respond, providing reinforcement).

Most importantly, the findings suggest that the CETS is associated with student engagement and student IEP outcomes. The significant correlations between CETS scores and observations of engagement indicate that teachers who demonstrate higher scores for CETS, also have students who are more engaged and make more progress on their goals. Analysis at the item level revealed that ability to obtain the child's attention and maintain it correlated with providing sufficient time for the child to respond. Further, these two items also were the only ones that correlated with child engagement. Thus, these particular elements of teaching fidelity may be most critical for student engagement that then leads to good IEP outcomes.

This study is unique in its attempt to demonstrate this connection to student IEP outcomes. The fact that teaching fidelity is related to better GAS outcomes is critical and relates to and expands on our prior work that IEP quality and fidelity of COMPASS teaching plans (other measures of fidelity) are related to goal attainment outcomes (Ruble et al., 2013; Ruble, Dalrymple et al., 2010). That is, we now have evidence that teaching fidelity evaluated as common elements is both impacted by COMPASS and has an impact on outcomes. Further, combined with our prior work, these data indicate that both non-specific or common elements and COMPASS (i.e., EBP; Ruble, McGrew, Adams, & Pinkman, 2019) specific elements can and do impact student outcomes. These findings are consistent with the larger literature on psychotherapy effectiveness and accentuate the utility of examining both general and specific elements of EBPs when attempting to understand effectiveness.

Overall, the use of CETS or similar instruments may be helpful tools for implementation science that is concerned with understanding the gap between research and practice (2009b, Odom, 2009a). One factor that impedes the use of EBPs in our classrooms is the large number of EBPs available. Being able to decide which EBP to apply for a particular student is challenging enough, but to be able to faithfully implement 27 EBPs is even more daunting. Our hope is that the use of CETS can serve as a feasible and usable measure that will assist with improving teaching fidelity and subsequent student educational outcomes. The CETS does not replace the need to assess EBP fidelity, both are necessary. However, because common factors likely explain more variance, their assessment is arguably more important yet rarely if ever attempted. CETS is one such promising attempt. Further work is needed to understand how common factors and EBP fidelity relate (or not) and which is more predictive of outcomes. A critical question remains: Does common factors adherence underpin EBP fidelity (as is often argued) or is their impact independent? In other words, do common factors, or features effective across different EBPs, correlate with the fidelity of specific EBPs or not?

In summary, the development of effective teaching plans is a complex task that could be made more feasible with the use of a framework for writing educational interventions such as common elements. Nevertheless, this study was limited in its relatively small sample size and also in the age group represented by the children with ASD in this study. Future research should include testing the

CETS in different samples and replicating the results. Without a range of ages, the study is not generalizable to all individuals with ASD. Our selection of common elements may have excluded items also important and in need of testing. Additional information on the usability, feasibility, and satisfaction of the measure with non-research samples is also needed.

CRediT authorship contribution statement

Lisa A. Ruble: Conceptualization, Methodology, Resources, Data curation, Writing - original draft, Writing - review & editing, Supervision, Funding acquisition. **Abigail M.A. Love:** Formal analysis, Investigation, Data curation, Writing - original draft, Writing - review & editing. **Venus W. Wong:** Formal analysis, Investigation, Data curation. **Jennifer L. Grisham-Brown:** Conceptualization, Writing - original draft, Writing - review & editing. **John H. McGrew:** Conceptualization, Resources, Writing - original draft, Writing - review & editing, Funding acquisition.

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