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Response Cards to Increase Engagement and Active Participation of Middle School Students With EBD

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Abstract

This study employed an A-B-A-B design to examine engagement and active participation among five middle school students with emotional/behavioral disorders (EBD) while using response cards for mathematics instruction. Students with EBD often exhibit off-task behaviors, which limit their engagement with classroom learning. This is of concern as students with EBD tend to have lower academic achievement compared with their peers and have shown a marked decline particularly in mathematics performance as they move from the elementary into secondary grades. When students have increased opportunities to respond (OTR)—through methods such as response cards—they are more likely to be engaged with and actively participate in instruction. In the baseline phase, students participated by traditional hand-raising. The intervention phase introduced the use of response cards. Visual analyses reveal that response cards increased the engagement of all participants. Findings were translated into the between-case standardized mean difference effect size estimates and the effect size was 1.3, suggesting that response cards may be an inexpensive and easily implemented method for increasing OTR for students with EBD.

Keywords

response cards, opportunity to respond, emotional/behavior disorders, middle school

Students with emotional/behavioral disorders (EBD) often have difficulty learning and interacting in socially appropriate ways in academic settings (Vaughn & Bos, 2011). It is common for students with EBD to demonstrate off-task and disruptive behaviors, which interfere with their learning (Kauffman & Landrum, 2013). Due to these behaviors, students with EBD participate in classroom instruction significantly less than their peers (Bradley, Doolittle, & Bartolotta, 2008; Mulcahy, Krezmien, & Maccini, 2014; Weeden, Wills, Kottwitz, & Kamps, 2016). This is concerning as active student participation increases positive student behaviors, such as engagement (Heward & Wood, 2015; Simonsen, Myers, & DeLuca, 2010). Engaged behavior will likely lead to decreases in disruptive behavior, which is associated with academic achievement (Heward & Wood, 2015). Students with EBD tend to exhibit off-task and disruptive behaviors, as compared with other disability categories, and evidence suggests that this group of students generally has lower levels of academic achievement and higher rates of drop out (Blackorby, Chorost, Garza, & Guzman, 2003, 2005; Bradley et al., 2008; U.S. Department of Education, Office of Special Education and Rehabilitative Services, Office of Special Education Programs, 2016). This study aims to address the need for instructional methods to promote engagement among students with EBD. As such, the purpose of the present investigation was to explore the utility of student response cards as method for increasing the engagement and active participation of middle school students with EBD. To extend the evidence base on students with EBD in middle school, we focus on mathematics instruction being delivered in a self-contained classroom setting.

Academic Performance of Students With EBD

On average, students with EBD perform 1.5 grade levels behind their peers by the end of elementary school (Kauffman & Landrum, 2013) and national data report that just 9% of students with disabilities are achieving at proficient levels in math

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by the end of middle school (National Assessment of Educational Progress, 2017), with students with EBD among the lowest performers (Ysseldyke et al., 2017). Recent national statistics further estimate that only 54.7% of students with EBD receive a regular high school diploma (U.S. Department of Education, Office of Special Education and Rehabilitative Services, Office of Special Education Programs, 2016). Students who drop out are more likely to be involved in the criminal justice system and be under-/unemployed (Sanford et al., 2011). Yet, little is known about the middle school years for students with EBD, as intervention research for this population remains scarce (Lane, 2004; Mulcahy et al., 2014, 2016).

Research has consistently reported that students with EBD struggle across all academic areas, but demonstrate more rapid decline in mathematics performance. For instance, in a cross-sectional study of students with EBD in kindergarten through 12th grade, Nelson, Benner, Lane, and Smith (2004) found that levels of reading and written language performance remain low but stable across grade levels. However, their findings revealed a significant decrease in math performance over time. Lane, Barton-Arwood, Nelson, and Wehby (2008) reported performance below the 25th percentile in reading, writing, and math for students with EBD in elementary and middle school. Similar to Nelson et al. (2004), they noted substantial differences in math performance between elementary and secondary students ($SE = -2.23$). These findings make it clear that promoting engagement in mathematics instruction may be of particular concern for students with EBD.

Behaviors of Students With EBD That Influence Academic Performance

Engagement

Considering these academic deficits, researchers are interested in specific factors that may address the needs of students with EBD. One factor that has been found to be important for student learning is engagement (Kortering & Christenson, 2009; Mulcahy et al., 2014). There is evidence that increased academic engagement is associated with decreased disruptive behavior (Heward & Wood, 2015). Disruptive behavior is frequently observed among students with EBD (Kauffman & Landrum, 2013), and is a behavior often dealt with by removal from the classroom or using suspensions (Theriot, Craun, & Dupper, 2010). Not surprisingly, student engagement is also strongly associated with academic performance (Hattie, 2012). Students with EBD who exhibit low levels of engagement are often seemed to lack skill development and content knowledge acquisition (Kauffman & Landrum, 2013). These skill deficits, combined with missed instructional time in response to disruptive behaviors (Weeden et al., 2016), emphasize the critical need for students to be actively engaged in classroom learning.

Active Participation

Empirical and theoretical research supports the assertion that learning is improved with the rate that students are able to respond actively and be engaged with instruction (Dewey, 1916; Tincani & Twyman, 2016). The positive correlation between active participation and improved academic performance has been found to be both stable and robust across 40 years of empirical research (Heward & Wood, 2015). Such methods increase academic performance and decrease problem behaviors (Hattie, 2012). Research suggests engaging students through participation as an effective instructional practice that shows effects for decreasing disruptive behavior (Menzies, Lane, Oakes, & Ennis, 2017). With increased time to actively respond to instruction, there are fewer opportunities for students to engage in off-task, disruptive behavior (Singer, Crosland, & Fogel, 2013). Particularly for students with EBD, a need exists for interventions that provide students with frequent opportunities to respond (OTR) actively to teacher instruction, which supports both active engagement in appropriate behavior and learning.

OTR are created within a teacher-directed instructional plan (i.e., materials, questioning, prompts) that produces active participation by providing students with routes to generate answers or respond to instruction in the classroom (Cappizzi, Wehby, & Sandmel, 2010; Greenwood, Delquadri, & Hall, 1984). OTR can increase engagement, academic outcomes, and reduce problem behaviors (Schnorr, Freeman-Green, & Test, 2015). Evidence indicates that increased levels of teacher-directed OTRs for students with EBD yield positive effects on academic and behavioral outcomes, including increased engagement (MacSuga-Gage & Simonsen, 2015; Sutherland & Wehby, 2001). The present study focuses on one instructional tool—response cards—as a potential method to increase OTR and, therefore, engagement for middle school students with EBD during mathematics instruction.

Response Cards as an Instructional Tool

Student response cards provide a potential method of active participation that increases attention and has shown to decrease disruptive and off-task behavior for students with EBD (George, 2010). They can be held up simultaneously by individual students as a means of responding to a question or problem presented by an instructor (Narayan, Heward, Gardner, Courson, & Omness, 1990). Response cards give students an equal opportunity to participate actively in their own learning process and minimize the occurrence of answers by only a few students in a classroom.

Current research illustrates that response cards (e.g., white tile boards, premade cards, electronic responders) can be an effective method for increasing active participation for students with and without disabilities over the broad range of ages and development (Horn, 2010; Randolph, 2007; Schnorr et al., 2015). Several studies have investigated middle school students, self-contained settings, and/or math achievement (Berrong, Schuster, Morse, & Collins, 2007; Davis & O'Neill, 2004; Horn, Schuster, & Collins, 2006; Lambert, Cartledge, Heward, & Lo, 2006; Maheady, Michielli-Pendl, Mallette, & Harper, 2002). Overall, these studies illustrated (a) increased engagement, active responding, skill acquisition, and accuracy of responses; (b) gains in academic achievement; and (c) decreases in off-task and disruptive behavior.

Although a majority of studies investigating response cards include at least one participant with behavior problems, only one published study focused exclusively on a population of students with EBD. George (2010) examined response cards with middle school students with EBD in five emotional support classrooms during social studies. A within subjects cross-over design was used to determine effects. Two of the five classrooms were randomly assigned to the response card condition whereas the other three continued to use the traditional hand-raising procedure. After 10 sessions, groups received the opposite condition and data were collected for 10 additional sessions. Results indicated that students' on-task behavior was at acceptable rates and high during both conditions with only slightly better performance during response cards (M = 84% during hand-raising; M = 93% during response cards). Consistent with other studies (Cakiroglu, 2014; Clarke, Haydon, Bauer, & Epperly, 2016), academic responses increased during response card conditions (M = 84%) as compared with hand-raising (M = 31%). Furthermore, there was no significant difference in academic posttest scores (M = 66.27 during hand-raising; M = 75.82 during response cards).

Purpose of the Current Study

Adolescents with EBD are failing to meet established curriculum standards across subjects' areas. As students with EBD transition through middle school, research has illustrated that academic deficits grow in mathematics (Lane et al., 2008; Stevens, Schulte, Elliott, Nese, & Tindal, 2015; Temple-Harvey & Vannest, 2012). Thus, middle school years are crucial to equip students with supports that engage them with instruction. Targeting engagement through active response methods (i.e., response cards) has potential for improving outcomes for students with EBD (George, 2010). Previous research has shown response cards to be effective across grade levels and disability types; no study is yet to explore the utility of response cards for middle school students with EBD in a self-contained setting during math. This is concerning given the high drop-out rates and low math achievement for this population. Often having greater academic deficits, engaging students with EBD served in self-contained setting is a critical need (Carr-George, Vannest, Willson, & Davis, 2009). Students with EBD participate in classroom instruction less than their peers (Bradley et al., 2008), especially in segregated settings where the primary focus tends to be behavioral interventions (Mulcahy et al., 2014). The purpose of the present study is to replicate findings under these conditions. We posed three research questions:

Research Question 1: Does the use of response cards increase the individual engagement of middle school students with EBD during mathematics instruction?
Research Question 2: Does the use of response cards increase the small group engagement of middle school students with EBD during mathematics instruction?
Research Question 3: Does the use of response cards increase the small group active participation of middle school students with EBD during mathematics instruction?

Method

Study Procedures

After obtaining university and district permission, a middle school (Grades 5–8) in an urban school district was randomly selected for participation. The authors contacted and met with the principal to obtain permission to contact teachers in the school. Three teachers were contacted through email and two responded. The primary investigator (PI) met with the two teachers and obtained both teacher consents. Between the two classrooms, nine parent consents were sent home with students who met inclusion criteria. After 3 days, six consents had been returned: five in one classroom and one in the other. The PI excluded the teacher in the classroom with only one returned parent consent and proceeded to assent the children in the classroom with five participants. Assents were obtained one-on-one with the students and PI outside the classroom. All five students provided assent.

Participants and Setting

The procedures were implemented in a middle school, multigrade, self-contained classroom during math. The middle school was Title I and located in the southwestern United States. Participants included five male students ranging from ages 12 years to 14 years and in sixth through eighth grades. Three students were Black and two students were White. The participants were identified as EBD by a multidisciplinary school team. To be included in the study, students had to be enrolled in a self-contained EBD classroom at least 4 days a week for mathematics instruction. Students were excluded from the study if they had a cognitive impairment listed on their individualized education plan (IEP).

The teacher was certified in special education. He was a Black male, with over 10 years of teaching experience. During the study, the teacher continued to use the same classroom management techniques and no changes to the setting were requested beyond the use of response cards during instruction. No identifiable curriculum was being taught. Instead, the teacher designed lessons with opportunities for repeated practice on algorithms. The instructional format used was whole group with no time allocated to small groups or individualized instruction. Research has noted that this context (e.g., whole group) has often been observed for instruction of students with EBD (Hayling, Cook, Gresham, State, & Kern, 2008). Observational studies indicate that students with EBD rarely receive evidence-based practices, including self-contained settings (Maggin, Wehby, Partin, Robertson, & Oliver, 2011; Scott, Alter, & Hirn, 2011).

Measures

We focused on two dependent variables of interest to the intervention: engagement and active participation. As the primary variable of interest, *engagement* was defined as (a) actively answering teacher questions either by hand-raising or writing down a response, (b) looking at the teacher while instructions are being given, and (c) looking at other speakers if they are answering the teacher's question. Engagement was not coded if the student demonstrated off-task behavior. This included (a) physical movement that is not directed by the teacher, (b) gazing longer than 10-s in places other than where the instruction is taking place, (c) using response cards in ways other than writing the response to the teacher's questions, (d) getting out of one's seat without teacher permission, (e) talking out of turn, (f) putting hands on other students, (g) throwing or using materials in unintended ways, (h) drawing on response cards, and/or (i) yelling/aggressive responses.

Our second dependent variable, *active participation* was defined as academic responding by either hand-raises or shown response cards and had to occur within 10-s after a question was asked by the teacher. Active participation was coded within three categories: hand-raising, response cards, or nonresponses. Hand-raising had to occur (a) after teacher questions, (b) before another student answers, or (c) before the teacher supplies the answer. Response cards had to occur (a) after the teacher asks the students to write down the answer, and (b) after the teacher tells the students to reveal their response. Nonresponses were defined as responses that occurred (a) before the teacher asked the class to show their response, and (b) after the teacher supplied the answer.

Observations. Observations occurred 5 days a week during math lessons over the course of 1 month. Individual engagement was recorded using a partial interval recording system and MotivAiders, small battery-operated devices, which are programmed to vibrate at predetermined time intervals. For the present study, the MotivAiders were set to vibrate at 20-s intervals during a 15-min period. The observations rotated between participants systematically every 20-s until the end of the 15-min observation period. If a participant was not engaged, as evidenced by off-task behavior, during any of their specified observation interval, the interval was coded as off-task and marked by a "1." If a student was engaged for the entire interval and no off-task behavior occurred, a "0" was coded for that interval. To calculate the individual engagement score, the number of intervals engaged was divided by the total number of observed intervals for that participant and multiplied by 100. To calculate the small group engagement percentage, the number of total engaged intervals (across all participants) was divided by the total number of observed intervals and multiplied by 100.

For active participation, frequency counts were recorded for the number of hands raised or the number of boards held up after questions were asked. The number or responses counted was written next to a number indicating what number question the teacher asked. This served purposes of keeping track of how many questions were asked per each observation period. The number of responses was divided by the number of possible responses (number of students present multiplied by total number of questions posed) and multiplied by 100 to determine the percent of small group active responses during the 15-min observation period.

Observer training. The PI and three graduate research assistants (RA) pursuing their master's degree in special education with a concentration in EBD served as observers. The PI trained the observers on the data collection procedures and provided the operational definitions. Training occurred prior to classroom observations. Operational definitions were reviewed with opportunities to ask questions. Several example classroom scenarios were supplied in which observers identified what code would be marked. Examples were given until the RAs coded five consecutive prompts correctly. Each RA was given the opportunity to practice the recording systems during a math lesson. Interobserver agreement (IOA) was collected for practice sessions. An IOA percentage of 85% or higher had to be achieved for the RA to begin collecting data for the study.

Experimental Design

An A-B-A-B design was chosen for this study (Kennedy, 2005). This is the primary design used in single-case methodology in which participants serve as their own control (Kennedy, 2005). We considered individual responses to determine the overall effectiveness of an intervention. Data

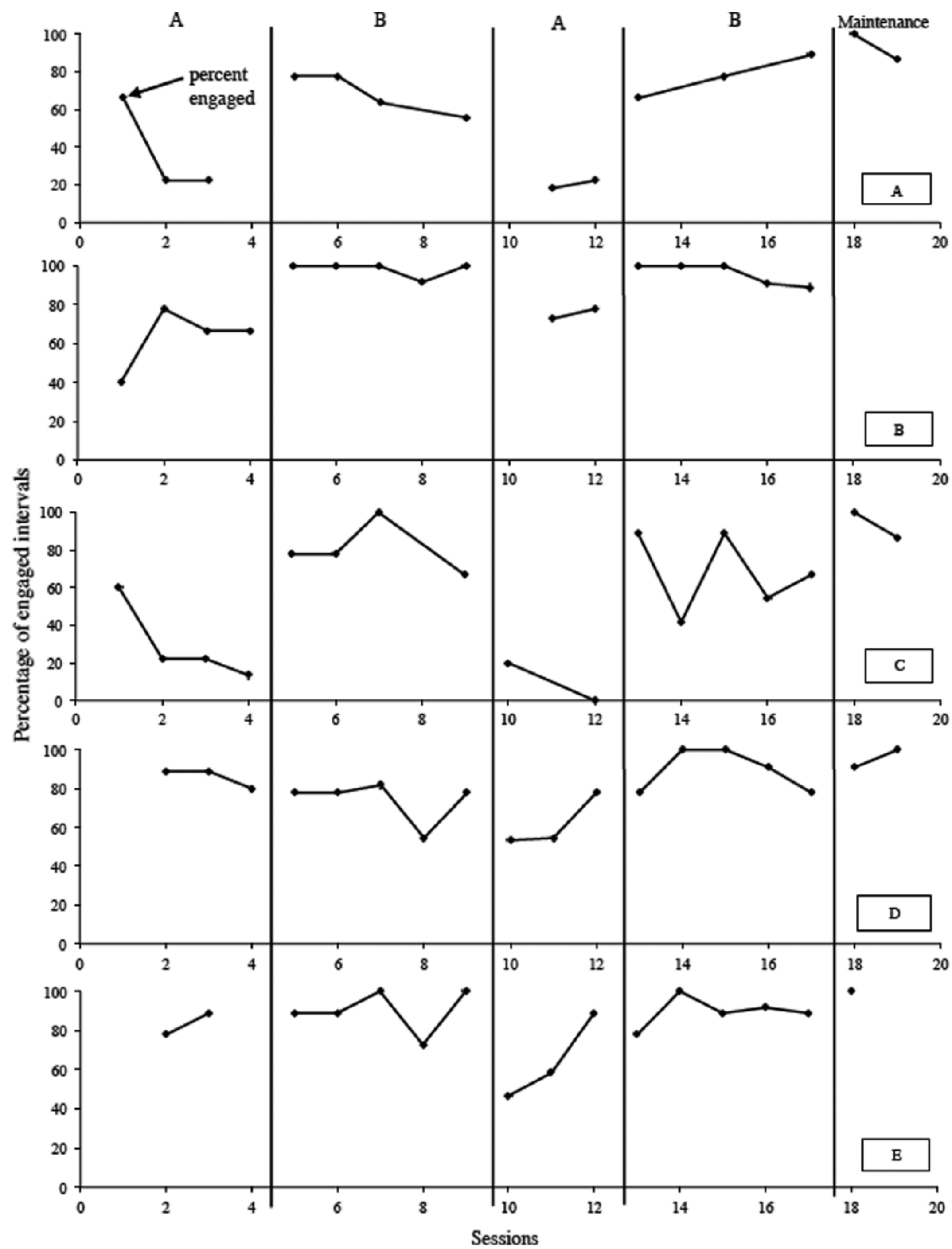

Figure 1. Individual engagement.

are provided for both individual performance and small group (see Figures 1 and 2). For the small group data, the percent of intervals engaged and the percent of active responding were averaged across all participants for each session.

Measurement during phases (A or B) continued until the pattern of responding was stable and consistent to predict future responding if conditions remained the same (Horner et al., 2005). *Stable and consistent* was defined as having a predictable pattern related to trend, level, and variability such that if the study phase was extended there is enough evidence available that it would be collectively assumed that the student would continue responding at a similar level and trend

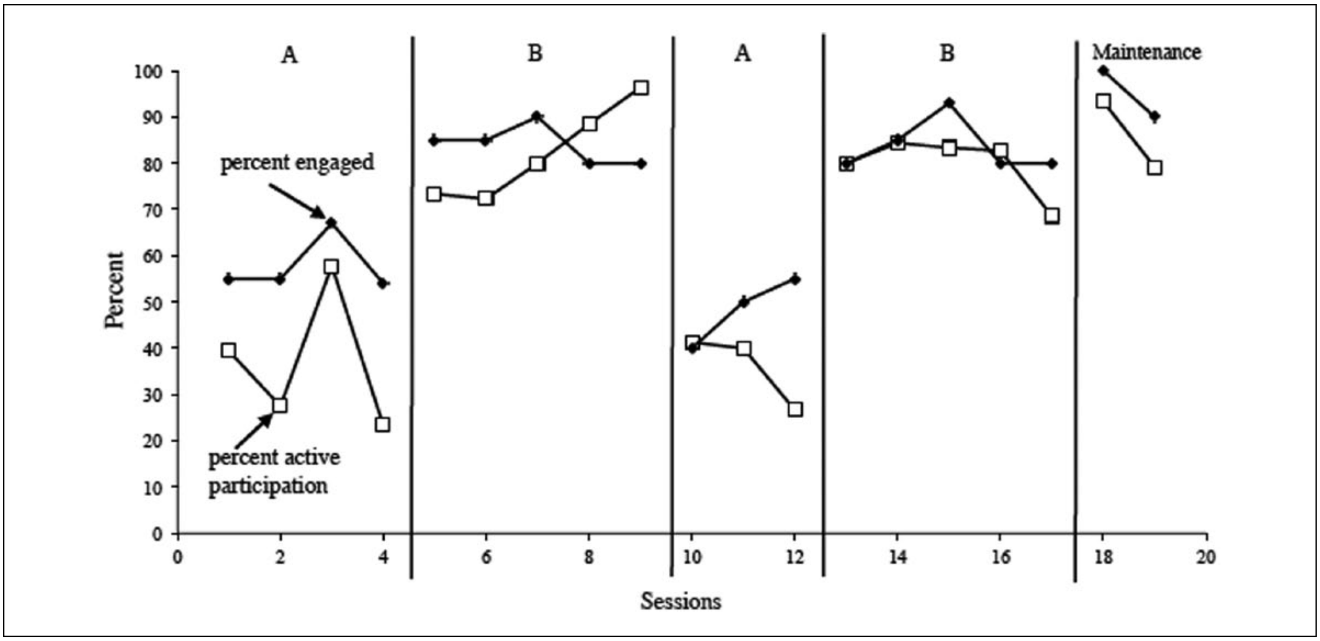

Figure 2. Average whole class engagement and active responses.

(Cooper, Heron, & Heward, 2007; Gast & Ledford, 2014; Kennedy, 2005). Baseline logic elements were used to determine that the response cards produced an effect (Cooper et al., 2007; Tincani & Travers, 2018): *verification*, the baseline behavior would remain the same had the independent variable not been introduced; and *replication*, obtaining similar results on repeated iterations to determine reliability.

Although visual analysis is available for both individual and small group, decisions pertaining to phase changes were made based primarily on the small group data, with consideration given to both engagement and active participation. As the intervention was delivered to the whole class, it makes sense to make decisions on group data. The small group data illustrated experimental control across participants and phase changes. Due to the decision to change phases based on the small group data, analysis of individual data illustrate that experimental control was obtained for three out of the five participants.

Although five data points of measurement of the dependent variable is typically recommended, three data points per phase is acceptable (Kennedy, 2005; Kratochwill et al., 2013; Reichow, Volkmar, & Cicchetti, 2008). Considering the well-established research base and stability of the levels of the small group data, less than five data points were used in some phases. As stated earlier, students with EBD are often removed from instruction due to disruptive behavior. Particularly in this study, participating students had high levels of absences due to school suspensions. As a result, Phase A included four baseline sessions, which were conducted when the teacher delivered a math lecture in the conventional format of hand-raising. Phase B included five sessions in which students responded using the response cards. This phase was followed by a second baseline (A) phase that lasted for three sessions followed by a second experimental (B) phase that lasted for four sessions.

Baseline (A). During the baseline condition, the teacher provided instruction during math lessons and students were expected to respond to questions by raising their hands and waiting to be called on by the teacher. The teacher was asked to pose a minimum of 10 questions during the 15-min observation period. Questions focused on content being covered in the current class period. Content differed daily but the majority of lessons were focused on fractions. No other curricular changes were requested.

Intervention (B). During this condition, the teacher presented questions to the students in the same way as in the baseline condition, except all students were asked to respond with response cards. The response cards used in this study were 9 × 13 inch white tile boards provided by the PI. Students were given boards and one black, dry-erase marker. Boards were distributed by the teacher before time of use and collected at the end of the lesson.

The teacher was again asked to supply a minimum of 10 questions over a 15-min time interval. Students were instructed to write their answers on their individual boards, place the marker back on their desk when finished, and then simultaneously present their answers when cued by the teacher, "Show your answers."

Training. Prior to the start of the first experimental (B) phase, training procedures occurred for the teacher. The teacher was trained by the PI using a direct instruction approach through explanation, modeling, practice, and feedback on how to teach with response cards. He was observed teaching a lesson incorporating response cards by the PI in a social studies lesson. The teacher reported that he was comfortable, and the PI determined satisfactory performance based on all components of a predetermined checklist. Following the teacher training, students were instructed on the use of response cards during a math lesson also using direct instruction through explanation, modeling, practice, and feedback. Examples and nonexamples of proper usage were provided. This lesson lasted 30-min and was taught by the teacher with minimal assistance from the PI during a math lesson.

Replication. Visual analysis of stability and trend was consulted daily to assess when phase changes were to occur. The response cards were withdrawn during the second baseline phase (A) and the teacher returned to providing instruction in the same manner, and students were asked to respond with hand-raises. The teacher was again asked to provide a minimum of 10 questions over a 15-min time interval. The teacher asked for a response from one of the children who had raised a hand voluntarily. Finally, to illustrate experimental control and replication of effects, the response cards were reintroduced for the second intervention phase (B) and the teacher presented questions to the students the same way as in the prior response card phase.

Maintenance. At the end of intervention, the PI informed the teacher the study was completed. The teacher kept the white tile boards and was allowed the option to continue using them without researcher observation. Two weeks after the intervention was complete, the observers reentered the classroom for 2 consecutive days to observe whether the boards were still being used. Data were collected on the students' engagement and academic participation. During this time, the teacher was observed using the response boards.

Implementation Fidelity

IOA. RAs collected IOA data at least 25% of each phase. To obtain IOA, RAs counted the number agreements and the number of disagreements. The percent of IOA agreement was calculated by dividing the total number of intervals by the number of agreements and multiplying by 100. Mean IOA for coding engagement during the initial baseline phase was 89.58%. Mean IOA for coding active participation during the initial baseline phase was 100%. When the intervention was implemented, mean IOA for coding engagement was 97.78%. Mean IOA for coding the active participation during the initial intervention phase was 100%. During the second baseline phase, mean IOA for coding engagement was 97.78%. Mean IOA for coding the active participation in the second baseline phase was 100%. The mean IOA for coding engagement during the final intervention phase was 97.78%. Mean IOA for coding active participation during this intervention phase was 100%.

Procedural fidelity. The PI and RAs completed procedural fidelity sheets after each session. The procedural fidelity sheet consisted of six statements in which the researcher had to answer "yes" it occurred or "no" it did not occur: (a) teacher asks a minimum of 10 questions in math lessons; (b) students are prompted to respond via response cards; (c) students are supplied with white laminated tile boards and a dry-erase marker; (d) If applicable, boards remain under their desks until asked by teacher to retrieve them for the question and answer portion of the lecture; (e) students prompted to write their answers on their boards, cover up their answer until the teacher asks them to reveal their answers simultaneously; (f) PI/RA counts the number of boards/hands and records it on a data collection sheet; and (g) PI or RA collect data using the partial interval system. During baseline phases, only the first three questions were relevant. Procedural fidelity was collected after every session across every phase.

Social validity. The *Intervention Rating Profile-15* (IRP-15; Martens, Witt, Elliott, & Darveaux, 1985) was used to assess social validity to determine whether the teacher believed the intervention was socially appropriate. It is a 15-item questionnaire obtaining information regarding appropriate classroom interventions. A high score on the questionnaire indicated an intervention with high social validity. It was given to the teacher prior to the beginning of the study and at the completion of the study. When introduced to the intervention, the teacher thought that it would be an acceptable intervention and that it matched the replacement behaviors needed in the classroom. On the IRP-15, the teacher rated 73 out of 90, agreeing that it would be a socially valid intervention for the classroom. At the completion of the study, the teacher was reassessed and rated the intervention 75 out of 90, still viewing it as a valuable tool for classroom management.

Data Analysis

To estimate treatment effects, between-case standardized mean difference effect sizes were calculated (Pustejovsky, 2016). These effect sizes make it possible to assess magnitude and direction of effect (Valentine, Tanner-Smith, Pustejovsky, & Lau, 2016). The model tested used restricted maximum likelihood estimation, selected for efficiency and precision (Pustejovsky, Hedges, & Shadish, 2014). Furthermore, the model run does not allow for random

Table 1. Individual Student Engagement Across Conditions, Mean and Standard Deviation.

	A		B		A		B	
Participant	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
A	37.04	25.66	54.94	11.34	20.20	2.86	77.78	11.11
B	62.78	13.91	98.33	3.33	75.25	3.58	95.96	5.58
C	29.44	18.01	80.56	12.11	10.00	14.14	68.13	20.9
D	85.93	4.19	73.94	9.83	61.83	11.25	89.29	11.15
E	83.34	7.86	90.10	10.01	64.63	17.80	89.47	7.95

variation of treatment effects. To ensure this approach was adequate, moment estimation methods were also used (Hedges, Pustejovsky, & Shadish, 2012, 2013) to compare the results to the restricted maximum likelihood estimation without random effects model. Moment estimation methods require restrictive assumptions, such as the absence of trends within phases (Valentine et al., 2016). Accordingly, if effects are similar between models, it can be assumed that effects did not vary across participants. The models were run to compare baseline to intervention conditions for individual engagement data.

Results

To address our research questions, data points were graphed and visual analysis was conducted. Figure 1 shows the percentage of engagement for individual participants across all baseline and intervention sessions. The means and standard deviation for individual student participants across all sessions are shown in Table 1. Figure 2 shows the percentage of engagement and active participation for the small group across experimental sessions. First, we describe the overall conclusions of the individual participant results. Next, we report the between-case standardized mean difference effect size. Finally, our results conclude with a description of the results for the small group.

Individual Performance

Engagement for Participants A, B, and C increased when response cards were used and decreased during baseline conditions. Data for Participant D revealed that during the initial introduction to the intervention (B), overall engagement decreased from an average of 85.93% (SD = 4.19) during baseline (A) to an average of 73.94% (SD = 9.83). When the response cards were withdrawn (A), engagement decreased further with an average of 61.83% (SD = 11.25). However, there was a notable increase in engagement when the intervention was reintroduced (B), with an average of 89.29% (SD = 11.15). For Participant E, while descriptive data illustrate that performance was higher during response card phases (M = 89.77) compared with baseline (M = 72.11), visual analysis of the data show an upward trend during the second baseline phase (A). Sessions 10 and 11 weight the overall percentage of engagement during this phase. Engagement levels are similar to overall levels by Session 12.

Effect sizes. Findings were translated into between-case standardized mean difference effect sizes (Hedges et al., 2012, 2013) to analyze the effect of response cards on individual students' engagement compared with hand-raising conditions. For the data from this study, using restricted maximum likelihood estimation without a random effect for treatment phase level yields an effect size estimate of 1.3 ($p < .00$) with a standard error of 0.31 and a 95% CI of [0.76, 1.95]. For this data set, moment estimation yields similar results with between-case standardized mean difference effect size of 1.37 with a standard error of 0.38 and a 95% CI of [0.77, 2.17]. The similar effect size between the two estimates indicates that the basic model, which assumes treatment effect does not vary across participants, is an acceptable method for these data.

Small Group Performance

During the baseline phase (A), the percentage of intervals where the group demonstrated engagement averaged 55.56% (SD = 1.82), with a range of 53% to 57%. The trend of time engaged was stable across baseline data points determined by the restricted range. When the response card intervention was introduced (Phase B), there was a marked increase in the percent of engaged intervals for the group, averaging 83.11% (SD = 2.98) and ranging from 80% to 86%. The trend of time engaged was stable across intervention data indicated by the restricted range and leveled slope. When the intervention was withdrawn (A), the percent of engaged intervals for the group averaged 47.41% (SD = 6.79), with a range of 40% to 53%. The trend of time engaged increased slightly at the end of the phase to match original baseline levels but still remained well below response card levels of engagement. When we attempted replication by reintroducing the intervention (B), the increase in behavior was once again observed. The percent of engaged intervals for the group averaged 84.44% (SD = 4.80), with a range of 80% to 91% and similar stable trends were observed. Finally, across two maintenance data points, percent of engaged intervals for the group averaged 94.45%.

Figure 2 also shows the percentage of active participation for the small group across experimental sessions. During the baseline phase (A), the percentage of opportunities where the group demonstrated active participation averaged 26.13% (SD = 10.43), with a range of 14% to 39%. During Phase B, the percent of active participation for the group also increased, averaging 82.09% (SD = 10.26) and ranging from 72% to 96%. When the intervention was withdrawn (A) the percent of active participation for the group averaged 35.98% (SD = 8.09), with a range of 41% to 46%. When the intervention was reintroduced (Phase B), the percent of active participation for the group averaged 82.60% (SD = 1.87), with a range of 80% to 84%. During maintenance, the percent of active participation for the group averaged 85.75%.

Teacher Implementation

Across the initial baseline sessions (A), procedural fidelity was 91.50% and the average number of questions posed by the teacher in each session was 11. Across the first intervention phase (B), procedural fidelity was 96.66% and the average number of questions posed in each session was 12.80. For the second baseline phase (A), procedural fidelity was 88.89% and the average number of questions posed in each session was 11.67. During the final Phase B, procedural fidelity was 96.66% and the average amount of questions posed by the teacher in each session was 13.80. During maintenance, procedural fidelity was 100% and the average number of questions posed was 15.50.

Discussion

Among five middle school students with EBD, we examined student engagement and active participation when using response cards for mathematics instruction. Students with EBD often display a range of off-task behaviors, which limit their access to and interaction with classroom instruction (Weeden et al., 2016). This is of concern for students with EBD as their academic achievement tends to be lower when compared with their peers. Furthermore, students with EBD have shown a marked decline particularly in mathematics performance as they move from elementary into the middle and high school years (Lane et al., 2008; Temple-Harvey & Vannest, 2012). Past research has shown that traditional classroom instruction relies on passive responding, which is not likely to support on-task behavior for students with EBD. When students have increased OTR—through active methods, such as response cards—they are more likely to be engaged with and actively participate in their own learning (Tincani & Twyman, 2016).

The results from this single-case design align with previous research (e.g., George, 2010) and support the use of response cards as a method of increasing engagement for students with EBD in self-contained settings. Engagement has been shown to increase through methods that encourage active participation (Menzies et al., 2017) such as response cards. The data revealed that response cards did increase the engagement of all participants. However, the average engagement actually decreased for one participant (D) when he was initially introduced to the response cards (see Table 1). Interestingly, when the response cards were withdrawn, his behavior decreased further. When reintroduced to the response cards, his engagement increased and was at its highest level across conditions. Field notes stated that off-task behavior for this student primarily included drawing on response cards during instruction. In this case, it may be appropriate to use other classroom management strategies, such as reteaching behavior expectations, to provide further intervention for this student's engagement. Reteaching behavior expectations is identified as a supportive practice for students who display problem behaviors (Lewis, McIntosh, Simonsen, Mitchell, & Hatton, 2017).

The small group's engagement was 55.56% at baseline compared with 83.11% during the response card intervention. Further strengthening these findings, we were able to test replication through the use of an A-B-A-B design. Replication illustrated that the small group's engagement declined to 47.41% when the response cards were removed and students responded by hand-raising (baseline phase), and increased to 84.44% when response cards were reintroduced. Past research provides clear evidence that student engagement is related to academic achievement; and as such, this is of particular importance for students with EBD who tend to be at risk of both poor academic performance and high levels of off-task behavior (Hattie, 2012).

In addition to engagement, evidence from this study supports the use of response cards as a method of providing OTR for middle school students with EBD. We found that, during the intervention phase, use of response cards increased the small group's active participation when compared with the more traditional method of hand-raising that was used in the baseline phase. Specifically, the small group's average of active participation increased from 21.33% at baseline to 82.09% during the response card intervention. Replication illustrated that the small group's average active participation declined to 35.98% of total opportunities given to respond when the response cards were removed and they returned to hand-raising (baseline phase). The increase in active participation was replicated when response cards were reintroduced, with an average of 82.60% for the group. Active participation is positively related to improved academic performance (Heward & Wood, 2015). When students, particularly those with behavior concerns, are actively participating, they have less opportunities to be off-task or disruptive (Singer et al., 2013). These findings provide evidence that response cards support students with EBD in moving from passive to more active participation during mathematics instruction.

Interestingly, it was noted that the number of questions provided by the teacher increased during each of the intervention phases. This provides evidence that not only are students engaged and actively participating while using response cards, but teachers may also increase OTR. It is possible that the teacher felt encouraged to ask more questions when the students were actively engaged in instruction. Another possibility is that the teacher had more time to ask questions during instruction due to reduced time correcting problem behavior. To answer these questions, further exploration is required.

Implications for Practice

Without effective supports or training, teachers report frustration in teaching students with EBD. Few teachers of students with EBD are implementing evidence-based practices to support their students (Bradley et al., 2008; Maggin et al., 2011). Teachers' instructional behaviors, such as providing frequent OTR, have strong associations with student behavior and achievement (Sutherland, Lewis-Palmer, Stichter, & Morgan, 2008; Toste, Vaughn, Martinez, & Bustillos-SoRelle, 2018). Response cards could function as a teacher-level intervention, influencing the amount of time they spent on task in their own instruction and the number of OTR provided, as well as student-level intervention to promote engagement and active participation.

This study investigated an inexpensive method for providing OTR and demonstrates the simplicity of using response cards as evidenced by the high levels of procedural fidelity maintained by the teacher. The materials to create response cards can be found in any public school (e.g., laminated paper, white tile boards, dry-erase markers). Response cards use readily accessible materials with existing curricula to generate improvements in behavior of students who tend to be less responsive to more traditional methods of instruction (Tincani & Twyman, 2016), and students with EBD were able to follow the expectations with ease. Response cards also have potential to improve other areas of teachers' instruction, such as pacing and checking for student understanding. Increased instructional pacing has been suggested to increase on-task behavior (Menzies et al., 2017; Sutherland, Alder, & Gunter, 2003) and checking for understanding allows the teacher to adapt instruction to meet students' needs in the moment. Further replication is needed to study the teacher level effects when response cards are used during instruction.

Limitations and Future Directions for Research

Although the current study provides promising results, there are several limitations that must be noted. First, academic performance data were not collected as this was beyond the scope of the present study—which focused on increasing engagement and participation to set the stage for good instruction. Second, the length of the study is relatively short (approximately 1 month). Therefore, we did not expect changes in academic performance to be discernable. George (2010) did not observe posttest score differences in social studies for students with EBD in self-contained settings within a similar time frame. Our goal was to replicate the use of response cards for increasing engagement and active participation as a first step to improve educational outcomes for students with EBD. Future research needs to apply academic components within the research design to replicate effects on accuracy of academic responses in mathematics.

Social validity data were only collected from the teacher. Although the teacher reviewed response cards positively, there is no information on the students' level of satisfaction with response cards. Middle school students with EBD are the primary subjects of the research and social validity is not representative of their needs. Previous research (Cakiroglu, 2014; George, 2010) has reported that students prefer response cards as compared with hand-raising to answer teachers' questions. Future replications of response card use with middle school students with EBD should include a student social validity measure.

In addition, our study is limited by the number of sessions chosen in each phase. Five is the preferred number of sessions per each study design phase (Kratochwill et al., 2013) to allow enough data to determine stable patterns in level and trend, which would better demonstrate experimental control. What Works Clearinghouse Standards for single-case design state that at minimum phases should include three data points (Kratochwill et al., 2013). The smaller number of data points per phases reduces the confidence that a pattern of data has been established. For the current study, three and four points were used during baseline phases. This decision was primarily based on visual analysis of the small group data. The drastic change in levels for both engagement and active participation established evidence that a predictable pattern of responding was present. Certainly, our design could have been strengthened if phases were extended to five data points, however, it is in our opinion that experimental control was established.

Due to the nature of single-case research, our sample size was small. Caution should be taken when generalizing the results to all middle school students with EBD. Also, we were unable to obtain participant information in regard to students' current academic or social functioning further making the extent results are generalizable to a larger population questionable. Also, the intervention took place during one activity period (i.e., mathematics). Testing the effectiveness of response card use in other core subjects and across the school day for this population and setting will further add value to the literature. With small population sizes to determine how an intervention affects a particular population of students under specific conditions, replication research of single-case design is particularly important to determine an intervention's external validity (Travers, Cook, Therrien, & Coyne, 2016). Although the present study replicates effects of response cards on the engagement and active participation for a population of students with EBD, it is still important for future research to replicate our findings.

For future research, further exploration is needed to understand how instructional variables might influence the efficacy of response card use. As noted, response cards serve as an intervention to improve student behavior, as well as teacher behavior; as such, more data should be collected on instruction (e.g., quality, depth, and number of questions asked). Our results indicate that the teacher asked more whole-class questions during response card conditions compared with traditional hand-raising. Replications should continue to report the rate with which questions are presented, as well as other aspects of teacher behavior. It is possible that response cards require more thoughtful planning to incorporate their use into existing lessons or perhaps teachers are able to ask more questions because the time to address problem behavior has decreased.

The response cards in this study were "low technology" items. Response card systems that involve small devices (i.e., clickers) are available as a method of incorporating technology into instruction. Students respond to questions posed by the teacher with a clicker, and the results are calculated for projection onto a screen. Blood (2010) found increased active participation for secondary students with EBD in a self-contained setting during history instruction using clickers. Future research should consider the effects of using more technologically advanced systems as compared with low technology response cards to evaluate the overall cost-effectiveness of such systems. The potential and immediate data that these systems produce has high value for teachers' data-based decision making.

In sum, results from this study make a unique contribution to existing literature—evidence to support the utility of an instructional practice (e.g., OTR via response cards) that increases the engagement and active participation during whole-group math instruction for students with high behavioral needs. As demonstrated by high rates of procedural fidelity, social validity as rated by the teacher, and high levels of engagement and active participation maintained by students, response cards are an easily implemented whole-group intervention valued by the teacher. Furthermore, the intervention requires minimal training for teachers to execute the procedures effectively and is easily integrated into existing instructional lessons. Taken together, this study offers evidence for an intervention that has potential to increase the active engagement of students with EBD, a population of students at risk of negative academic outcomes.

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