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Providing Student Opportunities to Respond in Reading and Mathematics: A Look Across Grade Levels

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The evidence for providing sufficient opportunities for students to respond has been established in terms of student engagement and achievement in reading and mathematics. Although supported by research, the question remains whether teachers are incorporating this effective practice in their classroom instruction. This study examines the analysis of data from direct teacher observations during reading and mathematics instruction. Results from the analysis indicate that there is a statistically significant difference between teachers' rate of opportunities for students to respond across grade levels during mathematics and reading instruction. Although opportunities for students to respond rates across grade levels may vary, the rates at all grade levels are lower than recommended. Implications and areas of future research will be discussed.

Keywords: instructional strategies, mathematics instruction, opportunities to respond, reading instruction

Across the United States, there are consistently large numbers of students who are at risk for academic or social failure, or are already being served under the Individuals With Disabilities Education Act for identified academic or social failures. According to the "31 st Annual Report to Congress on the Implementation of the Individuals With Disabilities Education Act, 2009" (U.S. Department of Education, 2009), in 2007, 9% of the residential population of 5–21 year-olds were served under IDEA Part B in the United States. The largest disability category continues to be specific learning disabilities (43.6%), followed by speech or language impairments (19.2%), other health impairments (10.5%), intellectual disabilities (8.3%), and emotional disturbance (7.3%). Because Section 504 of the Rehabilitation Act of 1973 (U.S. Department of Education, 2007) requires students with disabilities to be placed in the least restrictive environment, this trend affects special education and general education teachers. Data from the U.S. Department of Education indicated that in 2008, 80% of all students with disabilities (6–21 years of age) spent at least some portion of their day in a regular education classroom, and 58% spent 80% or more of their day in a regular education classroom (Data Accountability Center, 2010).

Researchers have suggested there is a relation between inappropriate classroom behaviors and academic achievement (Nelson, Benner, Lane, & Smith, 2004; Sutherland & Wehby, 2001). For example, the reported prevalence rates of academic difficulties for students with emotional behavior disorder have ranged from 25% to 97% (Nelson et al., 2004). In addition, students with attention deficit hyperactivity disorder experience behavior difficulties that affect their academic success (Barry, Lyman, & Klinger, 2002; Zentall, 2007). Although it is not clear which causes the other, there is a reciprocal relation between behavior and academic achievement (Sutherland & Wehby, 2001). This makes it essential that both special education teachers and general education teachers implement evidence-based practices in an effort to make sure all students are successful academically and socially.

Two academic content areas that children who are at risk or already identified for special services have in the past struggled with are mathematics and reading. Between 5% and 8% of school-aged children have some form of memory or cognitive deficit that affects their learning of mathematics (Geary, 2004). According to Fuchs, Fuchs, and Hollenbeck (2007), this number has been steadily increasing since it first became recognized as a disability in 1975. In addition, many students with mathematics and reading disabilities have comorbid disorders (Geary, 2004). For example, Landerl and Moll (2010) stated that comorbidity rates across studies range from 17% to 70% for students with mathematics disabilities showing reading problems and 11% to 56% for students with reading disabilities showing problems in mathematics.

Recent reports of student performance suggest that although students are making progress in the area of reading and mathematics, there is still much work to be done to ensure that all students are making adequate progress.

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Results from the 2013 National Assessment of Educational Progress (National Center for Education Statistics, 2013) indicated fourth- and eighth-grade students are showing improvement on mathematics and reading assessments with the 2013 scores in mathematics being higher than in all previous years at Grades 4 and 8; and reading scores being higher in 2013 in comparison to all previous years at Grade 8, and all but 2011 at Grade 4. Although progress is being made, results show the percentage of fourth-grade students performing below the basic level of performance was 27% in reading and 14% in mathematics. When looking only at students with disabilities, the percentage of fourth-grade students performing below the basic level of performance was 69% in reading and 45% in mathematics. Results in eighth grade show that the percentage of all students performing below the basic level of performance was 18% in reading and 21% in mathematics, and the percentage of students with disabilities performing below the basic level of performance was 60% in reading and 65% in mathematics. Although there are signs of some progress, it is disturbing that the gap is becoming wider for students with disabilities.

With the documented struggles of students in mathematics and reading, it is critical that we identify variables that can increase the probability of student success in these areas. Student engagement can play a crucial role both academically and socially. Students who are engaged in the learning process are less likely to exhibit inappropriate behaviors and more likely to achieve academic success (Conroy, Sutherland, Snyder, & Marsh, 2008; Simonsen, Fairbanks, Briesch, Myers, & Sugai, 2008; Sutherland & Wehby, 2001). That being said, a traditional practice during instructional time consists of the teacher presenting or explaining information while the students are expected to sit quietly and listen. If the teacher provides students with opportunities to respond (OTR), it usually involves individual responses whereby one student actively responds to the teacher's question while the rest of the students are only passively involved (Armendariz & Umbreit, 1999). Furthermore, it has been suggested that higher achieving students are more likely to actively respond to the teacher's questions than are lower achieving students (Greenwood, Delquadri, & Hall, 1984).

One effective, evidence-based teaching practice that focuses on increasing student engagement and consequently reducing inappropriate behavior is providing students frequent OTRs within the classroom environment (Sutherland & Wehby, 2001). An *OTR* can be defined as the interaction between a teacher's academic prompt (i.e., verbal, visual, or written) and a student's response. According to Conroy and colleagues (2008, pp. 26–27), OTRs generally include the following components:

- Increasing rates of teacher instructional talk that includes repeated verbal, visual, or verbal and visual types of prompts for responding.
- Presenting information in a manner that increases student correct responding (e.g., "This is an A. What letter is this?").
- Implementing individualized instructional modifications appropriate for the students' level of functioning, along with frequent checks for understanding and accuracy.
- Using repeated instructional prompting that incorporates wait time to allow students to respond.
- Providing corrective feedback, error correction, and progress monitoring.

Research has suggested that increasing the rate of OTR improves students' academic performance (Christle & Schuster, 2003; Lambert, Cartledge, Heward, & Lo, 2006; Skinner, Belfiore, Mace, Williams-Wilson, & Johns, 1997; Skinner, Ford, & Yunker, 1991; Sutherland, Alder, & Gunter, 2003) increases student engagement during instruction (Carnine, 1976; Christle & Schuster, 2003; Davis & O'Neil, 2004; Haydon et al., 2010; Haydon, Mancil, & Van Loan, 2009; McKenzie & Henry, 1979; Sutherland et al., 2003), and decreases disruptive behavior during instruction (Armendariz & Umbreit, 1999; Haydon et al., 2010; Haydon et al., 2009; Lambert et al., 2006; Sutherland et al., 2003; West & Sloan, 1986).

Providing increased OTR also has the potential benefit of improving student-teacher interactions. A study conducted by Hamre and Pianta (2001), which followed students from Kindergarten to eighth grade, suggested that negative relations between teachers and students with behavior problems in Kindergarten are associated with academic and behavioral problems through eighth grade. In addition, instructional interactions between teachers and students with behavior problems consist of less than 30% of all teacher–student interactions and, of these interactions, students at risk for aggressive behaviors received low rates of praise while receiving high rates of reprimands (Van Acker, Grant, & Henry, 1996; Wehby, Symons, Canale, & Go, 1998). Sutherland, Wehby, and Yoder (2002) investigated the relation between teacher praise and OTR in classrooms and their findings suggest there is a significant positive relation between the two. Giving students with problem behaviors sufficient opportunities to respond can allow for positive reinforcement following a student response, which can lead to positive teacher–student interactions.

In addition to the social-behavioral benefits associated with increased OTR, there also are potential academic benefits in the areas of reading and mathematics. Because of national legislation and high-stakes accountability, teachers have been challenged to ensure all students are proficient in reading and mathematics. Incorporating OTR in mathematics and reading instruction can provide students with the means to communicate their knowledge and thought processes while giving the teacher an opportunity to formatively assess individual student learning. With increasing numbers of students with learning and behavioral disorders included in regular education classrooms, it is essential that both regular and special education teachers are provided with effective, evidence-based strategies to ensure that these students are successful academically and socially.

Purpose

Given that OTRs positively affect academic and behavior outcomes for students, examining the teacher's rate of

providing OTR during reading and mathematics instruction across grade levels would be beneficial for all educators who deliver reading and mathematics instruction. The primary purpose of this study is to examine whether there is a statistically significant difference between teachers rate of OTR during mathematics and reading instruction across elementary, middle, and high schools. The following research questions were explored:

1. Is there a statistically significant difference between teachers rate of OTR during mathematics and reading instruction across grade levels?
2. Is there a statistically significant difference between teachers rate of OTR during reading instruction across grade levels?
3. Is there a statistically significant difference between teachers rate of OTR during mathematics instruction across grade levels?

Method

Sample

The sample used for data analysis was part of a larger sample of data collected on 3,972 unique 15-min observations of teacher and student behavior between 2009 and 2012. Observations were conducted across various grade levels, in various classroom settings (e.g., general education, resource, self-contained), and during various academic content areas (e.g., mathematics, reading, social studies, science). Interobserver reliability was collected for more than 20% of the total number of observations, and the mean interobserver reliability rate was more than 90% with the range of 84% to 99% (Scott, Alter, & Hirn, 2011).

The present sample was comprised of 900 direct observations randomly sampled among 2285 unique observations of teacher behaviors in the general education classroom during reading and mathematics instruction across elementary, middle, and high school. To create equal groupings across grade levels in reading and mathematics for data analysis, a stratified random sample was used. The observations were divided into six groups by subject area and grade level (e.g., elementary reading, elementary mathematics) and 150 observations were randomly selected from each group ($n = 150$). The sample consisted of 18 elementary schools, 9 middle schools, and 7 high schools.

Measures

The dependent variable in this study was the rate of teachers' providing OTRs to groups of students. *OTR group* was defined as the teacher providing the group or class an opportunity to respond to a question or request. This included any instance where the teacher asked a question (e.g., "Who can tell me the answer?") or made a request ("Show me how you came up with that answer.") to prompt a student response that could be verbal, gestural, or an action (Scott et al., 2011). To be considered an OTR, the question or request had to be related to academic content and not for behavioral issues (e.g., "Why are you out of your seat?") or directions not related to the curriculum (e.g., "Get out a pen or pencil)."

Results

To answer the first question, we used a one-way analysis of variance to examine whether there was a significant difference between teachers rate of OTR during mathematics and reading across grade levels. The independent variable represented the three grade levels elementary, middle school, and high school. In addition, two additional analyses of variance were performed to examine whether there was a significant difference between teachers rate of OTR during reading instruction only and mathematics instruction only across elementary, middle, and high. Given that separate analyses of variance were performed, alpha levels were adjusted from .01 to .03 using a Bonferroni correction ($1–0.99^3$). A summary of mean rates of OTR across grade levels is presented in Table 1 and Figure 1 for reading and mathematics, mathematics only, and reading only.

Rates of OTR in Mathematics and Reading Instruction Across Grade Levels

For both reading and mathematics instruction combined, rates of teachers providing group OTR decreased as the grade levels advanced. Elementary teachers averaged 0.68 OTRs per minute (1 every 1.4 min); middle school teachers averaged 0.65 OTRs a minute (1 every 1.54 min); and high school teachers averaged 0.47 OTRs a minute (1 every 2.13 min). To determine whether there was a statistically significant difference between teachers rate of OTR during mathematics and reading, we performed a one-way analysis of variance. Levene's test revealed that the variances of OTR rates were homogenous among the groups ($p = .076$). Results from the analysis of variance, presented in Table 2, show that the obtained F value, $F(2, 897) = 7.774$, $p = .000$, was statistically significant at the .03 Bonferroni adjusted alpha level; therefore, there is a statistically significant difference in OTR rates across grade levels for reading and mathematics

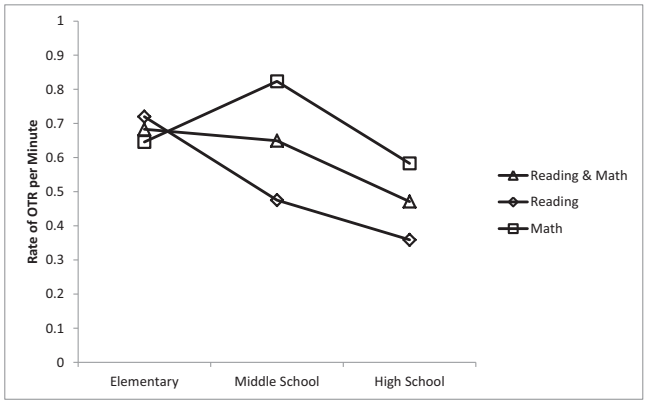

Fig. 1. Mean rate of teacher OTRs across grade levels. OTR = opportunities to respond.

Table 1. Mean Rate of Teacher Providing Opportunities for Students to Respond Across Grade Levels

	OTR group: reading and mathematics		OTR group: reading only		OTR group: mathematics only	
Grade level	*M*	*SD*	*M*	*SD*	*M*	*SD*
Elementary school	0.68	0.59	0.72	0.63	0.65	0.53
Middle school	0.65	0.60	0.48	0.42	0.82	0.70
High school	0.47	0.56	0.36	0.44	0.58	0.63
Total	0.60	0.59	0.52	0.53	0.68	0.63

Note. OTR = opportunities to respond.

combined. The effect size ($\omega^2 = .023$; $\eta^2 = .025$) estimates showed only 2% of the variance in OTR rates is accounted for by the differences in grade level, which is considered a small effect size (Cohen, 1977).

Post hoc tests among group means were carried out with Tukey's honest significant difference pairwise comparisons to determine whether there was any significant difference between any pairs of the three grade levels ($p = .03$ used as overall error rate). These results, displayed in Table 3, indicate the mean rate of OTR in elementary ($M = 0.68$) and middle school ($M = 0.65$) were both significantly higher than the mean rate in high school ($M = 0.47$). Effect sizes for both significant pairwise differences were small ($d = .37$; $d = .29$). Although there was a higher rate of OTR in elementary school than middle school, there was no significant difference detected.

Rates of OTR in Reading Instruction Across Grade Levels

As with reading and mathematics combined, rates of teachers providing group OTR during reading instruction only decreased as the grade levels advanced. Elementary teachers averaged 0.72 OTR s per minute (1 every 1.39 min); middle school teachers averaged 0.48 OTRs a minute (1 every 2.08 min); and high school teachers averaged 0.36 OTRs a minute (1 every 2.78 min). Because Levene's test revealed that the homogeneity of variance assumption was not met ($p = .000$), Welch's F test was used. The one-way analysis of variance revealed a statistically significant main effect, Welch's $F(2, 290.28) = 16.275$, $p = .000$, indicating that not all grade levels had the same average rate of OTR. The effect size ($\omega^2 = .06$) estimates showed only 6% of the variance in OTR rates is accounted for by the differences in grade level, which is considered a small effect size (Cohen, 1977).

We conducted post hoc comparisons, using the Games-Howell post hoc procedure, to determine whether there was any significant difference between any pairs of the three grade levels. The results, displayed in Table 4, indicate the mean rate of OTR in elementary ($M = 0.72$) was significantly higher than both middle school ($M = 0.48$) and high school ($M = 0.36$). Both significant pairwise differences had moderate effects ($d = .54$; $d = .65$). Although there was a higher rate of OTR in middle school than high school, there was no significant difference detected.

Table 2. Analysis of Variance Summary for Reading and Mathematics

Source	SS	*df*	*MS*	*F*	Significance *F*
Scores	7.774	2	3.88	11.464	.000
Error	304.166	897	.339		
Total	311.941	899			

Note. SS = sum of squares.

Rates of OTR in Mathematics Instruction Across Grade Levels

Rates of teachers providing group OTR during mathematics instruction showed a different trend than during reading instruction. Middle school teachers had the higher average rate of OTR per minute ($M = 0.82$; 1 every 1.22 min), followed by elementary school teachers ($M = 0.65$; 1 every 1.54 min), then high school teachers ($M = 0.58$; 1 every 2.72 min). Because the Levene's test revealed that the homogeneity of variance assumption was not met ($p = .004$), the Welch's F test was used. The one-way analysis of variance revealed a statistically significant main effect, Welch's $F(2, 294.055) = 5.149$, $p = .006$, indicating that not all grade levels had the same average rate of OTR. The effect size ($\omega^2 = .02$) estimates showed only 2% of the variance in OTR rates is accounted for by the differences in grade level, which is considered a small effect size (Cohen, 1977).

We conducted post hoc comparisons, using the Games-Howell post hoc procedure, to determine whether there was any significant difference between any pairs of the three grade levels. The results, displayed in Table 5, indicate the mean rate of OTR in middle school ($M = 0.82$) was significantly higher than high school ($M = 0.58$), with a small effect size ($d = .36$). Although there was a higher rate of OTR in middle school than elementary, there was no significant difference detected.

Discussion

Given the evidence that OTRs positively affects both academic and behavior outcomes for students, this study examined whether this evidence-based practice was being sufficiently provided by teachers across grade levels during reading and mathematics instruction. Results of the statistical analysis show that there was a statistically significant difference in overall rates of OTR across grade levels for reading and mathematics combined, reading only, and mathematics

Table 3. Pairwise Comparison of Mean Scores on the Basis of Estimated Marginal Means for Reading and Mathematics

			97% CI for difference[a]	
Comparisons	Mean difference	p[a]	Lower bound	Upper bound
Elementary school vs. middle school	.033	1.00	–.089	.156
Elementary school vs. high school	.212*	.000	.089	.334
Middle school vs. high school	.178*	.001	.056	.301

[a]Bonferroni adjustment for multiple comparisons.
*$p < .03$.

only. Further analysis showed that there was a downward trend in the overall rate of OTR and the rate of OTR during reading instruction across grade levels. Elementary teachers had the highest average rate of OTR, followed by middle and high school teachers. However, results did not indicate this to be true in mathematics. Middle school mathematics teachers not only had the highest average rate of OTR when compared with rates of mathematics teachers in elementary and high school, but the highest average rate of OTR overall when compared with the other conditions explored in the study.

At first glance, the comparatively lower rates of OTR provide by high school teachers may be a considerable cause for concern. High school teachers average one opportunity for students to respond every 2.78 min during reading and one every 2.72 min in mathematics instruction. While this is a valid concern, one could argue that the data show teachers are demonstrating low rates of OTR in both reading and mathematics across all grade levels.

The Council for Exception Children (as cited in Sutherland & Wehby, 2001) suggested that the optimal rate for OTR is 4 to 6 responses per minute for new material and between 8 to 12 OTR responses for material being reviewed. While this may be an unrealistic number for the general education setting, Scott and colleagues (2011) reported that recent research has suggested that at least three OTRs per minute is the optimal rate to positively affect student academic and behavioral outcomes. This analysis showed middle school mathematics teachers having the higher average rate of OTR per minute ($M = 0.82$; 1 every 1.22 min), which is well below the recommended rate. Furthermore, out of the 900 observations analyzed, 14% of the observations had teachers providing no OTRs. When looking across grade levels, elementary had 13% of the observations with no OTRs, middle school having 10% with no OTRs, and high school having 19% with no OTRs.

Implications for Practice

Although providing sufficient opportunities to respond has been demonstrated to positively affect student academic and social-behavioral outcomes, results from this study suggest that reading and mathematics teachers across all grade levels are not sufficiently implementing this evidence-based practice. Increasing teachers' knowledge and use of providing opportunities for all students to respond into reading and mathematics instruction can be the first step to bridging this research-to-practice gap. Two common methods used to increase the rate of opportunities for all students to respond are choral responding and response cards. Choral responding occurs when the students verbally respond in unison following a teacher prompt or question (Wolery, Ault, Doyle, Gast, & Griffin, 1992). Blackwell and McLaughlin (2005) indicated that the criteria for choral responding are that students must be able to respond in short answers (one to three words) and there is only one correct answer to the prompt. An example of choral responding during mathematics instruction may be the teacher saying, "When I give the signal, everyone answer this question: What is 5×6?," the students chorally responding, "30," and the teacher replying, "Yes! The correct answer is 30."

A response card is any sign that can be held up simultaneously by all students in response to a teacher's prompt or question. Response cards can be preprinted cards (e.g., yes/no, agree/disagree, or true/false) or dry-erase materials in which students can write down their response. Blackwell and McLaughlin (2005) suggested that it is important to use a fast pace and to consistently use cues to prompt student responses when incorporating either pre-printed or write-on response cards. An example of using response cards during mathematics instruction may be the teacher writing the problem "$5 + 2 =$" on the board and asking students to write the correct answer on their individual dry-erase boards. After waiting for

Table 4. Pairwise Comparison of Mean Scores on the Basis of Estimated Marginal Means for Reading

			97% CI for difference[a]	
Comparisons	Mean difference	p[a]	Lower bound	Upper bound
Elementary school vs. middle school	.245*	.000	.086	.403
Elementary school vs. high school	.361*	.000	.199	.522
Middle school vs. high school	.116	.054	–.011	.244

[a]Bonferroni adjustment for multiple comparisons.
*$p < .03$.

Table 5. Pairwise Comparison of Mean Scores on the Basis of Estimated Marginal Means for Mathematics

			97% CI for difference[a]	
Comparisons	Mean difference	p[a]	Lower bound	Upper bound
Elementary school vs. middle school	–.178	.037	–.362	.006
Elementary school vs. high school	.063	.662	–.109	.235
Middle school vs. high school	.240*	.006	.044	.437

[a]Bonferroni adjustment for multiple comparisons.
*$p < .03$.

a few seconds, the teacher asks the students to raise their boards up simultaneously and gives the appropriate feedback. While choral responding and response cards are common methods of increasing the rate of opportunities for students to respond, there are numerous other methods, and simply providing a prompt that requires a response of any kind is a valid OTR.

While the previously mentioned methods will help teachers incorporate opportunities to respond into instruction, teachers self-evaluating their current rate of OTR and setting goals to increase active student responding may be just as important. Partin, Robertson, Maggin, Oliver, and Wehby (2010) suggested that teachers reviewing audiotaped instructional sessions as a way to self-evaluate their own behavior can be effective for increasing the rate of OTR. The authors presented guidelines for effective self-evaluation of OTR that included teachers recording 15 min of an instructional activity each week and graphing their results. Having a visual representation of baseline levels of OTR can help individual teachers set goals, and make data-based decisions about the amount of OTR they provide in their classrooms during instruction.

Limitations and Future Research

Several limitations of this study have been identified and should be considered when interpreting current findings as well as conducting future research. The most serious limitation of this study is in regard to the procedures used to analyze the data. Because of unequal variances on the rate of OTR in reading and mathematics, a more efficient and robust procedure could not be used (e.g., factorial analysis of variance). Although corrections were made to account for the variance (e.g., Bonferroni-adjusted alpha, Welch's adjusted F, Games-Howell post hoc procedure), caution should be used when interpreting the statistically significant findings of this study given that the use of multiple analyses of variance increases the risk of a type I error. In addition, using multiple analyses of variance did not allow for testing statistically significant interactions between OTR in reading and mathematics instruction.

The second limitation to this study is in regard to the dependent variable, rate of teachers' providing opportunities to respond to groups of students. Because this study wanted to examine the opportunities for all students to respond, OTR was defined as the teacher giving the group or class an opportunity to respond to a question or request. This did not include the teacher giving an individual student an opportunity to respond. Although this will underestimate the total number of teacher OTRs, it provides analysis on including all students, including lower achieving students and students with behavior issues. This is especially important because it has been suggested that higher achieving students are more likely to respond to a teacher's questions or prompt than are lower achieving students (Greenwood, Delquadri, & Hall, 1984).

Although this study examined the rate of teachers' providing opportunities to respond to groups of students during mathematics and reading in the general education setting, future research should also examine the rate of OTRs with individual students, specifically students with disabilities. This is especially important because 58% of all students with disabilities are spending 80% or more of their day in a regular education classroom (Data Accountability Center, 2010). In addition, future research should examine the quality of OTR being delivered during mathematics and reading instruction given that research has shown that students' being prompted to explain their thinking is positively related to achievement outcomes while giving only answers is not related or negatively related to achievement outcomes (Fuchs et al., 1997).

Although it is encouraging to see positive effects from research in the area of OTR, the data in this study suggest that there is a disconnect between the research and what is occurring in the schools. Reading and mathematics teachers are demonstrating low rates of OTR in both reading and mathematics across all grade levels when compared with the recommended optimal rate to positively affect student academic and behavioral outcomes. Knowing what is actually occurring in the schools is an important step to bridging the research to practice gap, but increasing teachers' knowledge and use of providing sufficient opportunities for all students to respond in reading and mathematics instruction is the necessary next step.

Author Notes

Todd Whitney, PhD, is an assistant professor in the Department of Special Education at the University of Memphis. Research areas of interest include evidence-based interventions in mathematics for students with disabilities and the effective use of evidence-based instructional practices.

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Amy S. Lingo, EdD, is an associate professor in the Department of Special Education at the University of Louisville. Her research interests are academic interventions for students with disabilities.

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