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Increasing Opportunities to Respond to Intensify Academic and Behavioral Interventions: A Meta-Analysis

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ABSTRACT
Research indicates that intensification in multitiered systems of support (MTSS) can prevent problem behavior and academic deficits from worsening and ensure that students with the most intensive needs receive the most appropriate supports. In MTSS, it is important to consider evidence-based practices that teachers can intensify to improve student responsiveness to intervention. One such practice is opportunities to respond (OTRs). Research finds that increased OTRs are associated with improved academic outcomes and reduced disruptive behaviors. Previous reviews assessed the impact of increased teacher-directed OTRs on student outcomes and focused on specific populations of students. This meta-analysis extends findings of previous reviews by specifically assessing the utility of increasing OTRs as a method to intensify interventions. Results extend the current literature base by identifying specific interventions associated with increased OTRs that may be feasible to implement as methods to intensify interventions across the school day for students with academic and behavioral deficits.

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Schools have increasingly adopted multitiered systems of support (MTSS; e.g., response to intervention and school-wide positive behavior interventions and supports [SW-PBIS]) to better meet students' academic and behavioral needs. MTSS create a framework for addressing the needs of students who struggle in academics and with behavior. Multitiered systems place academic and behavioral supports into distinct tiers, use data to make decisions for students who are nonresponsive to Tier 1 (i.e., universal) supports, and allow schools to more effectively and efficiently meet students' academic and behavioral needs (Maggin, Zurheide, Pickett, & Baillie, 2015).

In MTSS for academics, Tier 1 consists of high-quality, differentiated instruction that all students receive in a general education classroom. In MTSS for behavior, Tier 1 consists of the following components: (a) school-wide expectations, (b) a system for recognizing and reinforcing appropriate behavior, (c) a system of consistent consequences for inappropriate behavior, and (d) collecting data and monitoring progress toward school-wide goals (Lewis & Sugai, 1999). In MTSS for both academics and behavior, when students are nonresponsive to Tier 1, they receive additional support in Tier 2 interventions (e.g., evidence-based small group tutoring programs or behavioral interventions). Schools collect data to monitor a student's response to these interventions, and if a student is nonresponsive, she or he moves on to Tier 3, which consists of more intensive, individualized interventions (Ervin, Schaughency, Matthews, Goodman, & McGlinchey, 2007; Fuchs, Fuchs, & Compton, 2012; Lam & McMaster, 2014; Maggin et al., 2015).

The Process of Intensification in MTSS

The hallmark feature of MTSS is the movement toward more intensive levels of services for nonresponders to prior tiers. Movement to these advanced tiers often occurs outside the context of general instruction. Even when students receive more intensive interventions due to more significant degrees of academic or behavioral deficits, these interventions often occupy relatively small portions of a school day and may inadequately address the need to intensify supports for students throughout the school day.

For example, one of the most commonly used Tier 2 behavior interventions is Check-In/Check-Out (CICO; McDaniel & Bruhn, 2016). Students participating in CICO receive behavioral feedback at the end of every class period or instructional block. In many schools, these class periods or instructional blocks last between 45 and 90 min. Although CICO provides students with feedback at the end of these instructional blocks, it does not address ways

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to intensify behavior supports for students throughout Tier 1 instruction.

Similarly, students participating in Tier 2 reading interventions often receive small group tutoring for limited time periods (e.g., 30–45 min, a few days each week). If students have deficits in reading, they likely need, in addition to Tier 2, more intensive levels of support for the entire duration of their reading block. Unfortunately, Tier 2 interventions often do not include explicit plans for intensifying supports in the context of daily reading instruction (e.g., Tier 1 instruction) for these students (Baker, Fien, & Baker, 2010), nor do teachers know how to make data-based changes in core instruction (e.g., Tier 1; Greenfield, Rinaldi, Proctor, & Cardarelli, 2010).

Although Tier 2 interventions provide targeted supports to students with academic and behavioral deficits, these students likely need additional supports throughout the school day in order to access the instruction they receive in their general education classrooms. As we search for ways to better serve students with intensive academic and behavior needs, we should revisit strategies to intensify Tier 1 academic instruction and behavior supports in a way that supports Tier 2 plans.

Targeting Opportunities to Respond as a Method of Intensification

In the context of strategies that teachers could use to intensify at Tier 1, OTRs may be a particularly strong method for a variety of reasons. OTRs have been found to improve both student behavior and academic outcomes, including areas targeted in SW-PBIS and response to intervention, across diverse populations of students. Use of OTRs has been shown to increase academic engagement, decrease disruptive behavior, and provide students with additional opportunities to practice academic skills, yielding increases in academic achievement. Although there are several evidence-based practices that teachers can implement to improve student engagement (e.g., peer tutoring, technology mediated instruction), OTRs are a unique practice in that they provide in the moment assessment data to teachers, allowing them to adjust their instruction to better meet student needs (MacSuga-Gage & Simonsen, 2015). Although data-based individualization (Fuchs, Fuchs, & Vaughn, 2014) utilizes formal assessment data to intensify or adapt interventions, more informal assessments of student understanding or engagement, such as OTRs, could be used in a similar way to more frequently adapt the content, pace, or method of instruction to better meet a student's academic or behavioral needs.

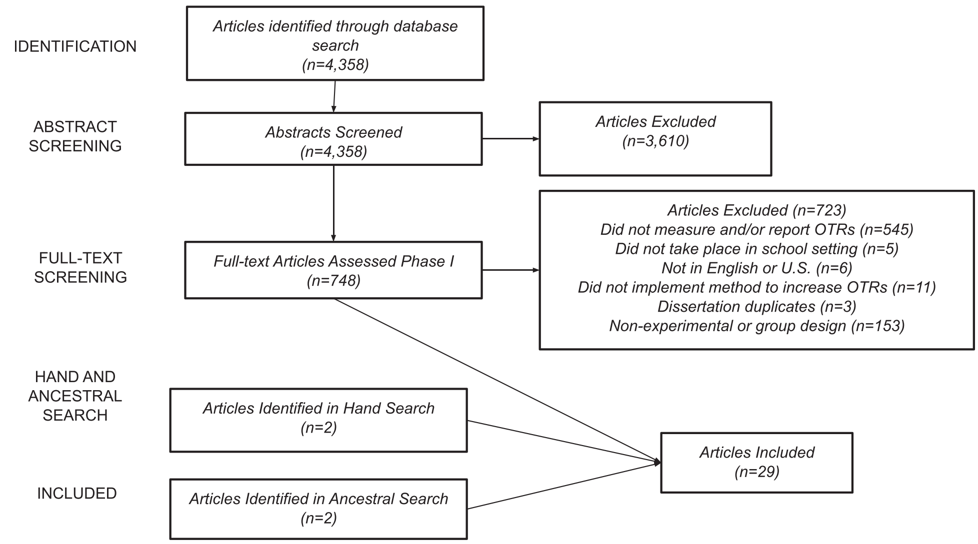
Further, OTRs are a naturally occurring part of daily instruction, indicating that teachers have the requisite skills to implement OTRs. For this reason, efforts to intensify OTRs may focus on increasing the rate at which teachers deliver OTRs and the quality of OTRs delivered. This may make OTRs a more feasible target for intensification. Teachers can intensify the quality or rate of OTRs delivered in the context of daily instruction, making it resource efficient when compared to traditional methods of intensification.

Opportunities to respond are defined as behaviors that require student responses and are followed by feedback (MacSuga-Gage & Simonsen, 2015). OTRs can be delivered by teachers, by peers, or via technology (Haydon, MacSuga-Gage, Simonsen, & Hawkins, 2012). Frequent OTRs allow teachers to adjust instruction based on student feedback, improve the quality of a lesson, and increase engagement of students (Council for Exceptional Children [CEC], 1987). Increased OTRs have been found to improve outcomes in reading (Carnine, 1976; Skinner, Smith, & McLean,1994) and math (Skinner, Belfiore, Mace, Williams-Wilson, & Johns, 1997). Increased OTRs are also associated with increased academic engagement (Carnine, 1976; Sutherland & Wehby, 2001) and decreases in disruptive behavior (Sutherland & Wehby, 2001; West & Sloane, 1986). Finally, increased rates of OTRs give teachers more opportunities to praise students, another practice that has been found to promote positive student outcomes (Sutherland & Wehby, 2001), and rates of OTRs and praise have been shown to be associated during naturally occurring instruction for students with emotional and behavioral disorders (EBD; Sutherland, Wehby, & Yoder, 2002). Methods identified as effective strategies to increase OTRs include response cards (e.g., Cavanaugh, Heward, & Donelson, 1996), unison responding (e.g., Wolery, Ault, Doyle, Gast, & Griffen, 1992), coaching and feedback (e.g., Sutherland, Alder, & Gunter, 2003), presentation rate (e.g., West & Sloane, 1986), technology-based instruction (e.g., H. E. Sterling, Robinson, & Skinner, 1997), and peer tutoring (e.g., Bowman-Perrott et al., 2013; Heward, Heron, Ellis, & Cooke, 1986).

Increasing OTRs as a Method to Intensify Instruction or Intervention

Although most Tier 2 and Tier 3 interventions provide additional supports to students in small group or one-on-one contexts, these students often need additional supports throughout the school day, including in the context of Tier 1 instruction and behavior supports. In terms of intensification of intervention for students with intensive

Figure 1. Search Methods



service needs, increasing OTRs are an ideal starting point for a variety of reasons. OTRs can be utilized for both behavioral and academic domains and within any instructional format.

To this end, methods for increasing OTRs can be utilized across all tiers within MTSS, both response to intervention and SW-PBIS. Second, following the taxonomy for intensification (Fuchs, Fuchs, & Malone, 2017), increasing OTRs can be a strategy when looking at methods for increasing dosage, aligning targeted skills to a broad academic (e.g., reading curriculum) or social–behavioral (e.g., school-wide expectations) domain, aiding in the transfer or generalization of information and skills to other formats, increasing the comprehensiveness of instruction delivery, and individualizing instruction within a group instructional context. Again, the utility of OTRs across tiered interventions is a strong rationale for targeting them for intensification purposes.

Purpose

As indicated above, OTRs have been found to improve academic and behavioral outcomes for a wide range of students, including students with and without disabilities in elementary, middle, and high school. Due to the positive outcomes associated with OTRs, particularly for students with learning or behavioral difficulties, it is important to identify ways in which teachers can intensify their delivery of OTRs to improve outcomes for these populations of students. Considering OTRs as a method of intensification for these students in the context of Tier 1 instruction or Tier 2 and Tier 3 interventions may enhance student outcomes above and beyond the impact of the standard protocol of Tier 2 or Tier 3 interventions, providing students with improved supports and potentially improved access to instruction.

The purpose of this review is to systematically examine the literature for methods used to increase OTRs and investigate the utility of considering OTRs as a method to intensify tiered instruction and behavioral supports across the school day. The review will attempt to assess the effectiveness of interventions to increase OTRs and improve academic and behavioral outcomes for students with or at risk for EBD or learning disabilities. Additionally, this review aims to identify in what instructional contexts and in what tiers of support different methods to increase OTRs are commonly applied. A recent review of teacher-directed OTRs investigated the effects of increased OTRs on student outcomes and the differential effects of different modalities of OTRs (e.g., individual OTRs versus group OTRs; MacSuga-Gage & Simonsen, 2015). Previous reviews focused on students with EBD (Sutherland & Wehby, 2001) and specifically assessed performance feedback as a method to increase OTRs (Cavanaugh, 2013). The present review extends previous reviews by looking more specifically at the usefulness of considering OTRs to intensify interventions in the context of MTSS and by assessing the effectiveness of common methods used to increase OTRs (e.g., coaching and feedback, response cards, technology-directed instruction). Specifically, this review aims to answer the following research questions:

1. What methods are used to increase OTRs?
2. In what instructional context and tier are these methods applied?
3. What is the relative effectiveness of different methods used to increase OTRs?

METHOD

The methods employed in this systematic review and meta-analysis, including search, screening, full-text coding, effect size calculation, and meta-analyses, are described below.

Search

Researchers conducted an electronic database search of the PsycINFO, ERIC, and ProQuest Dissertations & Theses Global databases in August 2017 using the following search terms: "opportunit* to respond" OR "teacher question*" OR "response card*" OR "choral respon*" OR "unison respon*" OR "presentation rate" OR "peer tutor*" OR "unison handrais*". The search yielded 4,358 articles after eliminating duplicates. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) was used to guide the methods and reporting of results of the search and screening process. The PRISMA Statement provides a set of standards for transparent reporting of four stages of the search and screening process employed in systematic reviews and meta-analyses: (a) identification, (b) screening, (c) eligibility, and (d) included (Moher, Liberati, Tetzlaff, Altman, & The PRISMA Group, 2009).

Screening

Coders systematically screened the abstracts and full texts of articles identified in the electronic database search to identify articles relevant to the review. Coders included trained PhD students studying special education. Abstract and full-text screening procedures are described below and illustrated in Figure 1.

Abstract Screening

Two coders independently reviewed abstracts to identify articles potentially relevant to the review using the following inclusion criteria: (a) studies took place in preschool to 12th grade educational settings; (b) studies implemented a method or strategy to increase OTRs; and (c) studies measured and reported OTRs in baseline and intervention phases. If any of this information could not be determined through a review of the abstract, coders were instructed to include the article at this stage and reviewed these articles further during full-text screening. A primary and secondary coder screened 70% of abstracts for reliability purposes. If both coders identified an article as relevant to the review, the article moved on to the full-text screening phase. If only one coder identified an article as relevant to the review, a third coder made the final decision about inclusion or exclusion. Seven hundred forty-eight articles moved on to the full-text screening phase described below.

Full-Text Screening

Two coders independently reviewed the full texts of the 748 articles identified during the abstract screening phase. Coders applied the same inclusion criteria used during the abstract screening phase during the first full-text screening phase, with an additional requirement that studies implement an experimental single-case design. Eighty percent of full texts were screened by a primary coder and a secondary coder for reliability purposes. Similar to the abstract screening phase, if only one coder identified an article for inclusion, a third coder reviewed the full text and made the final decision about inclusion or exclusion. Coders identified 25 articles for inclusion at this phase and excluded the remaining articles for the following reasons: (a) 545 articles were excluded because they did not measure and/or report OTRs during both a baseline and intervention condition; (b) 5 articles were excluded because they did not take place in a school setting; (c) 6 articles were excluded because they were not in English or did not take place in the United States; (d) 11 articles were excluded because they did not implement a method to increase OTRs; and (e) 153 articles were excluded because they implemented group or nonexperimental single-case designs. In cases where the search yielded both published and unpublished versions of dissertations, the published article was included instead of the dissertation. Three dissertations were excluded for this reason. Coders identified 25 studies for inclusion at this phase.

Hand Search and Ancestral Search

Following full-text screening, coders recorded and tallied the number of articles published in each journal. Journals with the highest number of included articles were included in the hand search. Additionally, two professors of special education reviewed this list of journals and identified any journals missing from the list that were relevant for inclusion in the hand search. Following full-text screening, one coder conducted a hand search of the following journals: *Behavioral Disorders*, *Education & Treatment of Children*, *Exceptional Children*, *Journal of Applied Behavior Analysis*, *Journal of Behavioral Education*, *Journal of Emotional and Behavioral Disorders*, *Journal of Positive Behavior Interventions*, *Teacher Education and Special Education*, *Journal of Special Education*, and *Remedial and Special Education*. Two additional articles were identified for inclusion from the hand search.

The same coder also conducted an ancestral search of all included articles and five previous related reviews (Cavanaugh, 2013; Haydon et al., 2012; Kern & Clemens, 2007; MacSuga-Gage & Simonsen, 2015; Sutherland & Wehby, 2001). Two additional articles were identified for inclusion from the ancestral search. This resulted in a final list of 29 articles identified for inclusion in the review. Publication dates of included studies spanned from 1986 to 2017.

Full-Text Coding

All coders were trained on the codebook and met a training criterion of 85% on two training articles before coding articles independently. Researchers developed a codebook using the RedCap database (Harris et al., 2009). The codebook allowed coders to extract descriptive data from included articles across the following categories: setting, participants, design, measures, instructional context, instructional content, tier of instruction, independent variable, and quality. Definitions for independent variables are found in Table 1. Definitions for instructional context, content, and tier are available from the first author upon request.

Quality

Coders used the CEC's quality indicators to assess the quality of included articles and rated each indicator on a scale of 0 to 2 (CEC, 2014). The CEC created this set of indicators to help consumers of research and special education researchers identify methodologically sound intervention studies. Through quantifying the methodological rigor of studies, researchers can better assess the trustworthiness of study findings. There are eight total categories of indicators, with each category including one to nine subindicators. The categories cover issues related to context and setting, participants, intervention agent, intervention description, implementation fidelity, internal validity, dependent variables, and data analysis. Some of the indicators only apply to single-case or group design studies. Due to the exclusion of group design studies in this meta-analysis, we only scored studies on indicators relevant to studies implementing single-case designs.

The indicators were designed to be scored dichotomously, with studies addressing the indicator at either a satisfactory or unsatisfactory level. To provide a more nuanced rating of these indicators, we rated each indicator on a scale of 0 to 2 and operationally defined each of these scores for every indicator. A copy of this portion of the codebook is available from the first author upon request. A score of 0 indicated that the indicator was not present or at an unacceptable level. A score of 1 indicated that the indicator was present but was not implemented with high quality. A score of 2 indicated that the indicator was present and met or exceeded expectations for quality. To calculate an overall quality score for each article, subcategories within quality indicators were initially averaged. Coders then calculated an average across all eight quality indicators.

Table 1. Independent Variable Definitions

Independent Variable	Definition
Coaching and/or feedback	Studies using professional development, coaching, performance feedback, and goal setting in the context of feedback as the primary method to increase OTRs. This category also included studies in which researchers or outside individuals instruct or coach teachers on increasing or decreasing the presentation rate of OTRs
Self-monitoring	Studies in which teachers self-monitor rates of OTRs
Unison or choral responding	Studies in which researchers increase OTRs through the use of response cards or student response systems
Peer-directed OTR	Studies in which the independent variable includes the use of peers to increase the rate of OTRs
Technology-directed OTR	Studies in which the primary independent variable includes the use of a technology-based program to provide increased OTRs

Data Extraction

To calculate effect sizes for studies employing single-case designs, coders extracted data from all graphs in these studies using Plot Digitizer, a plot-digitizing software available for free download online (Plot Digitizer, 2015). Two coders independently extracted data from all single-case graphs in included studies. Coders corrected obvious errors that occurred during extraction in the following ways: (a) negative values on outcomes in which the minimum value was 0 were corrected to 0; (b) values that exceeded the maximum outcome value were corrected to the maximum (e.g., outcomes over 100 when the maximum value was 100 were adjusted down to 100); and (c) outcomes measured as frequency counts were rounded to the nearest whole number (Zimmerman et al., 2018).

Effect Size Calculations

For studies employing a single-case design, coders used extracted data to calculate log response ratios—increasing (LRRi) as a measure of effectiveness. LRR is calculated by taking the natural logarithm of the ratio of the average outcome during a treatment condition to the average outcome during a baseline condition (Pustejovsky, 2018). LRR has several advantages over other effect size indices, including its comparability to percentage change and its insensitivity to how dependent variables are measured (Pustejovsky, 2018). Coders calculated LRRi using R statistical software (R Core Team, 2018) for each A–B comparison across all studies employing single-case designs. LRRi outcomes were then transformed into percentage changes using the following formula: $100\% \times [\exp(\hat{\gamma}) - 1]$ (Pustejovsky, 2018).

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Coders calculated LRRi for all studies that measured and graphed OTRs. For studies in which OTR data were not graphed but were instead reported as means across phases, the difference between the natural logarithm of the intervention mean and the natural logarithm of the baseline mean was calculated. These values were then transformed to percentage changes using the same formula described above.

As a measure of effectiveness in improving student outcomes, coders calculated LRRi for studies that measured and graphed on-task behavior and student responding (Pustejovsky, 2018). LRRi cannot be calculated in cases where the average outcome in a condition is 0. For this reason, it was not possible to calculate LRRi for participants whose average rates of responding or on-task behavior were equal to 0 in one condition.

Visual Analysis

In addition to LRR estimates, all graphs included in the OTR meta-analysis were visually analyzed. Visual analysis was employed to assess whether graphs met the assumption of the LRR statistic that no within-phase trends existed. Two coders visually analyzed all OTR graphs for reliability purposes. One coder had a PhD in special education, a BCBA-D, and extensive experience synthesizing effects from single-case studies using visual analysis and quantitative measures. The second coder was a certified behavior analyst with an MEd in special education and extensive experience employing and visually analyzing effects from single-case designs. Coders employed a systematic process for visually analyzing graphs described in Ledford, Lane, and Severini (2018). In addition to the questions outlined by Ledford and colleagues (2018), coders specifically assessed graphs for the presence or absence of within-phase trends.

Meta-Analysis Method

To synthesize effects across studies, researchers meta-analyzed LRR estimates from studies that measured and graphed OTRs, engagement, and responding. Because the focus of the meta-analysis was on the use of OTRs as a method to intensify intervention, included studies that measured and graphed other dependent variables (e.g., engagement, responding) were meta-analyzed separately. Due to the inclusion of effect sizes for multiple participants from the same study, a multilevel meta-analysis model was employed with participants nested in studies. Robust variance estimation techniques were used to account for potentially inaccurate sampling variances. Researchers estimated τ and ω using restricted maximum likelihood methods (Pustejovsky, 2018). Researchers used the *metafor* package in R to conduct the meta-analysis (Viechtbauer, 2010) and the *clubSandwich* package for robust variance estimation (Pustejovsky, 2018). Researchers conducted an outlier analysis by running a meta-analysis with and without each included study to assess the relative influence of each study on the average effect and estimates of within-study and between-study variance.

Interobserver Agreement

To ensure all data were accurate, interrater reliability was calculated across the screening, full-text coding, data extraction, and visual analysis phases. These procedures are described below.

Screening Interrater Reliability

A primary coder and a secondary coder screened 70% of abstracts and 80% of full texts. Interobserver agreement (IOA) was 90% and 81.5% for abstract and full-text screening, respectively. As noted above, a third coder screened 305 abstracts (6%) and 110 full texts (14%) to settle discrepancies that occurred during the abstract and full-text screening phases.

Full-Text Coding Interrater Reliability

For reliability purposes, 34.5% of articles were independently reviewed by two coders. To calculate interrater reliability, we divided the number of agreements on all codes included in the codebook by the number of agreements plus disagreements and multiplied by 100. Mean interrater reliability across articles was 89.6%, ranging from 83.2% to 97.9%. Mean agreement for instructional content, instructional context, and independent variable classifications was 93.7%, 92.1%, and 98.6%, respectively. Mean agreement on coding of CEC quality standards was 69.1%. All disagreements were settled using consensus coding.

Data Extraction Interrater Reliability

Data in all graphs were extracted by a primary coder and a secondary coder. Coders used point-by-point agreement to calculate IOA (total number of agreements over total number of agreements plus disagreements multiplied by 100). When primary and secondary coders' extracted values differed by more than a value of 1% of the maximum value of the range on the *Y* axis of a graph, the graphs were digitized by a third coder. IOA for data extraction was 90.6%. Coders reached 100% agreement after the third coder extracted data for any data points falling outside the specified window of agreement.

Visual Analysis Interrater Reliability

All graphs were visually analyzed by two coders. To calculate IOA, coders used point-by-point agreement.

Agreement on the presence of within-phase trends was 88.9% and agreement on presence of a functional relation was 100%. When primary and secondary coders' analyses differed, a third coder visually analyzed the graph. Coders reached 100% agreement on visual analysis once the third coder visually analyzed graphs with discrepancies.

RESULTS

The results from the systematic review and meta-analysis are described below across the following categories: participants, setting, design, dependent variables, independent variables, instructional context and content, study quality, effect sizes, and meta-analysis.

Participants

Across 29 single-case design studies, there were a total of 405 student participants. These participants included 168 females and 210 males; gender was not reported for 27 participants. Participants' ages ranged from 5 to 18 years old and grades ranged from prekindergarten to 11th grade. Of studies that reported participants' disability status ($n=23$), 48.4% of participants studies had identified disabilities. These studies included students with learning disabilities, EBD, other health impairments, autism, multiple disabilities, speech or language impairments, and intellectual disabilities.

There were a total of 64 teacher participants across the 29 studies. Grade levels taught ranged from prekindergarten to 12th grade. Teacher participants taught a variety of subject areas, including English language arts, math, social studies, and science. In studies that reported teacher participants' years of experience, participants had an average of 8.2 years of experience (range = 0–33 years). Teachers' certifications included special education, elementary education, and secondary mathematics.

Settings

Studies took place in a variety of instructional settings. As shown in Table 2, only two studies took place in a preschool setting. The largest number of studies took place in elementary school settings ($n=17$), and a smaller number of studies took place in secondary school settings ($n=4$) or in a combination of elementary and secondary settings ($n=2$). Four studies did not report the school level.

Design

The following experimental designs were employed: Four studies employed an A–B–A–B withdrawal design, 15 studies employed a multiple baseline design, 9 studies employed an alternating treatments design, and 1 study employed a multielement or multitreatment design.

Dependent Variables

Studies measured a variety of dependent variables, including both teacher and student outcomes. In addition to OTRs, a small number of studies measured teacher praise ($n=11$). Student outcomes measured included problem behavior ($n=9$), academic engagement ($n=9$), responding or correct responding ($n=25$), and academic achievement ($n=17$). Researchers generally employed direct observation methods to measure problem behavior, academic engagement, OTRs, responding, correct responding, and praise. Permanent product review was generally employed to assess academic achievement.

Methods to Increase OTRs

Independent variables used to increase OTRs are recorded for each study in Table 2. Of 29 studies reviewed, 25 used a single approach for increasing OTRs, whereas 4 used two or more approaches to increase OTRs. The most common independent variables implemented to increase OTRs were coaching and feedback interventions and response cards. Seventeen studies implemented a coaching and feedback intervention to increase teachers' OTRs and five studies implemented response cards. Several studies implemented a combination of approaches to increase OTRs.

Instructional Content and Context

Table 2 notes the instructional context and tier in which methods to increase OTRs were implemented by study. Across included studies, most methods to increase OTRs were implemented during small group or large group instruction. Eight studies implemented methods to increase OTRs during small group instruction. Five studies implemented a method to increase OTRs during large group instruction. Several studies implemented methods to increase OTRs during a variety of instructional contexts. Three studies did not provide enough information to determine the instructional context during which methods to increase OTRs were implemented.

Across included studies, methods to increase OTRs were most commonly implemented during Tier 1 instruction. Thirteen studies implemented methods to increase OTRs during Tier 1 instruction, 12 studies implemented methods to increase OTRs in special education settings, and 4 implemented methods to increase OTRs during Tier 2 interventions.

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Table 2. Independent Variable, Grade Level, Context, and Content of All Included Studies

Study	Independent Variable	Grade	Context	Tier	Content	Quality (Range)	% Change
Capizzi, Wehby, and Sandmel (2010)	Coaching and/or feedback	ES	NR	SPED	Math and reading	1.3 (1–2)	27.7*
Cavanaugh et al. (1996)	Response cards	S	L	1	Science	1.1 (0–2)	100
Cheek (2016)	Coaching and/or feedback	NR	S and O	SPED	Reading	1.4 (1–2)	417.5*
Cooke et al. (2011)	Coaching and other	E	S	2	Reading	1.5 (1–2)	219.7*
Crozier (2006)	Coaching and/or feedback	S	NR	1	Math, reading, and science	1.4 (1–2)	99*
Cuticelli, Collier-Meek, and Coyne (2016)	Coaching and/or feedback	NR	L	1	Reading	1.3 (0–2)	61*
Gardner, Heward, and Grossi (1994)	Response cards	E	L	1	Science	0.9 (0–2)	−35.7
Gettinger and Stoiber (2014)	Coaching and/or feedback	E	L	1	Reading	1.5 (0–2)	1,247.9*
Heward et al. (1986)	Peer-directed	E	P	1	Reading	1.1 (0–2)	75.2
Johnson (2007)	Coaching and/or feedback	E	L	1	Reading	1.4 (0–2)	30.6*
Jones (2017)	Coaching and/or feedback	E	L and S	1	Reading	1.5 (1–2)	38.4*
Kamps et al. (1994)	Unison responding and peer-directed	E	S	SPED	Language and functional skills	1.25 (0–2)	286.5
Koury (1990)	Peer-directed	S	L and P	SPED	Spelling	1.3 (0–2)	54.6
Lamella and Tincani (2012)	Coaching and/or feedback	P	O	SPED	Early learning skills	1.4 (0–2)	60.8
Maheady, Mallette, Harper, and Sacca (1991)	Other (Numbered Heads Together)	E	L and P	1	Social studies	1.1 (0–2)	−50.5
Maheady, Michielli-Pendl, Mallette, and Harper (2002)	Response cards and other (Numbered Heads Together)	S	L and P	1	Science	1.2 (0–2)	−6
Narayan, Courson, Gardner, Heward, and Omness (1990)	Response cards	E	L and I	1	Social studies	0.9 (0–2)	−36.8
O'Keeffe (2009)	Coaching and/or feedback	E	S	2	Reading	1.4 (1–2)	401.7*
Oram (2017)	Coaching and/or feedback	E	L and S	1	Math and reading	1.2 (0–2)	10*
Randolph (2017)	Coaching and/or feedback	ES	S	SPED	Math and reading	1.3 (0–2)	137.1*
Rodriguez and Anderson (2014)	Coaching and/or feedback	E	S	2	Reading	1.6 (1–2)	38.1
Savio-Wolf (2016)	Coaching and/or feedback	E	NR	1	Math	1.4 (0–2)	28.8*
R. M. Sterling, Barbetta, Heward, and Heron (1997)	Technology-directed and other	NR	O	SPED	Health	1.2 (0–2)	400
Sutherland et al. (2003)	Coaching and/or feedback	E	L and I	SPED	Math	1.5 (0–2)	88.2*
Tincani and Crozier (2008)	Response cards and other	E	S	SPED	Reading	1.3 (0–2)	73
Tincani et al. (2005)	Coaching and/or feedback	P	S	2	Oral language	1.4 (1–2)	122*
Westover (2010)	Coaching and/or feedback	E	O	SPED	Reading	1.3 (0–2)	66.8*
Wilson et al. (1996)	Technology-directed and other	E	O and I	SPED	Math	1.2 (0–2)	−66.9
Wolery et al. (1992)	Unison responding	NR	S	SPED	Identifying community sign words	1.3 (0–2)	300

Note. Grade levels are represented as follows: P = preschool, E = elementary, S = secondary, ES = elementary and secondary, NR = not reported. Contexts are represented as follows: L = large group, S = small group, O = one-on-one, I = independent work, P = peer-directed, NR = not reported. For consistency across studies, LRRi were converted to percentage changes. All studies included in the OTR meta-analysis are indicated with an asterisk (*) in the % Change column.

In terms of instructional content, 8 studies implemented methods to increase OTRs during instruction of new material, 10 studies implemented methods to increase OTRs during instruction of new material and review of previously taught material, and 11 studies did not provide enough information to categorize the instructional content taught while the method to increase OTRs was implemented.

For academic content area, studies most commonly implemented methods to increase OTRs during reading ($n = 15$) and/or math instruction ($n = 7$). Other content areas taught included social studies, science, functional skills, play skills, health, oral language, and calendar lessons. Instructional content is detailed by study in Table 2.

Study Quality

Across 29 included studies, two studies had an average quality score less than 1, meaning that on average the quality indicators were not present or were implemented at an unacceptable level. The remaining studies achieved a score between 1 and 2, meaning that on average the indicators were present but were not implemented with high quality. Across included studies employing a single-case design, average quality scores differed between indicators. For example, on average, studies had higher quality scores for indicators related to internal validity, dependent variables, and independent variables ($M = 1.8$, 1.7, and 1.4, respectively). Conversely, studies had lower average quality scores for indicators related to implementation fidelity, context and setting, and the intervention agent ($M = 0.8$, 1.0, and 1.1, respectively). Many studies failed to report information related to dosage of treatments (e.g., length of and number of sessions), critical features of the context or setting in which the intervention was implemented, or the individual who implemented the intervention, leading to lower scores for these indicators. Average quality scores for individual studies are listed in Table 2.

Effect Sizes

Due to the limited number of studies that graphed OTRs, LRRi could only be calculated for studies implementing coaching and feedback interventions. Across included studies that graphed OTRs, LRRi estimates indicate that coaching and feedback interventions generally produced large increases in OTRs. The impact of these interventions was variable across participants and studies, with percentage changes ranging from −40.1% to 7,008.7%.

For studies that did not graph OTRs, the difference between the natural logarithm of the mean in intervention and the natural logarithm of the mean in baseline was calculated. These values were then transformed to percentage changes. Percentage change estimates indicate that, on average, most independent variables produced an increase in OTRs. Nevertheless, there were differences in magnitude and direction of change across interventions, studies, and participants. Average percentage changes were calculated for interventions implemented in two or more studies. For this reason, average percentage changes were calculated for coaching and feedback, response cards, and peer-directed interventions. The largest average percentage change in OTRs across these interventions was associated with unison responding interventions. Two studies assessed the effectiveness of unison responding interventions but did not graph OTRs. On average across these studies, unison responding interventions were associated with a 293.2% increase in OTRs (range: 286.6%–300%). Across peer-directed interventions, there was an average 116.2% (range: 39.9%–286.5%) increase in OTRs. Across five studies, a negative percentage change was associated with response card interventions with a mean −17.7% decrease in OTRs (range: −50.5% to 100%).

Visual Analysis

All graphs included in the meta-analysis of OTR outcomes were visually analyzed to assess how well each graph met the assumptions of the LRR statistic. An assumption of the LRR statistic is that no within-phase trends are present. Across 54 participants, within-phase trends occurred for eight participants in at least one phase. For these eight participants, the assumption of the LRR of no within-phase trends was violated. There are other parametric effect size statistics that are not sensitive to within-phase trends. Unfortunately, these statistics cannot be applied flexibly across designs, dependent variables, and observation systems. Due to the inclusion of studies employing varied designs and observation systems, we believe that the LRR statistic was most appropriate even in light of within-phase trends occurring in some studies.

Meta-Analysis

Table 3 includes the average effect size estimate across studies. The average effect size for OTRs across studies included in the meta-analysis was large and statistically significant, with increases of nearly one standard deviation over baseline levels. When transformed to a percentage change, this effect size is equivalent to a 112.8% increase in OTRs from baseline to intervention phases. The estimate of between-study variance was estimated as τ = 0.6177. If the average effects were normally distributed, then about two thirds of the effects should fall within one standard deviation of the average effect or, in this case, between 0.1376 and 1.373. This indicates that there is a substantial amount of heterogeneity in effects across studies. The 0.5823 value of ω also indicates substantial levels of within-study variance (Pustejovsky, 2018). Although we aimed to assess the relative effectiveness of different methods used to increase OTRs, we were unable to answer this question due to the smaller number of studies that graphed OTRs. All of these studies implemented a coaching and feedback intervention.

To assess whether published studies were associated with larger effects than unpublished studies, we conducted a moderator analysis with publication status as the moderator. The impact of publication status on overall effect size was nonsignificant. To assess whether the presence of within-phase trends affected the results of the meta-analysis, participants for whom within-phase trends occurred were removed from the analysis. When these participants were removed from the analysis, the average effect across studies increased to 0.7965 ($p < .01$). Because the outcomes of the meta-analysis were similar with and without these participants, all participants were included in the meta-analysis summarized in Table 3.

As noted in the Methods section, researchers conducted an outlier analysis to assess the relative influence of each included study on the average effect and the estimates of within-study and between-study variance. The average effect with and without each included study ranged from .6166 to .8198. Estimates of τ ranged from 0 to .5962.

Table 4 summarizes average effect size estimates across two student outcomes: on-task behavior and responding.

Table 3. Average Effect Size Estimate for OTRs

Studies	Effects	Estimate	*SE*	*df*	*p*	τ	ω
14	59	0.7553	0.1933	58	.0001	0.6177	0.5823

Table 4. Average Effect Size Estimate for Student Outcomes

Dependent Variable	Studies	Effects	Estimate	*SE*	*df*	*p*	τ	ω
On-task	7	22	0.206	0.078	21	.008	0.353	0.000
Responding	5	28	1.461	0.678	28	.031	1.190	0.672

The average effect size for on-task behavior across studies included in the meta-analysis was moderate and statistically significant. When transformed to a percentage change, the effect size for on-task behavior is equivalent to a 22.9% increase in on-task behavior. For responding, the average effect size was large and statistically significant. When transformed to a percentage change, methods to increase OTRs were associated with a 331% increase in student responding. Across all student outcomes, there was a substantial amount of between-study heterogeneity, with larger levels of between-study heterogeneity for responding. There was a negligible amount of within-study heterogeneity for on-task behavior but a substantial amount of within-study heterogeneity for responding.

DISCUSSION

The purpose of this review was to systematically examine the literature base for methods used to increase OTRs and to assess the usefulness of considering OTRs as a method to intensify instruction and behavioral supports across the school day. Previous reviews focused specifically on teacher-directed OTRs (MacSuga-Gage & Simonsen, 2015), the effectiveness of increased OTRs for specific populations of students (e.g., students with EBD; Sutherland & Wehby, 2001), and specific interventions used to increase OTRs (e.g., performance feedback; Cavanaugh, 2013). This review extends the findings of previous reviews by including studies focused on diverse populations of students and employing any intervention that aimed to increase the number of OTRs that students received. Additionally, this review meta-analyzed outcomes across studies to assess the effectiveness of increased OTRs as a method to intensify interventions for students with intensive service needs. No prior reviews conducted a meta-analysis of this literature base.

Across 29 included studies, most took place in elementary school settings or secondary school settings. Of studies reporting students' disability status, a variety of disabilities were represented and ranged from learning and behavioral disorders to significant intellectual and developmental disabilities.

Instructional Context and Content

Most studies implemented interventions to increase OTRs in large or small group contexts while teachers provided math or reading instruction. Several studies implemented methods to increase OTRs during a combination of instructional contexts (e.g., independent work and one-on-one instruction). In terms of content, studies most commonly implemented methods to increase OTRs during instruction of new material or during both instruction of new material and review of previously taught material.

In the context of MTSS, studies most commonly implemented methods to increase OTRs during Tier 1 instruction or in special education settings (e.g., resource rooms, self-contained settings with students with EBD). A smaller number of studies implemented these methods during Tier 2 instruction. This provides some initial evidence that several of these methods can be implemented flexibly in a variety of contexts, with a variety of students (e.g., students without identified disabilities, students with high-incidence disabilities, students with low-incidence disabilities), while teaching diverse types of instructional content. It may be particularly relevant to consider that in Tier 1 contexts, these methods were often implemented with students with and without disabilities and have been shown to improve outcomes for both of these populations of students (e.g., Kamps, Dugan, Leonard, & Doust, 1994; Tincani, Ernsbarger, Harrison, & Heward, 2005). This may make these strategies particularly useful to consider as methods to intensify instruction for students with or at risk for disabilities in contexts in which they are educated with their general education peers (e.g., Tier 1 instruction and behavior supports).

The more limited application of methods used to increase OTRs during Tier 2 instruction points to a need for future research in this area. The Taxonomy of Intervention Intensity (Fuchs, Fuchs, & Malone, 2017) recommends that teachers and interventionists consider the number of OTRs students receive in a Tier 2 intervention as a measure of intervention dosage. Further, the Taxonomy recommends increasing the number of OTRs in Tier 2 interventions as a method of intensification when students are initially nonresponsive to intervention. To assess the degree to which increased OTRs improve student responsiveness to Tier 2 interventions, future research should assess the impact of methods used to increase OTRs on student academic and behavioral outcomes in these contexts.

Methods to Increase OTRs and Relative Effectiveness

Across included studies, coaching and feedback was the most common intervention implemented to increase OTRs. The other top methods included response cards and peer-directed interventions. The remaining studies used a mix of the other methods. Due to the small number of studies that measured and graphed OTRs, we could not rigorously assess the relative effectiveness of different interventions used to increase OTRs. All studies included in the meta-analysis of OTRs implemented coaching and feedback interventions.

In terms of student outcomes, methods used to increase OTRs were associated with significant and practically important increases in on-task behavior and student responding. Because LRR cannot be calculated when the average outcome in any condition is equal to 0, we could not calculate LRR for academic achievement outcomes. Although on-task behavior and student responding are not measures of academic achievement, one may hypothesize that increases in student engagement and student responding would be associated with improvements in academic outcomes.

To more rigorously assess whether increased OTRs are an effective method of intensifying interventions for students with academic and behavioral deficits, future research should assess the degree to which changes in OTRs account for changes in student outcomes (e.g., engagement, problem behavior, academic achievement). Due to the small number of studies that both measured and graphed OTRs and student outcomes, we could not conduct this analysis in the context of this review. We believe that it is important that research assessing the effect of methods used to increase OTRs measure and report the number of OTRs in all treatment conditions. Without these data, it is difficult to determine whether improvements in student outcomes are associated with increased OTRs or another component of the implemented interventions (e.g., changes in the way students respond to OTRs). This mediation question could also be answered in the context of larger scale group design studies. Only two studies were excluded from this meta-analysis due to the use of a group design. Future research should use group design methods to assess the differential effectiveness of these interventions (e.g., coaching and feedback, response cards, peer-directed instruction) in terms of their impact both on the number of OTRs teachers deliver and on student outcomes.

Implications for Practice

The findings of this review have several implications for practice. As noted above, we believe that teachers and school staff should consider the use of coaching and feedback interventions to increase OTRs in a variety of school settings. Specifically, we believe that implementing coaching and feedback interventions to support teachers' use of OTRs as a method to intensify intervention has the potential to improve student academic and behavioral outcomes.

When students are initially nonresponsive to Tier 1 or Tier 2 supports, it may be useful for teachers to consider intensifying the number OTRs they provide to these students. For example, if a student has high rates of challenging behavior during core reading instruction and also displays some deficits in reading, it may be useful for that teacher to receive coaching and feedback on the number of OTRs delivered to that student during core reading instruction. If a student receiving a Tier 2 math intervention is initially nonresponsive, it may be useful for the teacher to review the intervention protocol and increase the number of OTRs a student receives during each intervention session, providing the student with more opportunities to practice and receive corrective feedback on key math concepts.

Summary of Findings

Based on findings from this review and previous research, it may be important to consider the utility of coaching and feedback interventions as methods to increase OTRs and as a method of intensification in the context of Tier 1 instruction and behavior supports. Although our meta-analysis was limited to 14 studies implementing coaching and feedback interventions, coaching and feedback interventions were the most commonly implemented intervention across included studies and consistently produced significant and large increases in OTRs. Additionally, in the context of intensification of academic and behavior supports for students with or at risk for learning disabilities or EBD, other interventions to increase OTRs such as peer-directed interventions, technology-directed interventions, response cards, and unison responding may have limitations in terms of the type of instruction that can be provided using these strategies. These strategies may be more appropriate in the context of review of previously taught material or drilled practice of newly learned skills. Alternatively, coaching and feedback can be applied more flexibly across instructional contexts and types of academic content.

There is an extensive literature base for coaching and feedback interventions in the context of reading instruction, math instruction, and classroom management practices. In general, research finds that coaching in addition to an initial training on evidence-based practice can improve and more effectively maintain teacher implementation fidelity (Reinke et al., 2014). In a review of school-based behavior interventions that included a coaching component, 86% of included studies found coaching improved teachers' implementation of evidence-based behavior practices (Stormont, Reinke, Newcomer, Marchese, & Lewis, 2015).

In addition to a solid evidence base for the effectiveness of coaching across other instructional practices, coaching and feedback as a method to increase OTRs may be particularly useful when considering OTRs as a method to intensify instructional and behavioral supports for students. Coaching and feedback interventions can provide teachers with more holistic supports not only in their implementation of increased OTRs but also in improving the quality of OTRs. In the context of intensification, coaching and feedback on OTRs can also be tailored to individual student needs and can include feedback on other evidence-based teacher practices that may benefit specific students, such as behavior-specific praise.

Limitations

There are several limitations associated with this review. First, the studies included in this review had varying levels of quality based on the CEC standards. Most studies achieved a score between 1 and 2, meaning that, on average, all indicators were present but were not implemented with high quality. In general, studies received lower scores on indicators related to implementation fidelity such as dosage and intervention agent. Additionally, interrater reliability for coding of quality was low in comparison to other variables coded in the meta-analysis. Although all discrepancies were settled via consensus coding, it is important to interpret results in light of the reliability of quality coding and the overall quality of included studies.

We employed specific methods and definitions to classify independent variables. In some cases, the classification of these independent variables could be interpreted in different ways. For example, H.E. Sterling and colleagues (1997) implemented a taped words intervention at varying presentation rates to increase OTRs. Based on our methods, this independent variable was classified as a technology-directed intervention. Some may believe that this should have been classified differently due to the varied presentation rate implemented within the context of the taped words intervention. This may also be the case for articles that instructed teachers to increase presentation rate to increase OTRs. We classified these independent variables as coaching and feedback interventions because an outside individual provided the instruction and oftentimes the support needed to increase presentation rate.

It is also important to note we did not look at scripted lessons as a method to increase OTRs. With the exception of Wilson, Majsterek, and Simmons (1996) and Cooke, Galloway, Kretlow, and Helf (2011), none of the included studies implemented scripted lessons. Recently, Fuchs et al. (2017) identified several dimensions of interventions that educators should consider when selecting and intensifying an intervention for a student with academic deficits. One of these dimensions, dosage, is defined in the taxonomy as the number of opportunities a student has to respond and receive corrective feedback in the context of one intervention session. For this reason, it may be important to consider scripted lessons as a method to intensify OTRs for students. Further, in future research it may be useful for studies assessing the effectiveness of scripted lessons to report the number of OTRs provided to students during baseline and intervention phases so that this change can be assessed.

Several articles implementing methods commonly used to increase OTRs (e.g., response cards, unison responding) did not measure and/or report the number of OTRs provided during baseline and intervention phases and were therefore excluded from the review. We acknowledge that this may be a limitation of the review, but the absence of reported levels of OTRs made it impossible to assess interventions on this behavior. Because interventions such as response cards and unison responding are often presented as methods to increase OTRs, future research employing these interventions should measure and report the number of OTRs provided during both baseline and intervention phases to assess whether this is actually the case.

As noted earlier, an assumption of the LRR statistic is that no within-phase trend occurs in either condition. Visual analysis of OTR outcomes indicated that within-phase trends occurred for some participants across included studies. Although other parametric effect size statistics could have been employed that are not sensitive to within-phase trends, these effect size measures cannot be flexibly applied across different types of designs and observation systems (Moeyaert, Zimmerman, & Ledford, 2018). Due to the inclusion of studies employing a variety of designs and observation systems, we employed LRR, which can be used flexibly across designs, dependent variables, and observation systems (Pustejovsky, 2018).

CONCLUSION

This review extends findings of previous reviews by investigating the utility of considering OTRs as a method to intensify instruction and interventions for students with academic and behavioral deficits and measuring the relative effectiveness of common methods used to increase OTRs. Studies reviewed implemented methods to increase OTRs across diverse instructional contexts, illustrating the feasibility of intensifying this instructional practice in the context of both Tier 1 instruction and Tier 2 interventions for students with academic and behavioral deficits. Based on the relative effectiveness of different methods used to increase OTRs, we think that coaching and feedback interventions in the context of Tier 1 instruction can provide teachers with support not only in increasing the number of OTRs but also in improving the quality of OTRs that students receive.

Further, coaching and feedback interventions can easily be combined with other methods to increase OTRs (e.g., response cards, peer-directed interventions, unison responding) to enhance the impact of these interventions on both teacher and student outcomes.

Although current research focuses on assessing the effectiveness of Tier 2 or Tier 3 interventions in isolation, future research should assess the effectiveness of intensifying evidence-based teacher practices across the school day. As highlighted in this review, OTRs may be a particularly feasible evidence-based practice to target for intensification purposes and may have unique utility in improving both academic and behavioral outcomes for students with or at risk for learning disabilities and EBD. Specifically, research should assess the impact of intensifying OTRs in the context of Tier 1 instruction for students who qualify for Tier 2 behavior and academic interventions. As illustrated in this review and previous reviews of the literature, OTRs are associated with increases in academic engagement and academic achievement outcomes as well as decreases in disruptive behavior. Based on present evidence supporting the effectiveness of increased OTRs for students with or at risk for EBD or learning disabilities, intensifying this evidence-based practice across the school day has the potential to improve students' access to general instruction, thereby enhancing the effectiveness of Tier 2 and Tier 3 interventions.

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