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Response Cards as a Strategy for Increasing Opportunities to Respond: An Examination of the Evidence

Crystalyn I. Schnorr, PhD[1], Shaqwana Freeman-Green, PhD[2], and David W. Test, PhD[3]

Abstract

This study evaluated the quality of the research and evidence base for using response cards to increase opportunities to respond (OTR) for students with and without disabilities at the elementary level (i.e., kindergarten through Grade 5). Using quality indicator criteria for single-case research, six single-case studies investigating response cards were analyzed. Based on an analysis of quality indicators, results established the use of response cards as an evidence-based practice with a moderate level of evidence. Implications for future research and practice are discussed.

Keywords

response cards, elementary, evidence-based practice

Teachers who provide students with frequent opportunities to respond (OTR) to instruction are more likely to enhance the educational experience for students in their classrooms. In doing so, they provide students frequent opportunities to demonstrate learned knowledge and skills and also are able to provide critical feedback (e.g., praise, error correction) based on student responding. Heward (1994) suggested that to be proficient with any skill, students need frequent opportunities to actively respond to instruction. On the contrary, students who are not actively engaged in instruction receive fewer OTR and may be considered low achievers (Greenwood, Delquadri, & Hall, 1984). In addition, these students are more likely to engage in off-task behavior, thereby missing critical teacher input (Randolph, 2007).

Greenwood et al. (1984) defined OTR as "the interaction between (a) teacher formulated instruction (materials presented, prompts, questions asked, signals to respond, etc.) and (b) its success in establishing the academic responding desired or implied by materials, the subject matter goals of instruction" (p. 64). Research suggests fast-paced instruction results in more learning trials by the teacher (e.g., Lambert, Cartledge, Heward, & Lo, 2006), more active responses by students (e.g., Berrong, Schuster, Morse, & Collins, 2007), greater accuracy in student responses (e.g., Lambert et al., 2006), and increased on-task behavior (e.g., Berrong et al., 2007). Consequently, teachers who gave students more opportunities to actively respond during content instruction (e.g., reading, math) increased the accuracy and rate of reading comprehension, as well as the accuracy and fluency of solving multiplication problems (Haydon, Borders, Embury, & Clake, 2009). According to Sutherland, Conroy, Abrams, and Vo (2010), OTR can increase positive teacher–student interactions, enhance student engagement, increase student learning, and decrease problem behaviors. Using active student response (ASR) strategies during teacher-led instruction can provide an opportunity for all students to respond, and researchers suggest that in elementary-level classrooms, opportunities for increasing OTR are unlimited. Examples of ASR strategies that increase students' OTR include model–lead–test, choral responding, and response cards. Given the documented correlation between increased student engagement and academic achievement (e.g., Brophy & Good, 1986; Greenwood et al., 1984), it is imperative that teachers identify and use practices that not only enhance active student engagement and participation during teacher-led instruction but are also determined effective through research. Selection of such practices may result in improved academic performance for all students.

Unfortunately, research indicates low levels of ASR in classrooms. For example, Hall, Delquadri, Greenwood, and

[1]University of North Carolina Wilmington, USA
[2]Illinois State University, Normal, USA
[3]University of North Carolina at Charlotte, USA

Corresponding Author:
Crystalyn I. Schnorr, Department of Early Childhood, Elementary, Middle, Literacy, and Special Education, University of North Carolina Wilmington, 601 South College Rd., Wilmington, NC 28403-5940, USA.
Email: schnorrc@uncw.edu

Thurston (1982) revealed active responding for elementary students was less than 1% of total school time and as much as 45% of instructional time was spent passively attending to the teacher. Active student involvement during whole-class instruction typically took the form of hand raising, in which numerous students raised their hands to participate; however, only one student was called upon by the teacher to respond. Generally, a teacher would pose a question and then wait approximately 3 s before calling upon an individual student whose hand was raised. This instructional method does not provide the teacher with feedback from every student in the class and relies solely on gaining a response from a student whose hand was raised. Research has shown increased ASR improves academic achievement (Barbetta, Heron, & Heward, 1993; Narayan, Heward, Gardner, Courson, & Omness, 1990) and reduces disruptive behavior while increasing on-task behavior (Heward, 1994). As a result, providing students with more OTR gives teachers a way to increase ASR.

Numerous researchers have found using ASR strategies (e.g., choral responding, response cards, guided notes) in the classroom can increase OTR for all students (Heward, 1994; Lambert et al., 2006). In a classroom setting, use of these strategies enables all students to actively participate in academic tasks. In addition, ASR strategies are low cost, easy to implement, can be used across academic areas, and provide increased OTR (Barbetta et al., 1993; Carnine, 1976; Miller, Hall, & Heward, 1995). A review of the literature on ASR strategies conducted by Heward (1994) indicated instructional strategies that promote increased levels of ASR also increased student learning (Greenwood et al., 1984). Furthermore, the review indicated ASR provided immediate feedback to the teacher and was associated with promoting increased time on task (Carnine, 1976; Miller et al., 1995; Narayan et al., 1990). One strategy teachers can use to increase ASR and OTR for all students is response cards. Response cards are any item that can be held up simultaneously by every student in the class as a means of responding to a teacher-posed question (Heward et al., 1996). With response cards, students can respond to questions by writing a short response on a laminated board (i.e., write-on response card) or by holding up a preprinted card or sign (i.e., preprinted response card) to display their answer.

Need for Evidence-Based Practices

Historically, the term "best practice" has been used to describe instructional procedures established as effective (Mastropieri & Scruggs, 2007). Due to misuse or misunderstanding of the term, "best practice" based on personal experience and opinions has found its way into the classroom (Cook & Schirmer, 2003). As a result, well-intended teachers have taken these "best practices" and implemented ineffective practices in their classrooms (Kauffman, 1996). Horner et al. (2005) defined a practice as "a curriculum, behavioral intervention, systems change, or educational approach designed for use by families, educators, or students with the express expectation that implementation will result in measurable educational, social, behavioral, or physical benefit" (p. 175). To combat some of the confusion, Odom et al. (2005) defined the term evidence-based practice as a practice demonstrated effective by credible research. In addition, Horner and Kratochwill (2011) pointed out that a practice is evidence based "when there is repeated and convincing documentation of functional, or causal, relation between introduction of the practice and change in a valued outcome" (p. 3). Therefore, "evidence-based practice" has become an important term in the field of education.

The importance is demonstrated by the fact that both the No Child Left Behind Act of 2001 (NCLB; 2002) and the Individuals With Disabilities Education Improvement Act (IDEIA; 2004) emphasize use of scientifically based research. NCLB defines scientifically based research as "research that involves the application of rigorous, systematic, and objective procedures to obtain reliable and valid knowledge relevant to education activities and programs" (20 U.S.C. § 7801 [37]). Specifically, NCLB emphasizes providing students access to scientifically based instructional strategies (20 U.S.C. 70 § 6301 *et seq.*), whereas IDEIA emphasizes use of scientifically based instruction (20 U.S.C. § 1400 *et seq.*). Therefore, there is a need for effective teaching strategies that improve learning for all students in the classroom.

Further, the IDEA Amendments of 1997 mandate students with disabilities be educated in general education settings to the maximum extent possible with peers without disabilities, also known as the least restrictive environment (LRE). Providing appropriate instruction that meets the needs of low- to high-achieving students poses an additional challenge for general education teachers (Stichter et al., 2009). Low-achieving students are often less likely to participate and respond to teacher-posed questions. One way to ensure participation of all students is to increase active student involvement in instruction (Kern & Clemens, 2007).

Although federal mandates emphasize teachers' use of research-based practices within the classroom, the research-to-practice gap demonstrates research-based teaching practices have had minimal carryover into classrooms (Fuchs & Fuchs, 2001). For example, Burns and Ysseldyke (2009) demonstrated low self-reported and observed use of research-based practices in classrooms. Horner et al. (2005) recommended interventions be practical and cost-effective. Therefore, it is essential to identify feasible, low-cost research-based practices that teachers can use in the classroom.

Prior Reviews of Response Cards

Recently, Randolph (2007) conducted a meta-analysis of the literature on response cards. This article reviewed 18 studies that examined the effects of response cards on test achievement, quiz achievement, participation, and off-task behavior. Participants included in this review ranged in age from preschool to university level. The studies took place across a variety of academic areas (i.e., history, mathematics, science—natural and social, English, social studies, colors, calendar, research methods, psychology). Results indicated use of response cards increased test and quiz achievement, participation, and decreased off-task behavior. When compared with hand raising, results indicated response cards had statistically significant effect sizes (ES) for test achievement (ES = 0.38), quiz achievement (ES = 0.63), participation (a 47.7% increase in participation during response card condition), and reduction in intervals of disruptive behavior (34% lower in response card condition). Furthermore, there were no significant differences between use of write-on and preprinted response cards. Although these results supported Heward's (1994) findings that interventions that promote high levels of ASR could play a major role in the teaching and learning process of students, Randolph did not evaluate the quality of studies identified in the literature review.

Extending this research, Horn (2010) reviewed and examined six response card studies as a means of increasing academic responding for students with an identified physical or cognitive disability. Participants in this review included elementary through high school–aged students. The reviewed studies were conducted in the academic areas of science, social studies, English, calendar, and time telling. Horn indicated in this review that response cards could be considered an evidence-based practice based on Horner et al.'s (2005) guidelines of (a) minimum of five studies documented use of experimental control in peer-reviewed journals, (b) investigations conducted by a variety of researchers in a variety of settings, and (c) investigations conducted with a minimum of 20 total participants. Although the researcher acknowledged these criteria, the critical first step in identifying an evidence-based practice (i.e., determining whether studies are of sufficient quality) was not met. Without an analysis of the quality of each study, a decision of evidence based or not cannot be made. With the push by federal legislature for use of evidence-based practices in classrooms, it is imperative to establish practices as evidence based only if all of the guidelines and recommendations have been adhered to. Because previous researchers did not evaluate the quality of the research studies reviewed, additional information is needed to determine whether response cards is, in fact, an evidence-based practice.

Therefore, the purpose was to review experimental research literature on response cards using quality indicators to determine whether it was an evidence-based practice for increasing OTR for students at the elementary level (i.e., kindergarten through Grade 5). For the current review, OTR was defined as (a) student responding, (b) participation, or (c) active responding. Cook, Tankersley, and Landrum (2009) recommended, "Reviews focus on as broad a population as seems reasonable and meaningful and that authors carefully describe participants across studies reviewed to inform consumers about the population for whom the intervention has been shown to be effective" (p. 376). Therefore, authors narrowed their search to use of response cards with elementary students to target a specific audience as opposed to making a more general statement about a broader range of students.

Method

Literature Search Procedures

To conduct a thorough search of the experimental research literature on response cards to increase students' OTR, authors (a) reviewed articles analyzed in Randolph's (2007) meta-analysis and Horn's (2010) review, (b) conducted an electronic search, (c) hand searched peer-reviewed journals, and (d) reviewed reference lists of related articles. The current review encompassed articles published between 1990 and the present. First, articles included in Randolph's meta-analysis were reviewed for inclusion, with the earliest article to be included in the current review published in 1990 (i.e., Narayan et al., 1990). Articles included in Randolph's meta-analysis were then cross-referenced with the more current review by Horn to determine whether any additional, more recent, articles should be included. Second, electronic searches were conducted using ERIC, PsychINFO, and Education Research Complete from 2005 (i.e., Randolph's, 2007, meta-analysis) to 2013. When searching electronic databases, the following full and truncated keyword search terms were used: response cards, response cards and ASR, response cards and behavior, response cards and OTR, response cards and elementary, response cards and middle, response cards and secondary, response cards and university, response cards and evidence based, and response cards and research based. Although the current review did not encompass studies which included students in prekindergarten, Grades 6 through 12, or university, authors included the search terms (a) response cards and middle, (b) response cards and secondary, and (c) response cards and university in an effort to locate all research studies investigating response cards to increase students' OTR. Third, the following journals were hand searched to locate the most recent studies (2010–2013): *Education and Training in Autism and Developmental Disabilities, Education & Treatment of Children, Exceptional Children, Journal of Applied Behavior Analysis, Journal of Behavioral Education, Journal of*

Positive Behavior Interventions, The Journal of Special Education, Remedial and Special Education, Teacher Education and Special Education, Behavioral Disorders, Exceptionality: A Special Education Journal, and *Focus on Autism and Other Developmental Disabilities*. Websites of these journals were also searched for online first articles (search occurred December 2013). Finally, references from relevant studies were examined to locate additional articles. Unpublished master's theses and unpublished/published dissertations were not included in the search. Authors previewed titles and abstracts to identify potential articles. Each article was discussed, and 100% agreement was reached on the 24 studies identified for inclusion in this review.

Selection of Studies

A systematic review of the 24 identified studies was then conducted. Each article was reviewed to determine whether it met the following inclusion criteria: (a) published in peer-reviewed journal, (b) included elementary students in general or special education kindergarten through Grade 5, (c) used response cards as independent variable, (d) dependent variables measured included OTR, and (e) used a single-case design. Articles were not included if they met any of the following exclusion criteria: (a) published in any source other than a peer-reviewed journal; (b) included students in prekindergarten, Grades 6 through 12, or university; (c) no dependent variables measured OTR; (d) single-case design utilized did not yield a functional relation (i.e., ABA, alternating treatments); (e) experimental and quasi-experimental studies; or (f) unpublished/published master's thesis or dissertation. Although reversal (e.g., ABA) and alternating treatments are considered single-case designs, these designs do not yield a functional relation and were not included in the current review. Prediction, verification, and replication of effect are required to establish a functional relation. Given that there is no replication of effect in an ABA design, studies utilizing this design were excluded from the review. Furthermore, an alternating treatments design is designed to compare interventions and is susceptible to multiple treatment interference; therefore, authors chose to exclude studies utilizing this design from the review. Although group experimental studies were included in the search, none were reviewed because in one study identified at the elementary level (i.e., Fujiki, Spackman, Brinton, & Illig, 2008), the only dependent variable measured was student performance. From these 24 articles, a total of 6 studies (25%) were identified as meeting inclusion criteria and were included in the review.

Although six included studies are rather restrictive, it is important to note reasons for excluding additional articles identified ($n = 18$). Of the excluded studies, one article examined teacher, rather than student behavior. A second article examined only correct student responses, rather than number of student responses (Skibo, Mims, & Spooner, 2011). Furthermore, four studies (three conducted at the elementary level) did not utilize a design that would demonstrate a functional relation such as ABA or ANCOVA (e.g., Armendariz & Umbreit, 1999; Christle & Schuster, 2003; Fujiki et al., 2008). Five of the articles examined effects of response cards on middle school or university students (e.g., Davis & O'Neill, 2004; Desrochers & Shelnutt, 2012; Horn, Schuster, & Collins, 2006). The remaining seven articles, none of which were conducted at the elementary level, compared effects of response cards and an additional independent variable using an alternating treatments design and were excluded for inability to demonstrate a functional relation (e.g., Godfrey, Grisham-Brown, Schuster, & Hemmeter, 2003; Marmolejo, Wilder, & Bradley, 2004; Shabani & Carr, 2004).

Of the six identified studies included in the review, one study was included in the Randolph (2007) meta-analysis (i.e., Gardner, Heward, & Grossi, 1994), one was included in the Horn (2010) review (i.e., Berrong et al., 2007), and one was included in both the Randolph and Horn reviews (i.e., Narayan et al., 1990). The remaining three studies (i.e., Lambert et al., 2006; Munro & Stephenson, 2009; Wood, Mabry, Kretlow, Lo, & Galloway, 2009) were not included in previous reviews.

Selection and Application of Quality Indicator Criteria

Researchers used a 20-item single-case quality indicator checklist outlined by the National Secondary Transition Technical Assistance Center (NSTTAC) to code individual studies (Test et al., 2009; see Table 1). The NSTTAC quality indicator checklist was developed based on criteria set forth by Horner et al. (2005) and is not specific to transition practices. Components were organized into seven broad quality indicators: (a) participants, (b) setting, (c) dependent variable, (d) independent variable, (e) procedures, (f) results, and (g) social validity. Studies were rated for presence or absence of each subcomponent identified within the broad indicators as Cook et al. (2009) found interrater reliability was lower when using a 4-point rubric to rate presence or absence of quality indicators in single-case research, and therefore recommended future reviews use a dichotomous scale.

Interpreting quality indicators. According to quality indicator criteria set forth by Test et al. (2009), to be considered high quality, a single-case research study must meet all 20 quality indicators. To be considered acceptable quality, a study must meet all quality indicators except (a) #2: Participant selection described with replicable precision, (b) #11: Overt measurement of the fidelity of implementation for the independent variable, and (c) #17 to 20: must have one of four identified social validity subcomponents. Frequently, social

Table 1. Quality Indicator Checklist for Single-Case Studies.

Quality indicator
Participants
1. Described with sufficient detail
2. Participant selection described with replicable precision[a]
Setting
3. Critical features of setting described with sufficient precision to allow replication
DV/measures
4. All DVs described with operational precision
5. Each DV measured with a procedure that generates a quantifiable index
6. Measurement process was described with replicable precision
7. DVs were measured repeatedly over time
8. Data were collected on reliability or IOA associated with each DV, and IOA levels met minimal standards (e.g., IOA = 80%)
IV/intervention
9. IV was described with replicable precision
10. IV was systematically manipulated and under the control of the experimenter
11. Overt measurement of the fidelity of implementation for IV (treatment integrity/procedural reliability)[a]
Procedures
12. A baseline phase provided repeated measurement of a DV and established a pattern of responding that can be used to predict the pattern of future performance, if introduction or manipulation of the IV did not occur
13. Procedural characteristics of the baseline conditions were described with replicable precision
Results/graphs/design
14. Design provides at least three demonstrations of experimental effect at different points in time
15. Design controls for common threats to interval validity (e.g., permits elimination of rival hypotheses)
16. Experimental effects were replicated across participants, settings, or materials to establish external validity
Social validity (must have one of these four for acceptable quality)[a]
17. DV is socially important
18. Magnitude of change in DVs resulting from the intervention is measured as socially important
19. Implementation of IV was described by author as practical and cost-effective
20. Social validity is enhanced by implementation of IV over extended time periods, by typical intervention agents, in typical physical and social contexts

Note. This public domain document can be found at http://www.nsttac.org/sites/default/files/assets/pdf/pdf/ebps/Quality%20Indicator%20Single%20Subject%20template.pdf. DV = dependent variable; IOA = interobserver agreement; IV = independent variable.
[a]Quality indicator not required to be rated as acceptable.

validity and treatment fidelity measures are reasons studies do not meet quality indicator criteria. In an effort to refrain from further limiting identified studies for inclusion, researchers chose to utilize the quality indicator criteria outlined by NSTTAC in Test et al. (see Table 1 for a list of quality indicators).

Interrater reliability for quality standards. Using quality indicator criteria, authors independently reviewed and rated single-case studies that met inclusion criteria. The review team included two doctoral students studying special education with a combined total of 10 years teaching experience in special education. An item-by-item analysis was completed to calculate percentage of agreement. Percent of agreement was calculated by dividing the number of agreements by the number of agreements plus disagreements, and multiplied by 100. Only one discrepancy occurred between scorers. The discrepancy existed within the social validity quality indicator (i.e., whether or not magnitude of change in dependent variables resulting from the intervention was measured as socially important) on the Narayan et al. (1990) study. Interrater reliability on the quality indicator checklist was calculated for three of the six studies and was 98.3% with a range of 96.6% to 100%. Based on the 20-item checklist, articles were then rated to determine quality of the evidence base for response cards to increase OTR for elementary students. Each of the six single-case studies reviewed was rated either high or acceptable quality and was thus able to be used to determine the evidence base for response cards.

Categorizing the Strength of Evidence

For consistency, criteria used by Test et al. (2009) were used to make a final determination of response cards as an evidence-based practice. For single-case research, Test et al. developed decision rules for categorizing the strength of evidence (i.e., strong or moderate). These criteria were

developed based on work of the Institute of Education Sciences and Horner et al. (2005). For a practice to be labeled as having a "strong" evidence base, five studies of high quality must be identified. Of these studies, three independent research teams must conduct the research, and each study must demonstrate a functional relation and no contradictory evidence from a study reflecting strong evidence could exist. To be labeled as having a "moderate" evidence base, at least three studies of high or acceptable quality must be identified. Of these studies, research must be conducted by one or two independent research teams, and studies have to demonstrate a functional relation. These criteria were applied to the identified response card studies to determine the level of evidence for using response cards as a strategy for increasing OTR for students at the elementary level (i.e., K-5).

Results

Quality of Single-Case Research Studies

Six single-case studies were examined based on the 20 quality indicators. Table 2 provides a detailed description of individual studies. Of the six studies, two met all 20 quality indicators (i.e., Lambert et al., 2006; Wood et al., 2009) and were determined to be high-quality studies based on Test et al.'s (2009) criteria. The remaining four studies (i.e., Berrong et al., 2007; Gardner et al., 1994; Munro & Stephenson, 2009; Narayan et al., 1990) were determined to be acceptable quality. See summary of quality indicators for each of the six studies in Table 3.

Participants and setting. First, studies were examined to determine whether participants were described with sufficient detail (e.g., age, gender, disability, selection) and whether critical features of settings were described to allow replication. Based on criteria set forth in Test et al. (2009), studies could still meet acceptable quality if participant selection was not described with replicable precision. All six studies included all quality indicators outlined for this category.

Dependent variable/measures. Second, studies were reviewed based on the dependent variable quality indicator. For this indicator, studies were examined for description, measurement procedures, and frequency and reliability of implementation of the dependent variable, OTR. All studies were coded as including all dependent variable indicators.

Independent variable/intervention. Third, studies were examined to determine whether the independent variable (i.e., response cards) was described with replicable precision, systematically manipulated, and measured for fidelity of implementation. Four studies included each of these independent variable components. Two of the studies reviewed did not measure fidelity of implementation (i.e., Munro & Stephenson, 2009; Narayan et al., 1990) but were still eligible to be considered as acceptable quality studies.

Procedures. Fourth, each study was evaluated based on procedures used. This included description of baseline conditions with replicable precision and repeated measurement of dependent variable during baseline combined with an established pattern of responding used to predict a pattern of future performance. All studies met criteria for the baseline indicator.

Results. Fifth, studies were evaluated to determine whether the single-case design demonstrated experimental control, controlled for threats to internal validity, and whether effects were replicated across participants, settings, or materials. In all six studies, experimental control was demonstrated by (a) staggering introduction of the independent variable and documenting changes in trend and level or (b) researcher manipulation of the independent variable across different phases of the study. All studies included three demonstrations of experimental effect at different points in time.

Social validity. Finally, studies were examined for documentation of social validity. Studies were reviewed based on the following components: (a) importance of dependent variable, (b) magnitude of change in independent variable, (c) implementation of independent variable described as practical and cost-effective, and (d) independent variable implemented over extended periods of time, by typical interventionists (e.g., teachers) and in typical contexts (e.g., classroom). If studies included all four components, they had the potential to be considered high quality, based on results of other quality indicators examined. Only two studies reviewed met all four social validity quality indicators (i.e., Lambert et al., 2006; Wood et al., 2009). For this quality indicator, studies had to have at least one of four components to be considered acceptable quality. All studies included dependent variables that were socially important. Three studies did not include a measure of social validity with teachers (i.e., Berrong et al., 2007; Munro & Stephenson, 2009; Narayan et al., 1990), although one study did examine outcomes from students' perspective (Narayan et al., 1990). Without a social validity measure, these studies did not fully address the final indicator under social validity. Although typical intervention agents (e.g., teachers) conducted each of these studies in typical settings (e.g., classroom), teachers were not given a survey or questionnaire to measure the outcomes. Therefore, they were not given an opportunity to report the procedures as acceptable, feasible, or effective. Finally, three of six studies (i.e., Berrong et al., 2007; Gardner et al., 1994; Munro & Stephenson, 2009) did not assess the practicality and cost-effectiveness of response cards.

Table 2. Literature Review of RC and Opportunity to Respond for Elementary Students (K-5).

Study	Purpose	Participants	Setting	Design	Dependent variable(s)	Independent variable	Results of study
Berrong, Schuster, Morse, and Collins (2007)	Determine whether RC would increase active responding and on-task behavior, and decrease inappropriate behavior of students with moderate and severe disabilities	Eight students with moderate to severe disabilities; female (n = 3), male (n = 5); ages 10–12 years; IQ range of four students: 41–59; one student with physical disability, one student with hearing impairment	Self-contained special education classroom—During calendar time	ABAB design	Active responding On-task behavior Inappropriate behavior	Preprinted RC	Active responding: M%: HR1 (M = 21.7%), RC1 (M = 58.8%), HR2 (M = 28.7%), RC2 (M = 56.3%). No overlap across conditions. On-task behavior: M%: HR1 (M = 35.7%), RC1 (M = 79.4%), HR2 (M = 36.9%), RC2 (M = 71.5%). No overlap between conditions. Inappropriate behavior: M rate: HR1 (M = 0.77), RC1 (M = 0.40), HR2 (M = 0.89), RC2 (M = 0.27).
Gardner, Heward, and Grossi (1994)	Compare effects of HR and RC on frequency of active student responding, accuracy of student responses, next-day quiz performance, and test performance	Five students; ages 10–12 years	Fifth-grade inner-city classroom—During science instruction, midwestern city	ABAB design	Teacher presentation rate Number of student responses Accuracy of student responses Next-day quiz scores Biweekly review test scores	Write-on RC	Teacher presentation rate: M per minute: HR (M = 1.9), RC (M = 1.2). Student responses: M number of academic responses: HR (M = 1.5), RC (M = 21.8). Participation during oral group responses: HR (4%), RC (68%). Accuracy of responses: HR (92%), RC (93%). Next-day quiz scores: M quiz scores: HR1 (M = 59%), RC1 (M = 70%), HR2 (M = 51%), RC2 (70%). Overall M score of class: HR (M = 57%), RC (M = 70%). Review tests: Class M on review test items: HR (M = 49%), RC (M = 70%).
Lambert, Cartledge, Heward, and Lo (2006)	Determine effects of using RC during math lessons on disruptive behavior and students' academic responding	Nine students; ages 9–10 years; African American (n = 8), Caucasian (n = 1); low-math performance	Two fourth-grade general education classrooms—During math instruction	ABAB design	Disruptive behavior Rate of academic responses	Write-on RC	Disruptive behavior: M number of disruptive behaviors: SSR (M = 6.8), RC (M = 1.3). Rate of academic responses: M academic responses per minute: SSR (M = 0.12), RC (M = 0.94).
Munro and Stephenson (2009)	Examine effects of RC and HR on participation, academic achievement, and teacher behavior during whole-class vocabulary instruction	Five students, low to high achieving; male (n = 3), female (n = 2); ages 10–11 years	Fifth-grade whole-class English instruction; inner-city public school in British Columbia	ABAB design	Rate of teacher questions Rate of teacher feedback statements Percentage of student responses Test scores	Write-on RC	Teacher behavior rates: HR (M = 1.01), RC (M = 1.06); Teacher feedback (per minute): HR (M = 0.92), RC (M = 1.2); Student participation: HR to RC, respectively: Alice (0%–46%), Leo (22%–95%), Brenda (16% to 91%), Sam (26%–100%), Nicky (27%–100%); Test scores: Higher during RC than HR for all five students.

(continued)

Table 2. (continued)

Study	Purpose	Participants	Setting	Design	Dependent variable(s)	Independent variable	Results of study
Narayan, Heward, Gardner, Courson, and Omness (1990)	Evaluate RC in fourth-grade social studies class	Six students; ages 9–11 years	Fourth-grade whole-class social studies instruction	ABAB design	Teacher presentation rate Number of student responses Accuracy of student responses Daily quiz scores	Write-on RC	Teacher presentation rate: *M* per minute: HR (*M* = 1.54), RC (*M* = 0.99). Student responses: *M* number of academic responses: HR (*M* = 0.9), RC (*M* = 15.6). Participation during oral group responses: HR (4%), RC (68%). Accuracy of responses: *M* correct responses per session—HR (*M* = 0.74), RC (*M* = 13.0). Next-day quiz scores: Group *M* quiz scores: HR1 (*M* = 7.4), RC1 (*M* = 8.2), HR2 (*M* = 6.5), RC2 (*M* = 7.8).
Wood, Mabry, Kretlow, Lo, and Galloway (2009)	Investigate effects of preprinted RC on participation and off-task behavior in an inclusion classroom	Four students, two without disabilities, one with SLD and S/L, one without DD; ages 5–6 years; Caucasian (*n* = 3), multiracial (*n* = 1); male (*n* = 2), female (*n* = 2)	Urban kindergarten inclusion classroom—During calendar time	ABAB design	Participation Off-task behavior	Preprinted RC	Participation: Overall participation increased for all students during RC phases compared with HR phases. *M* responses: HR1 (*M* = 1.7), RC1 (*M* = 29.36), HR2 (*M* = 1.93), RC 2 (*M* = 28.35); Off-task behavior: Off-task behavior decreased during RC phases. *M* of off-task behavior: HR1 (*M* = 70.36%), RC1 (*M* = 1.84%), HR2 (*M* = 53.6%), RC 2 (*M* = 6.74%).

Note. RC = response cards; HR = hand raising; SSR = single student response; SLD = specific learning disability; S/L = Speech and Language; DD = Developmental Disabilities.

Table 3. Quality Indicators Met for Single-Case Research on Using Response Cards to Increase Opportunity to Respond.

Quality indicator	Narayan, Heward, Gardner, Courson, and Omness (1990)	Gardner, Heward, and Grossi (1994)	Lambert, Cartledge, Heward, and Lo (2006)	Berrong, Schuster, Morse, and Collins (2007)	Wood, Mabry, Kretlow, Lo, and Galloway (2009)	Munro and Stephenson (2009)
Participants						
1. Described with sufficient detail	Yes	Yes	Yes	Yes	Yes	Yes
2. Participant selection described with replicable precision	Yes	Yes	Yes	Yes	Yes	Yes
Setting						
3. Critical features of setting described with sufficient precision to allow replication	Yes	Yes	Yes	Yes	Yes	Yes
DV/measures						
4. All DVs described with operational precision	Yes	Yes	Yes	Yes	Yes	Yes
5. Each DV measured with a procedure that generates a quantifiable index	Yes	Yes	Yes	Yes	Yes	Yes
6. Measurement process was described with replicable precision	Yes	Yes	Yes	Yes	Yes	Yes
7. DVs were measured repeatedly over time	Yes	Yes	Yes	Yes	Yes	Yes
8. Data were collected on reliability or IOA associated with each DV, and IOA levels met minimal standards (e.g., IOA = 80%)	Yes	Yes	Yes	Yes	Yes	Yes
IV/intervention						
9. IV was described with replicable precision	Yes	Yes	Yes	Yes	Yes	Yes
10. IV was systematically manipulated and under the control of the experimenter	Yes	Yes	Yes	Yes	Yes	Yes
11. Overt measurement of the fidelity of implementation for IV (treatment integrity/procedural reliability)	No	Yes	Yes	Yes	Yes	No
Procedures						
12. A baseline phase provided repeated measurement of a DV and established a pattern of responding that can be used to predict the pattern of future performance, if introduction or manipulation of the IV did not occur	Yes	Yes	Yes	Yes	Yes	Yes
13. Procedural characteristics of the baseline conditions were described with replicable precision	Yes	Yes	Yes	Yes	Yes	Yes
Results/graphs/design						
14. Design provides at least three demonstrations of experimental effect at different points in time	Yes	Yes	Yes	Yes	Yes	Yes
15. Design controls for common threats to interval validity (e.g., permits elimination of rival hypotheses)	Yes	Yes	Yes	Yes	Yes	Yes

(continued)

Table 3. (continued)

Quality indicator	Narayan, Heward, Gardner, Courson, and Omness (1990)	Gardner, Heward, and Grossi (1994)	Lambert, Cartledge, Heward, and Lo (2006)	Berrong, Schuster, Morse, and Collins (2007)	Wood, Mabry, Kretlow, Lo, and Galloway (2009)	Munro and Stephenson (2009)
16. Experimental effects were replicated across participants, settings, or materials to establish external validity	Yes	Yes	Yes	Yes	Yes	Yes
Social validity (must have one of these four for acceptable quality)						
17. DV is socially important	Yes	Yes	Yes	Yes	Yes	Yes
18. Magnitude of change in DVs resulting from the intervention is measured as socially important	No	Yes	Yes	No	Yes	No
19. Implementation of IV was described by author as practical and cost-effective	Yes	No	Yes	No	Yes	No
20. Social validity is enhanced by implementation of IV over extended time periods, by typical intervention agents, in typical physical and social contexts	No	No	Yes	No	Yes	No

Note. DV = dependent variable; IOA = interobserver agreement; IV = independent variable.

Determination of Evidence-Based Practice

With only two studies (i.e., Lambert et al., 2006; Wood et al., 2009) rated as high quality, response cards could not be considered an evidence-based practice with a "strong" level of evidence at the elementary level based on the quality indicator criteria for single-case research proposed by Test et al. (2009). Although only two studies were high quality, the remaining four were rated as acceptable quality. All six articles were published in peer-reviewed journals. Among articles reviewed, four were conducted by different groups of researchers. Furthermore, research was carried out in four different geographical regions (Australia, North Carolina, Kentucky, and Ohio). In addition, a total of 37 elementary students in kindergarten through Grade 5 (ages 5–12 years) participated in these studies and were targeted for data collection. Studies included low- to high-achieving students. Five studies were conducted in a whole-class general education setting (i.e., Gardner et al., 1994; Lambert et al., 2006; Munro & Stephenson, 2009; Narayan et al., 1990; Wood et al., 2009). Of those, three studies included students who represented the class range of skill levels, low to high achieving (i.e., Gardner et al., 1994; Munro & Stephenson, 2009; Narayan et al., 1990). One of the five studies included students who were most disruptive, least attentive, and performed lowest academically (i.e., Lambert et al., 2006). The final study included students with high-incidence disabilities (i.e., developmental delay and specific learning disability) and was considered an inclusion classroom (i.e., Wood et al., 2009). The remaining study was conducted within a self-contained classroom with students with moderate to severe disabilities (i.e., Berrong et al., 2007). Therefore, the compilation of studies met the requirement of three high- or acceptable-quality studies suggested by Test et al. to support using response cards to increase OTR at the elementary level as an evidence-based practice with a moderate level of evidence.

Discussion

The purpose of this review of literature was to evaluate the quality of single-case studies examining effects of response cards on OTR for elementary students (K-5) to determine whether response cards could be considered an evidence-based practice based on the Test et al. (2009) criteria. Results of the current study indicate response cards can be considered an evidence-based practice with a moderate level of evidence for increasing OTR for elementary students.

Findings of this study extend research of both Randolph (2007) and Horn (2010). Although Randolph found statistically significant ES for the use of response cards on both test and quiz achievement and Horn indicated response cards could be considered an evidence-based practice based on the three guidelines suggested by Horner et al. (2005), neither study included the critical first step of determining the level of quality of the studies reviewed. Only studies that meet a specific level of quality can be used to establish an evidence-based practice. The current study reviewed, analyzed, and coded studies based on NSTTAC standards and quality indicators (Test et al., 2009). Based on the level of quality criteria, the current study was able to identify that using response cards to increase OTR for students at the elementary level is an evidence-based practice with a moderate level of evidence.

In addition, based on the coded studies, authors were able to identify areas across the literature using response cards as a strategy for increasing OTR for elementary-level students that could potentially be improved. These improvements include collecting data on procedural fidelity (e.g., Munro & Stephenson, 2009; Narayan et al., 1990) and social validity (e.g., Berrong et al., 2007; Gardner et al., 1994; Munro & Stephenson, 2009; Narayan et al., 1990). These findings are consistent with previous evidence-based practice reviews that also found identified studies did not meet minimum criteria on fidelity of implementation of the intervention (e.g., Chard, Ketterlin-Geller, Baker, Doabler, & Apichatabutra, 2009; Montague & Dietz, 2009) and often did not sufficiently address all four social validity indicators (Lane, Kalberg, & Shepcaro, 2009). However, other weaknesses identified in previous evidence-based practice reviews were not found in the current review. For example, previous reviews identified weaknesses in establishing and describing baseline performance (i.e., Chard et al., 2009; Montague & Dietz, 2009); lack of replication across participants, settings, or materials to establish external validity (e.g., Chard et al., 2009); and insufficient descriptions of participants and setting (e.g., Chard et al., 2009). None of these variables were missing from the studies included in this review.

Although it appears the quality of research studies using response cards is improving, the lack of consistent data on procedural fidelity and social validity is troubling. First, because procedural fidelity data (a) are recognized as necessary but insufficient for demonstrating a functional relation (Gresham, 2005), (b) that not collecting procedural fidelity data leads to doubtful conclusions about functional relations (Peterson, Homer, & Wonderlich, 1982), and (c) failure to ensure procedural fidelity can threaten internal validity, external validity, construct validity, and statistical conclusion validity (Perepletchikova & Kazdin, 2005), the lack of these data calls into question whether or not the "practice" under study was actually implemented as planned. Without these data, it is impossible to know what "practice" resulted in the effect found in a particular study.

Next, if we are to bridge the research-to-practice gap for use of evidence-based practices in classrooms (Burns & Ysseldyke, 2009), consumers (teachers) must view the

practice as acceptable and feasible. Therefore, collecting and reporting social validity should be a critical criteria for establishing evidence-based practices. In conclusion, for evidence-based practices to be believable, there must be procedural fidelity data, and for evidence-based practices to be acceptable and feasible for teachers, social validity data are needed.

Limitations and Directions for Future Research

Although results of this review establish response cards as an evidence-based practice with a moderate level of evidence for increasing OTR for students at the elementary level, there are several limitations that need to be mentioned. First, the current review only examined studies at the elementary level. The focus was narrowed to one specific level (i.e., elementary) to target a specific audience as opposed to making a more general statement about a broader range of students. Therefore, results of this study cannot be generalized to other grades (e.g., secondary). Future research is needed to examine effects of response cards with students at other academic levels. Given that studies conducted in prekindergarten, middle and high school, and at the university level were located, but not used in this review, it may be possible to determine the evidence base for effects of response cards on OTR across other educational levels.

Second, although this review only examined studies that measured OTR, several studies (e.g., Munro & Stephenson, 2009; Narayan et al., 1990) measured other dependent variables (e.g., off-task behavior, achievement) in addition to OTR. Therefore, future research is needed to investigate the level of evidence for using response cards to increase, or decrease, other dependent variables (e.g., on-task behavior, off-task behavior, student achievement).

Third, this review only focused on elementary students with varying ability levels. For example, researchers did not look at response card use with a specific population of students (e.g., students with disabilities, English language learners) or in a specific setting (e.g., inclusion classroom, self-contained classroom). Future research should focus on a specific population of students in various classroom settings. For example, additional research is needed to determine whether response cards are an evidence-based practice for students with disabilities, English language learners, or students at risk for academic failure. Use of response cards may aid these students in learning new material, maintaining previously taught material, recalling information, and generalizing knowledge or skills to other areas.

Finally, research using response cards to increase OTR for elementary students indicates this practice has only a moderate level of evidence. To establish response cards as having a "strong" level of evidence, three additional high-quality single-case studies are needed. As a result, future response card researchers must include all the quality indicators (e.g., treatment fidelity, social validity) necessary for high-quality single-case research.

Implications for Teachers

As noted previously, federal legislation requires teachers implement classroom practices that are evidence based (IDEIA, 2004) and proven effective through scientific research (NCLB, 2002). Results of this review offer several implications for teachers. First, similar to Horn (2010), the current review identifies response cards as a practical, cost-effective instructional tool that can be used to increase students' OTR in the classroom. It is feasible for teachers to include response cards as a part of daily or weekly instruction or review of material. In addition, response cards offer teachers a quick way to assess students and receive immediate feedback that can be used to drive instruction. By providing students' OTR to teacher-posed questions, students are actively participating in instruction, thus increasing the likelihood of on-task behavior, which could lead to a positive change in classroom management by teachers.

Pursuing this further, a key goal of research is to improve practice by making a practical difference in educational settings (Carnine, 1997). In the reviewed studies, classroom teachers implemented the study with their own students, thus making them a part of the decision-making process. Use of teachers as interventionists indicates the feasibility of implementing response cards in the classroom. Response cards offer an easy, cost-effective way to bridge the research-to-practice gap by providing teachers a solution to everyday problems that occur in the classroom (e.g., passive behavior) that may stem from single student responding (e.g., hand raising).

In addition, studies analyzed in this review were implemented by teachers in both general (e.g., Lambert et al., 2006; Wood et al., 2009) and special (i.e., Berrong et al., 2007) education classrooms. This is important because more and more students with disabilities are being educated in inclusive settings. Beginning with the IDEA (1975), schools were required to provide students with disabilities a free and appropriate education in the LRE appropriate to the individual student's needs. As an outcome of the present study, it is suggested that teachers use response cards to help students with disabilities access the general curriculum and fully participate in the instructional and learning processes in an inclusive classroom. Response cards can also be used as an accommodation for students with disabilities. Therefore, general and special education teacher preparation programs should consider including response cards as a component of the curriculum to provide preservice teachers with another evidence-based practice for all students at the elementary level.

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