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The Effects of Repeated Reading on Reading Fluency for Students With Reading Disabilities: A Meta-Analysis

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Abstract

The purpose of this research was to systematically review the effects of repeated reading (RR) interventions on reading fluency to provide instructional strategies for students with reading disabilities (RD). Correct words per minute were coded as an outcome variable in a search that yielded 34 RR intervention studies from 1990 to 2014 for students with RD in K-12. The estimated overall Hedges' *g* of the 39 independent effect sizes indicated the positive effects of RR on gains in reading fluency for students with RD, especially at the elementary grade level. The current findings also suggested that a combination of RR and a listening passage preview would be the most effective method for students with RD.

Keywords

reading disabilities, repeated reading, meta-analysis

Reading disability is the most common learning disability, affecting more than 80% of students identified with learning disabilities (LD; Lerner, 2003). In particular, students with reading disabilities (RD) have difficulties with reading fluency due to inadequate phonological skill and slowed oral language processing speed. For these reasons, 74% of those at age 9 continue through high school to read below grade level (Lyon, 1996; Zentall, 2014). Given these difficulties, reading fluency intervention may be especially important for later academic success across subject areas for students with RD.

Reading fluency is defined as the ability to read text quickly and accurately with few miscues and little effort and to read expressively with appropriate pausing, phrasing, and articulation. Reading fluency is considered an indicator of automaticity. The effectiveness of repetition and the effects of repeated reading (RR) intervention are derived from a theory of automatic word processing (LaBerge & Samuels, 1974; Logan, 1988). That is, when automaticity is achieved it allows students to focus on meaning (Ardoin, Morena, Binder, & Foster, 2013; LaBerge & Samuels, 1974; Swain, Leader-Janssen, & Conley, 2013).

RR has been reported as the most commonly recommended procedure to improve reading fluency for students with RD (National Reading Panel, 2000; O'Connor, White, & Swanson, 2007; Therrien & Hughes, 2008) and is often used in combination with other interventions, such as passage preview, systematic error correction (SEC), and performance feedback (Begney & Silber, 2006; Swain et al., 2013). RR instruction requires students to read the same passages more than once or until an established criterion is met (Chard, Ketterlin-Geller, Baker, Doabler, & Apichatabutra, 2009; Weinstein & Cooke, 1992). It has consistently been reported as an effective intervention to improve reading fluency (e.g., accuracy and rate) for beginning readers and for students with reading disabilities/difficulties (Chafouleas, Martens, Dobson, Weinstein, & Gardner, 2004; J. S. Nelson, Alber, & Gordy, 2004). Specifically for students with RD across grade levels, research has documented the effectiveness of RR on reading fluency (2nd–4th grade, O'Connor et al., 2007; 4th–6th grade, Therrien & Hughes, 2008; 10th–11th grade, Hawkins, Hale, Sheeley, & Ling, 2011).

Although What Works Clearinghouse (2014) recently concluded that there were no significant effects of RR on reading fluency for students with LD, this conclusion was based on one study (i.e., Wexler, Vaughn, Roberts, & Denton, 2010), which assessed only secondary-level students with LD (5th–12th grade) without considering the importance of RR for elementary readers. In addition, Wexler et al. (2010) included other disabilities, such as intellectual disorder and autism, in their sample.

There were, however, mixed findings on the effectiveness of RR in a comparison of different ability groups. For example, the effectiveness of RR has been documented

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regardless of classification (LD vs. non-LD) or level of functioning (instructional vs. mastery level) (Sindelar, Monda, & O'Shea, 1990). In contrast, when RR was combined with other instructional formats, group differences were documented (e.g., the highest performing readers with significant gains with RR alone vs. the lowest performing readers with gains only when RR was combined with performance feedback, Chafouleas et al., 2004). In line with the above research, the National Reading Panel (2000) concluded that RR was more beneficial to average than to poor readers.

In sum, there are consistent reports and conclusions that RR is an effective intervention to improve reading fluency. Effectiveness has been reported across type of disability, even though disability comparison studies are less consistent in outcome—sometimes favoring average readers rather than poor readers. In addition, questions remain about the frequent use of variables combined with RR intervention, which could explain some inconsistencies. In response to the heterogeneity of intervention components, Chard and his colleagues (2009) reported that "in all cases, the treatments were so sufficiently different from treatments in all other studies that it was impossible to generalize the findings" (p. 276) and concluded that RR was not an evidence-based practice.

Thus, the lack of purity of intervention may obviate some of the conclusions that have been drawn and make intervention comparisons difficult. For example, studies have reported no significant differences between conditions when they have compared RR with reading practice conditions such as assisted reading, involving teacher's modeling of a phrase or sentence (Homan, Klesius, & Hite, 1993); continuous reading, involving practice reading aloud across a range of materials (O'Connor et al., 2007); a modified Re-read-Adapt and Answer-Comprehend program, involving SEC, performance feedback, and adjustment of text difficulties (Therrien, Kirk, & Wood-Groves, 2012); and typical instruction (Wexler et al., 2010). It is for this reason that isolating intervention components and possible moderating variables may be important.

RR Instructional Components and Moderating Variables

Of those studies documenting gains in oral reading fluency, most have reported greater gains when RR was used in combination with other interventions. The interventions used with RR are (a) word preview, which involves an initial preview and practice of isolated words before reading; (b) listening passage preview, which involves initially listening to an audiotape or teacher's model reading the passage; (c) error correction, which involves correcting errors during oral reading; (d) performance feedback, which involves goal setting, self-evaluation, and extrinsic reward after reading; (e) peer-mediated reading, which involves peer tutoring or partner reading; and (f) textual factors, which involve introducing a gradual level of text difficulty, for example, from practiced passages (nontransfer) to unpracticed generalized passages (transfer) (for review, see Welsch, 2007).

Among these intervention components, listening passage preview combined with RR has improved reading fluency (Eckert, Ardoin, Daly, & Martens, 2002; Silber & Martens, 2010; Wexler, Vaughn, Edmonds, & Reutebuch, 2008). However, these improvements have been explained by the moderating variable of anxiety, which may be lessened for low-skilled students when they are in the presence of a model (Swain et al., 2013), especially a teacher modeling enhanced reading fluency more than a tape- or computer-modeled reading (Chard, Vaughn, & Tyler, 2002).

Studies have also reported that SEC and performance feedback are effective instructional components to increase reading fluency in RR for struggling readers (Kostewicz & Kubina, 2011; Lo, Cooke, & Starling, 2011). Therrien et al. (2012) found students made significant gains in reading fluency when they were provided teacher's correction of word errors (immediately following or after reading the passage) and performance feedback involving teacher ratings and a student self-assessment rubric. However, they found these gains with both RR ($p = .007$) and a nonrepetitive condition ($p < .001$).

RR instruction has also been conducted in a peer-mediated reading context, which included partner reading, small-group reading, and multiple grouping format (for review, see Vaughn, Gersten, & Chard, 2000). In partner paired reading, a higher and lower performer work together cooperatively to take different roles as a tutor or tutee (Vaughn et al., 2000) or to simply read to one another (Yurick, Robinson, Cartledge, Lo, & Evans, 2006). Similarly in small groups, three to five students take turns reading a passage (Yurick et al., 2006). The effectiveness of peer-mediated reading instruction could be explained by the moderating factor of increased active academic responding for students with RD (Mathes & Fuchs, 1993; Vaughn et al., 2000; Yurick et al., 2006) or by social motivation, which can act as a significant predictor of the reading achievement for struggling readers (Klauda & Guthrie, 2014; Lee & Zentall, 2012).

Finally, altering text difficulty using nontransfer practiced passages and generalized transfer passages is also an important component to facilitate performance in RR studies, even though type of difficulty manipulation in RR varies in outcome (Mathes & Fuchs, 1993). For example, Wexler et al. (2008) reported that improvement in reading rate in RR was observed only by using nontransfer practiced passages, while Lo et al. (2011) found the effectiveness of RR on reading rate for struggling second graders by using grade-level unpracticed generalized (transfer) passages. Other researchers have concluded that the greatest gains in reading fluency occur when a gradation of

instructional-level to independent-level passages was used (Daly, Bonfiglio, Mattson, Persampieri, & Foreman-Yates, 2005; Musti-Rao, Hawkins, & Barkley, 2009).

Meta-Analyses of RR Studies

Given the heterogeneity of intervention components in the area of RR intervention, meta-analysis could be the most effective means of separating out the overall effects that have been reported from the component effects. In chronological order, the National Reading Panel (2000) reported the effect sizes of RR intervention on students in kindergarten through 12th grade on (a) word recognition measured by informal measurements and standardized tests of word knowledge (Cohen's $d = 0.55$, $N = 8$), (b) reading fluency measured by informal reading inventories and standardized tests of reading rate and accuracy (Cohen's $d = 0.44$, $N = 10$), and (c) reading comprehension assessed by standardized tests of reading comprehension and informal assessments (questions and passages, retellings, and maze tests) (Cohen's $d = 0.35$, $N = 12$)—all with moderate effect sizes for repeated oral reading. However, this meta-analytic study did not report the intervention component of RR interventions.

With greater specificity, Chard et al. (2002, $N = 24$) also reported the overall effect size of RR intervention for reading fluency with RR only (Cohen's $d = 0.68$) and with RR with multiple components (e.g., listening passage preview, peer-mediated reading) (Cohen's $d = 0.71$) for elementary students with LD. Their findings further reviewed each RR intervention study with the added component of SEC and established performance criteria for increasing text difficulty. Although this study provided the overall effects of RR with and without multiple intervention components, it failed to provide effect sizes for each component intervention (i.e., modeling, text difficulty, number of repetitions, type of feedback) on RR—possibly due to the small number of studies (1–3) reviewed in each intervention.

Therrien (2004) most recently conducted separate analyses of effects of RR on practiced and not practiced generalization passages. He synthesized the results from 16 reading fluency studies on practiced passages and reported large effects on reading rate ($ES = 0.83$) by examining the following component variables: (a) cued reading ($ES = 0.72$), (b) corrective feedback ($ES = 0.68$) versus no corrective feedback ($ES = 0.88$), and (c) number of RRs—four times ($ES = 0.95$), which was higher than two or three times. In generalization passages, reading fluency ($ES = 0.50$) included the following intervention variables: (a) adult tutor ($ES = 1.37$) versus peer tutor ($ES = 0.36$), (b) peer modeling ($ES = 0.40$), (c) corrective feedback ($ES = 0.51$) versus no corrective feedback ($ES = 0.46$), and (d) number of RR—three times ($ES = 0.42$) with the mixed groups of students with and without LD. Although this study reported separate reading fluency outcomes for students with LD (nontransfer [$ES = 0.75$, $n = 4$] and transfer [$ES = 0.79$, $n = 5$]), the conclusion was based on small numbers of students with LD.

Summary. Despite recent attention to and documentation of the effectiveness of RR interventions, several studies that compared repeated and non-RR instruction found no differences between conditions (Homan et al., 1993; Mathes & Fuchs, 1993; Therrien et al., 2012). In addition, the current meta-analyses in the area of RR have not reported the effects of the add-on intervention variables that were paired with RR or their possible moderating effects on reading outcomes. Thus, it is unclear whether it is the combined instructional variables of RR that enhance reading fluency or the repetition of RR that leads the effects on reading fluency.

The importance of the current study is to provide the basis for further intervention by documenting the effects of RR with and without added intervention components, which may moderate the responses of students with reading disabilities/difficulties. This study will provide statistical support through a meta-analysis of pedagogies that promote RR intervention. Specifically, we examined responses to repeated oral reading intervention for students with RD on reading fluency by comparing add-on intervention variables (e.g., word preview, listening passage preview, SEC, performance feedback).

The following research questions guided this study: (a) What is the overall effect of RR on oral reading fluency measured by correct words per minute (CWPM) for students with RD? and (b) What are the effects of additional component variables within the RR interventions on CWPM?

Method

To answer the research questions, we systematically reviewed the literature in the area of RR intervention for students with RD or at risk for RD. Through a quantitative approach using a meta-analysis, we combined and contrasted results from empirical studies and identified significant variables that could affect the reading fluency of RR. The conjoined variables included in the study were word preview, listening passage preview, SEC, maximum number of repeats (i.e., comparisons among two, three, and four times or more), performance feedback including goal setting and extrinsic reward, peer-mediated reading, and textual factor focused on passage transfer (practiced passages vs. generalized passages). We also included the types of documentation (journal vs. dissertation) as a possible moderator to explore publication bias.

Population of This Study

The population of this meta-analysis study is empirical studies that provided sufficient information about the effects

of RR intervention for students with RD. This study included studies published from 1990 to 2014 (the past 25 years) in peer-reviewed journals, conference proceedings, and dissertations. Scholarly work fitting this description was identified through electronic databases including Education Resources Information Center, PsycINFO, ProQuest Dissertation and Thesis Database, and ArticleFirst and search engines such as Google Scholar. Online search keywords to locate relevant articles were combinations of the following: *repeated reading, reading fluency, correct words per minute (CWPM), reading disabilities*, and *learning disabilities.* We also examined references of identified articles through online searching. Primary search for relevant papers resulted in about 400 studies.

Additional in-depth searches were carried out on the most relevant journals, researchers, and ancestry searches. Inclusion criteria of primary studies were studies with (a) an experimental research design about the effects of RR interventions on K-12 students with RD or at risk for RD, (b) reading fluency interventions conducted in English, (c) pre- and postoutcome variables including reading fluency in the unit of CWPM, and (d) sufficient quantitative information (e.g., means and standard deviations on pre- and posttests, a correlation coefficient between pre- and postoutcomes to calculate an effect size). Exclusion criteria were (a) single-subject-design studies with fewer than three participants; (b) group design studies that reported only group means; (c) studies that involved participants with cognitive, visual, and hearing impairments; participants with English as a second language; and adults with RD; and (d) studies including computer-based RR interventions.

Coding of Studies

Two researchers developed a coding scheme to code key characteristics of primary studies including (a) pre- and postassessment outcomes of CWPM, (b) possible combined intervention variables with the RR intervention (e.g., word preview, listening passage preview, SEC, maximum number of repeats, goal setting, extrinsic reward, peer-mediated reading, and passage transfer), (d) demographic variables (e.g., grade, gender, ethnicity, IQ, and reading level), and (c) documentation type (e.g., peer review journal, dissertation). These components could explain the variation in effect sizes across primary studies (Lipsey, 2009; D. B. Wilson, 2009).

The primary effect size chosen for this meta-analysis was the standardized mean difference, Hedges' *g* (Hedges, 1981) between pre- and postassessments on treatment. Considering the usual characteristics of studies in special education with small sample sizes, Hedges' *g* is more appropriate because Cohen's *d* statistic tends to overestimate the population effect sizes with a small sample size (Borenstein, 2009). Agreement in coding was established with several iterations of trial coding and revisions. All studies were coded at least twice, and when an inconsistency occurred, the coders resolved that inconsistency through discussion to clarify the initial coding criteria and arrived at unanimous consensus, as a small sample size was involved.

Data Analysis

The meta-analysis was executed in the following steps. First, a forest plot with independent effect sizes was created. Second, the standard error was calculated and the 95% confidence interval was established around the observed effect size. Third, the weighted average of the effect sizes was computed. The weight assigned to each effect size was an inverse of its variance (i.e., the sum of within- and between-study variance). Fourth, the chi-square test of homogeneity of effect sizes (Q test; Hedges & Olkin, 1985) was conducted to see if there was a significant variation across effect sizes and to ensure the choice of the random-effects model was appropriate. If there is significant variation in effect sizes, then the Q statistic is significant at degrees of freedom of $k - 1$ (where k is the number of tested effect sizes). In addition, the I^2 statistics, proposed by Higgins, Thompson, Deeks, and Altman (2003), were reported as an alternative index to quantify the amount of heterogeneity of effect sizes. Finally, we conducted inferential analyses to identify moderators to explain the variation in effect sizes. We used a Q test to compare the weighted average effect sizes for subgroups created by a moderator variable (Borenstein, 2009). The Comprehensive Meta-Analysis Software and Microsoft Excel were utilized in the analyses.

Results

We identified more than 400 studies on RR using the inclusion/exclusion criteria defined in the method for this study. However, a limited number of primary studies was available to calculate an effect size for the meta-analysis. Thus, 39 independent effect sizes were identified out of 34 studies. Figure 1 shows the distribution of the 39 Hedges' *g*s. Among them, 23 effect sizes were from 19 journals, and 16 effect sizes were from 15 dissertations. Characteristics of the studies included in the meta-analysis are presented in Table 1. Most studies provided adequate information about the instructional components (e.g., preview, error correction, performance feedback); however, many important variables (levels of training, duration, frequency, total sessions of the interventions, text difficulties, and genre) for the process of implementing RR intervention and demographic variables of IQ and ethnicity were either absent or insufficient. Therefore, those variables were excluded from the study. In addition, students with RD and at risk for RD were combined into and referred to as RD, due to equivalence in academic characteristics and response to

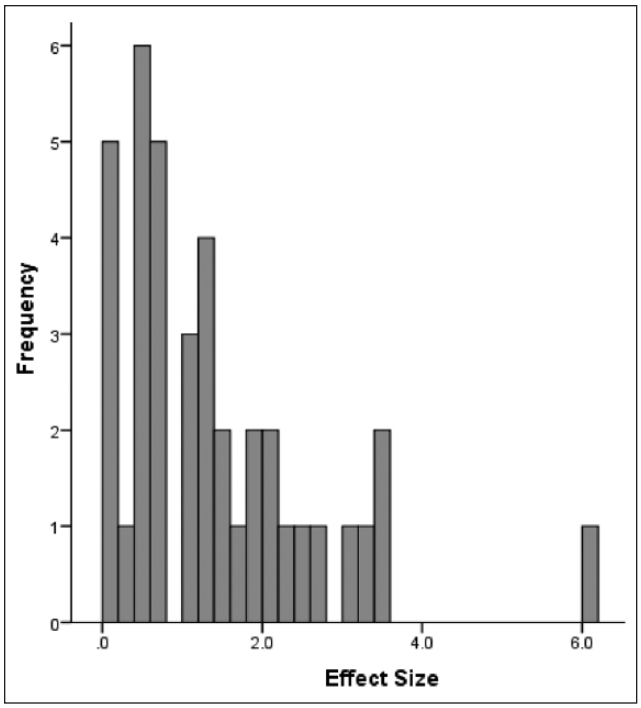

Figure 1. Distribution of 39 Hedges' *g* effect sizes.

intervention (e.g., Shaywitz, Morris, & Shaywitz, 2008). In the current study, the equivalence between RD and at risk for RD in pre-CWPM, $t(219) = 0.55$, $p = .583$, was also documented.

Coded component variables of RR intervention included word preview, listening passage preview, SEC, maximum number of repeats (two, three, and four times or more), goal setting, extrinsic reward, peer-mediated reading, textual factor such as passage transfer (generalized passages) versus nontransfer passages (practiced passages), grade levels (elementary vs. secondary), and reading levels (elementary vs. secondary). Outcome variables were pre- and postassessments of reading fluency (means and standard deviations of CWPM), correlation coefficients between pre- and post-CWPM, and the calculated effect sizes in Hedges' *g*.

Heterogeneity of Effect Sizes

A forest plot based on 34 studies is presented in Figure 2. The 39 independent Hedges' *g* effect sizes showed wide variations in 95% confidence intervals as depicted in the forest plot. The weighted mean effect size (Hedges' *g*) was 0.59 ($z = 36.62$, $p < .001$) with a 95% confidence interval between 0.56 and 0.63. The homogeneity test, $Q(38) = 996.47$, $p < .001$, shows that systematic variation across 39 cases was significant. Under the random-effects model, considering that all the studies were not conducted under the same conditions, the estimated overall average Hedges' *g* for the RR effects was 1.41 ($z = 11.18$, $p < .001$) with a 95% confidence interval between 0.99 and 1.41, which is a relatively large effect.

This indicates that, after the RR intervention, on average, the post-CWPM of a student with RD was about 1.41 standard deviations higher than the pre-CWPM before the intervention. The I^2 statistic of 96.2 implies a large proportion of the observed variation was due to systematic differences across effect sizes. This suggests the possible existence of moderators that require additional analyses to explain the variation in the observed effect sizes. Therefore, the following variables were considered in relation to the variation in the effect sizes of the RR intervention: students' grade levels (elementary vs. secondary school), reading level (elementary vs. secondary level), word preview, listening passage preview, SEC, maximum number of repeats, goal setting, extrinsic reward, peer-mediated reading, passage transfer (transfer vs. nontransfer passages), and types of documentation (journal vs. dissertation).

Combined Variable Effects

The weighted mean effect sizes by key variables are presented in Table 2.

Grade level. Subgroup analyses of studies grouped by students' grade level revealed that the RR intervention was more effective on elementary students (Hedges' $\bar{g} = 1.63$) than on secondary students (Hedges' $\bar{g} = 0.86$). The difference between subgroups with elementary and secondary was statistically significant, $Q(1) = 10.64$, $p = .001$.

Reading level. Similar to results from the subgroup analyses on students' grade level, the RR intervention was more effective on students at the elementary reading level (Hedges' $\bar{g} = 1.25$) than on students at the secondary reading level (Hedges' $\bar{g} = 0.80$). The difference between the two subgroups was statistically significant, $Q(1) = 7.89$, $p = .005$.

Word preview. While the RR intervention with word preview seemed to have a higher effect size (Hedges' $\bar{g} = 1.52$) than the RR intervention without word preview (Hedges' $\bar{g} = 1.12$), the difference was not statistically significant, $Q(1) = 2.32$, $p = .128$.

Listening passage preview. The effect of the RR intervention with the listening passage preview (Hedges' $\bar{g} = 1.95$) was significantly higher than the RR intervention without the listening passage preview (Hedges' $\bar{g} = 0.94$). The difference between the conditions was statistically significant, $Q(1) = 8.97$, $p = .003$.

SEC. There was no significant difference between the conditions of RR with and without SEC, $Q(1) = 0.009$, $p = .926$.

Table 1. Characteristics of the Studies Included in the Meta-Analysis.

ID	Author	D	*N*	GR	R_{Level}	WP	LP	SEC	#RR	G	R	P	T	M_{Pre}	SD_{Pre}	M_{Post}	SD_{Post}	*r*	*ES*
1	Ardoin, Wailliams, Klubnik, and McCall (2009)	J	4	2–5	1–3	0	1	1	3	0	1	0	1	45.2	21.7	81.4	17.5	.865	1.248
2	Barger-Anderson (2002)	D	6	5–6	3	0	0	1	3	1	0	0	0	94.3	17.6	214.8	5.9	.587	6.190
3	Begeny, Krouse, Ross, and Mitchell (2009)	J	4	2	2	0	1	0	4	0	0	1	0	65.3	7.3	98.2	9.0	.980	2.036
4	Christner (2009)	D	3	5	5	0	0	0	3	1	0	0	0	87.7	16.0	112.7	19.0	.995	0.409
5	Eckert, Ardoin, Daisey, and Scarola (2000)	J	4	1–5	1	0	0	0	3	0	0	0	1	31.7	14.1	54.1	3.6	.507	1.282
6	Fascio-Vereen (2004)	D	10	7–8	3–5	0	1	1	4	0	0	0	1	77.4	7.9	103.1	6.9	.564	3.120
7	Glazer (2007)	D	4	2	2	0	0	0	3	0	0	0	0	45.0	9.0	66.5	7.0	.748	1.859
8	Hawkins, Hale, Sheeley, and Ling (2011)	J	6	10–11	4–8	1	0	1	2	0	0	0	1	93.2	16.0	108.1	17.1	.979	0.723
9	Heath (2008)	D	3	4	1–2	0	1	1	4	0	0	0	0	58.0	5.0	122.0	22.5	.934	0.741
10	A. G. Jones (2010)	D	4	9–10	4	0	0	0	3	1	0	1	1	92.0	8.1	97.8	9.7	.880	0.441
11	K. M. Jones et al. (2009)	J	3	3	2	0	1	1	4	0	1	0	1	54.0	6.9	65.3	1.2	–.999	1.602
12	Josephs (2010)	D	5	9–11	2–5	0	0	1	3	0	0	1	1	104.7	41.6	129.5	49.1	.993	0.257
13	Klubnik (2009)	D	3	2	1	0	0	1	3	1	1	0	1	32.9	6.5	46.1	5.6	.971	1.066
14	Kostewicz and Kubina (2011)	J	7	7–8	7	0	0	1	4	0	0	0	1	85.7	13.1	93.7	16.2	.852	0.443
15	Lo, Cooke, and Starling (2011)	J	3	2	1–4	1	0	1	5	1	0	0	1	53.8	7.2	70.3	4.4	.313	1.534
16	Malanga (2003)	J	3	2	2	1	0	1	2	0	0	0	0	61.0	7.2	172.3	16.1	.820	3.481
17	Mercer, Campbell, Miller, Mercer, and Lane (2000)[a]	J	11	6	0.5	1	0	1	2	0	0	0	1	29.1	16.7	69.5	13.2	.828	2.332
18	Mercer et al. (2000)[b]	J	19	6	1.9	1	0	1	2	0	0	0	1	57.4	19.2	89.1	25.0	.254	1.353
19	Mercer et al. (2000)[c]	J	19	6	1.5	1	0	1	2	0	0	0	1	38.3	20.5	70.2	19.9	.721	1.513
20	Moyer (2012)	D	10	8	1–5	0	1	1	3	1	0	1	1	101.6	34.8	109.1	29.2	.915	0.198
21	Musti-Rao, Hawkins, and Barkley (2009)	J	11	4	1–3	0	0	0	2	1	1	1	0	48.8	19.0	62.7	23.0	.968	0.490
22	J. S. Nelson, Alber, and Gordy (2004)	J	4	2	1–2	0	1	1	2	0	0	0	1	48.8	9.2	70.0	5.2	.489	1.926
23	Paige (2006)	J	11	6, 8	6–8	1	1	0	2	1	0	0	0	87.6	25.9	116.3	23.3	.079	1.074
24	Scarborough (2012)	D	4	8	3–6	0	1	1	3	0	0	0	1	94.6	8.3	122.3	6.3	.723	2.611
25	Shimabukuro (2006)	D	4	6	2	0	1	0	3	1	0	0	1	56.8	27.6	89.6	19.7	.979	0.528
26	Stout (1997)	D	4	2–3	2	0	0	0	3	0	0	0	1	64.4	14.0	91.8	18.8	.974	0.747
27	Sukhram (2008)[a]	D	3	7	3–6	0	0	0	3	0	0	0	1	117.0	38.0	140.3	54.0	.983	0.136
28	Sukhram (2008)[b]	D	3	7	3–6	0	0	1	3	0	0	0	1	124.7	24.8	127.0	26.2	.969	0.051
29	Swain and Allinder (1996)	J	3	2	1	0	0	0	4	0	0	0	1	18.3	6.1	25.9	10.8	.998	0.058
30	Vadasy and Sanders (2008)	J	54	4–5	1–5	1	0	1	3	0	0	1	1	64.0	17.3	84.0	19.3	.680	1.070
31	Valleley and Shriver (2003)	J	3	9–10	9	0	0	0	4	0	1	0	1	74.0	3.6	90.7	5.9	–.994	2.012
32	VanAuken, Chafouleas, Bradley, and Martens (2002)	J	3	2–3	1–3	0	1	0	4	0	0	0	0	34.7	7.1	74.5	2.6	.534	3.587
33	Vandenberg, Boon, Fore, and Bender (2008)	J	3	10–11	1–3	0	0	0	U	0	0	0	1	88.7	26.4	123.3	25.5	.999	0.626
34	Vining (2007)	D	3	3	2–3	0	0	1	3	1	1	1	1	69.7	10.1	82.0	10.6	.990	0.649
35	Weinstein and Cook (1992)	J	4	2–3	1	0	1	0	U	1	0	0	0	32.1	11.3	56.0	14.2	.678	1.314
36	L. D. Wilson (2008)	D	4	7–8	3	0	0	1	3	0	0	1	1	91.3	14.9	96.3	16.7	.997	0.133
37	Yurick, Robinson, Cartledge, Lo, and Evans (2006)[a]	J	8	5	4	0	1	0	U	1	1	1	0	82.6	16.1	159.0	21.0	.799	3.398
38	Yurick et al. (2006)[b]	J	8	3	3	0	1	0	U	1	1	1	0	58.8	21.5	121.4	17.8	.936	2.518
39	Yurick et al. (2006)[c]	J	6	4	3	0	1	0	U	1	1	1	0	66.0	19.9	77.3	22.1	.915	0.442

Note. D = type of documentation (D = dissertation, J = journal); GR = grade; R_{Level} = initial reading level of students; WP = word preview (0 = no, 1 = yes); LP = listening passage preview (0 = no, 1 = yes); SEC = systematic error correction (0 = no, 1 = yes); #RR = maximum number of repetitions (U = unlimited); G = goal setting; R = reward (0 = no, 1 = yes); P = peer-mediated reading (0 = no; 1 = yes); T = passage transfer (0 = no, 1 = yes); M_{Pre} = mean correct words per minute (CWPM) on a pretest; SD_{Pre} = standard deviation of CWPM on a pretest; M_{Post} = mean CWPM on a posttest; SD_{Post} = standard deviation of CWPM on a posttest; *r* = correlation coefficient between pre- and post-CWPMs; *ES* = effect size in Hedges' *g*.
[a]Experiment 1. [b]Experiment 2. [c]Experiment 3.

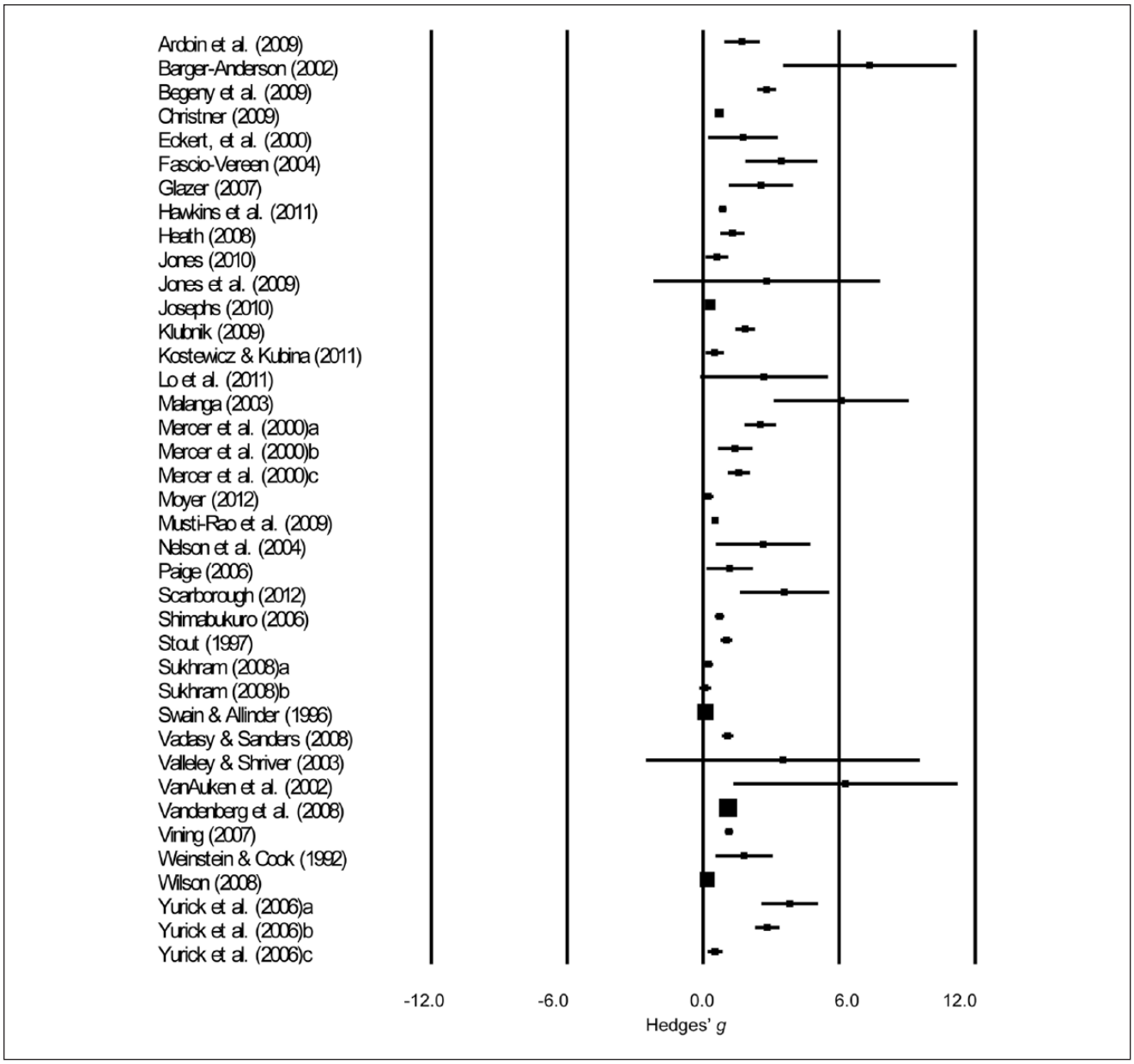

Figure 2. Hedges' *g*s and 95% confidence intervals of 39 cases.

The weighted mean effect sizes were Hedges' $\overline{g} = 1.20$ in RR with SEC and Hedges' $\overline{g} = 1.22$ in RR without SEC.

Maximum number of repeats. When the maximum number of repeats during the intervention was subgrouped by two, three, and four and more repeats, the difference among the three groups was statistically significant, $Q(2) = 12.68$, $p = .002$. When the maximum number of repeats was four and more, the effect of RR intervention (Hedges' $\overline{g} = 1.73$) was significantly different from two and three repeats (Hedges' $\overline{g} = 1.45$ and 0.82, respectively). Even though the effect of three repeats was smaller than two repeats, the difference between the effects was not statistically significant.

Performance feedback. For the performance feedback, goal setting and extrinsic rewards were measured in the study. The effect of goal setting (Hedges' $\overline{g} = 1.19$) was not statistically significant from the RR intervention without goal setting (Hedges' $\overline{g} = 1.21$). Similarly, there was no difference between with and without extrinsic reward, even though studies with the reward showed a larger weighted

Table 2. Subgroup Analyses Under Random Effects by Possible Moderating Variables.

Variable	*k*	Hedges'*g*		95% CI		*Q*	*df*	*p*
		M	*SD*	LL	UL			
Grade level								
Elementary	22	1.633	0.187	1.267	2.000	10.640	1	.001*
Secondary	17	0.861	0.145	0.577	1.146			
Reading level								
Elementary	35	1.249	0.115	1.024	1.474	7.890	1	.005*
Secondary	4	0.795	0.114	0.572	1.018			
Word preview								
Yes	8	1.524	0.236	1.062	1.986	2.321	1	.128
No	31	1.122	0.119	0.889	1.355			
Listening passage preview								
Yes	15	1.945	0.120	1.331	2.560	8.972	1	.003*
No	24	0.940	0.314	0.706	1.174			
Systematic error correction								
Yes	21	1.202	0.147	0.913	1.491	0.009	1	.926
No	18	1.223	0.168	0.894	0.1551			
Number of repeats								
2	8	1.454	0.251	0.963	1.946	12.677	2	.002*
3	17	0.824	0.119	0.590	1.058			
4 and more	14	1.725	0.265	1.206	2.245			
Goal setting								
Yes	14	1.191	0.164	0.869	1.513	0.011	1	.916
No	25	1.214	0.142	0.936	1.492			
Extrinsic reward								
Yes	9	1.652	0.295	1.073	2.230	3.117	1	.077
No	30	1.090	0.119	0.856	1.324			
Peer-mediated reading								
Yes	11	1.104	0.181	0.750	1.458	0.662	1	.416
No	28	1.291	0.143	1.012	1.571			
Passage transfer								
Yes	26	0.973	0.122	1.400	2.474	10.318	1	.001*
No	13	1.937	0.274	0.734	1.212			
Documentation type								
Journal	23	1.551	0.177	1.203	1.898	11.474	1	.001*
Dissertation	16	0.820	0.123	0.580	1.061			

Note. *k* = number of effect sizes from primary studies; CI = confidence interval; LL = lower limit; UL = upper limit.
*$p < .05$.

mean effect size (Hedges' $\overline{g} = 1.65$) than studies without the reward (Hedges' $\overline{g} = 1.09$).

Peer-mediated reading. The difference between RR with peer-mediated reading (Hedges' $\overline{g} = 1.10$) and without peer-mediated reading (Hedges' $\overline{g} = 1.29$) was not statically significant, $Q(1) = 0.66$, $p = .416$.

Passage transfer. The effect of generalized transfer passages (Hedges' $\overline{g} = 0.97$) was smaller than the effect of nontransfer practiced passages (Hedges' $\overline{g} = 1.94$). The differences between the textual factor condition was statistically significant, $Q(1) = 10.32$, $p = .001$.

Types of documentation. The analyses showed a significant difference in the estimated mean effect size by type of documentation. This implies the existence of a publication bias since studies published as journal articles showed, on average, a larger RR intervention effect (Hedges' $\overline{g} = 1.55$) than studies published as dissertations (Hedges' $\overline{g} = 0.82$).

Discussion

The prediction of this study was that the RR interventions would increase reading fluency for students with RD. In support of this prediction, the current results reported the

positive effect of RR on reading fluency gains for students with RD, especially in elementary grade levels. The grade effect of RR intervention consistently followed from previous RR intervention findings of beginning readers of students with RD (Chafouleas et al., 2004; J. S. Nelson et al., 2004). After several repetitions, students might gain more automatic word recognition and connect their reading to the text meaning, as predicted by automatic word reading process theory (LaBerge & Samuels, 1974).

We also documented statistical support for pedagogies that promote and are combined with RR interventions. For example, reading the passage at least four times increased reading fluency more than two to three times. The number of repetitions may have combined to produce the best effects. Thus, repetition is a critical variable, and automaticity was based on retrieval (memory) rather than adjustment of reading procedures (e.g., word decoding strategies) (for review, see Logan, 1997).

The responsiveness to the RR intervention that we documented also appears to be attributed to a listening passage preview prior to the RR. The listening passage preview with the proper prosody that was modeled by the teachers may have enhanced understanding of text and reduced the moderator of negative emotion (e.g., confusion, anxiety, frustration) presumed for students with RD (e.g., "with listening passage preview there is less anxiety," Swain et al., 2013, p. 13). Such opportunities might also reduce work avoidance following academic tasks that had been reported as an academic characteristic of students with RD (Lee & Zentall, 2012; J. M. Nelson & Manset-Williamson, 2006). In sum, the current findings suggested that the listening passage preview in combination with RR with at least four times of reading might be the most effective method for students with RD. In addition, our finding of the text difficulty level was consistent with previous research (Wexler et al., 2008) that reported the effects of RR on reading rate was observed only by using nontransfer practiced passages for students with RD.

Different from a previous study that assessed and found vocabulary preview effective (Hawkins et al., 2011), we did not find isolated word preview to be an essential component of RR for students with RD. Although not assessed in either study, it is possible that practicing vocabulary in connected text during RR (e.g., high word overlapping passages, Ardoin, McCall, & Klubnik, 2007, and text-to-speech accommodations, Shaywitz, Morris, & Shaywitz, 2008) would be more effective than previewing words in isolation. In addition, our study did not support the effects of (a) SEC, (b) performance feedback (goal and extrinsic reward), and (c) peer-mediated reading as essential components of RR for students with RD. In contrast, Therrien (2004) reported that SEC ($ES = 1.37$) and performance criteria (i.e., reading until a fixed number of CWPM, $ES = 1.70$) are essential components in generalized passages of RR. However, the number of effect sizes included in the study for students with LD was relatively small (without corrective feedback, $n = 2$), and the overall effect size was based on assessing mixed groups of students with and without LD. In summary, several predicted intervention component effects were not found. In particular, the expected RR differences with and without SEC, performance feedback (goal and extrinsic reward), and peer-mediated reading did not emerge.

In conclusion, the results of this study are consistent with prior findings supporting the effects of RR interventions on reading fluency for students with RD. These findings suggest the importance of RR instruction to reading fluency that involves opportunities to be familiar with the text. Specific additional components of listening passage preview in combination with RR appear to be the most effective methods to improve reading fluency for students with RD, especially in elementary grades and at elementary reading levels. In addition for students with and without disabilities, it is important to provide a reading developmental sequence (e.g., phonological awareness followed by letter pattern in first and second grade, fluency in second and third grade, and vocabulary in fourth grade; for review, see Zentall, 2014, p. 79). Without this developmental sequence leading to adequate reading fluency, later reading comprehension development could be limited (e.g., "less fluent readers have poor comprehension," Welsch, 2007, p. 116).

There are several limitations associated with this study. First, the purity of groups was not an objective of the reviews. That is, the reviewed studies included participants with RD with co-occurring disorders, such as ADHD or behavioral disorders, under the assumption that RD was the critical variable related to academic difficulties. Furthermore, many studies included students at risk for RD in the RD group. However, given similarities of their characteristics (e.g., academic, motivational, and emotional), the differences between clinical and school-based samples of students at risk for RD would be in degree more than in type (for review and data, see Barbaresi, Katusic, Colligan, Weaver, & Jacobsen, 2007; Epstein, Shaywitz, Shaywitz, & Woolston, 1991). Similarly, we found differences in reading achievement between these two groups, with each group performing worse than typical students.

In addition, the purity of the intervention procedures is questionable since the studies on RR that we examined provided insufficient information (e.g., levels of training, duration and total sessions of the interventions) and reading textual factors (e.g., text difficulties), as was similarly concluded by Chard et al. (2009, p. 277). The consistency of dependent variables also varies among the studies reported. We used a standard CWPM measure; however, studies may have used this measure on passages previously read, on novel passages, or on norm-referenced passages.

Among several ways to estimate an effect size, the preferred way is using pre-post changes in both treatment and control groups and the pooled pre-test standard deviation (Morris, 2008). However, few studies had quasi-experimental research designs (i.e., 3%); thus, we used only those studies with pre-post assessment outcomes in a treatment group, contributing to possible inflation of the estimated effect sizes.

Finally, there was an insufficient number of studies per variable that were assessed on generalized (transfer) passages. This precluded an examination of additional intervention variable effects. In addition, a larger sample size would have been helpful in assessing the generality of the relationship between reading fluency outcomes and the study variables. Yet our analysis included effect sizes to support our statistical findings. Also in relation to the generality of findings, there was a potential publication bias, as we identified only studies published in journals and dissertations, and differences between the two emerged. Although we searched for studies in conference proceedings, theses, and reports, those studies published in other documents may have been missed.

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