Performance on Reading Comprehension Assessments and College Achievement: A Meta-Analysis

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Abstract

Reading comprehension assessments are used for postsecondary course placement and advising, and they are components of college entrance exams. Therefore, a quantitative understanding of the relationship between reading comprehension assessments and postsecondary academic achievement is needed. To address this need, we conducted a meta-analysis to examine how well performance on college reading assessments (e.g., ACT, COMPASS, Nelson-Denny, SAT) correlated with academic achievement (GPA and college grades). Additionally, to help explain the variation in previous findings, we examined whether the type of reading assessment used, performance indicator, publication bias, or year of publication served as moderators. Results based on 26 studies and a total of 25,090 students revealed a small association between performance on reading comprehension assessments and college grades (r = .29, SE = .02, 95% CI [.25, .33], p < .001), with no variation based on study moderators. These findings highlight the importance of college students' reading comprehension skills for college academic achievement.

Keywords: college students, meta-analysis, reading comprehension

Performance on Reading Comprehension Assessments and College Achievement: A Meta-Analysis

It is often assumed that reading comprehension skills are important for college achievement throughout various disciplines (Desa et al., 2020; Gregory & Bean, 2021; Howard et al., 2018), but the overall magnitude of that importance is not known. In addition, the predictive value of various standardized reading assessments for college achievement is also not well understood. The importance of reading comprehension skills and the predicative validity of standardized reading assessments should be examined because students are placed in college courses based on their reading comprehension assessment performance (Perin & Holschuh, 2019), including placement in developmental courses that delay enrollment in credit-bearing courses that count towards degree completion (Bahr et al., 2019). Numerous studies have examined reading comprehension and college achievement with findings ranging from no significant relationship to a moderate relationship (Levin, 1976; Lottes-Bishop, 2015; Qin, 2017). This variation in findings indicates a need to have an overall examination and analysis of past findings. The purpose of this meta-analysis was to quantitively synthesize studies correlating performance on reading comprehension assessments and college grades. A secondary purpose was to examine factors that may explain the variation in previous findings on reading comprehension and college achievement.

College student achievement is critical to consider because many students who enroll in postsecondary education do not finish their degrees. In the United States (U.S.) for example, the three-year graduation rate for associate degree students was 32.6%, and the six-year graduation rate for bachelor's degree students was 59.6% in 2018 (National Center for Higher Education Management Systems, 2020). Degree completion is even more of an issue with students who

have been traditionally underserved in higher education, such as students of color and first-generation college students (Cataldi et al., 2018; National Center for Education Statistics, 2018). Therefore, it is important to address changeable factors that could enhance college student achievement. The reading comprehension skills of college students are changeable through instructor and support services (e.g., Bauer-Kealey & Mather, 2019; Yang, 2010). Unfortunately, budget constraints have led to eliminating or reducing student support services that could assist students with improving their reading comprehension skills (Butrymowicz & D'Amato, 2020; DuPaul et al., 2017; Mitchell et al., 2016). A thorough examination of the aggregated effect size of reading comprehension on college student achievement may help justify continued funding for educational support services (see Flippo & Bean, 2018).

Reading Comprehension and Assessment

Reading comprehension involves making connections throughout the text and between the text and background knowledge in a meaningful way. This is articulated in the construction-integration model, which provides a framework of reading specific to comprehension (Kintsch, 1998). According to the construction-integration model, comprehension involves developing three levels of representation of text: the surface structure, the textbase, and the situation model (Kintsch, 1998). The exact words and grammar of the text are represented in the surface structure level. These words and grammatical structures are used to communicate the ideas in the text, known as propositions. In the textbase level of representation, readers connect the propositions in the text together. Readers build a situation model of the text when the textbase is integrated with relevant background knowledge including personal experiences (Kendeou, 2015).

Colleges typically use standardized reading comprehension assessments as part of college admissions requirements, for placement into courses, to monitor student progression, or for

research purposes (Flippo & Bean, 2018). Built into each of these assessments are adjoining reading comprehension measures. Specifically, in the U.S., the ACT and SAT are commonly used in college admissions, and both contain subtests of reading comprehension (ACT, Inc., 2021; College Board, 2021). In contrast, the ACCUPLACER is not intended for admissions, but instead designed for placement into courses and monitoring student performance (College Board, 2021). The COMPASS Reading assessment is similarly designed for course placement and identifying students in need of support services (ACT, 2014). The Nelson-Denny Subtest of Reading Comprehension may be used to screen incoming college students and is commonly used as a research instrument (Fishco, 2019; see Clinton et al., 2018; Hebert et al., 2018; Kotzer et al., 2021; Perin et al., 2017). Across the various assessments, there are a variety of reading passages across disciplines and genres. In addition, the questions about the passages are varied and assess multiple levels of reading comprehension representation.

Correlations between standardized reading comprehension assessment scores and college grades are often reported by the companies that develop the assessment in technical manuals or other reports (College Board, 2021; Westrick et al., 2019). However, assessment developers typically focus on the validity testing of their own assessment (e.g., ACT College Readiness Benchmarks). Moreover, validating information with college grades is not reported for all assessments (e.g., Nelson-Denny; Fishco, 2019) or may be reported as a composite measure (e.g., ACT, 2020). In addition, these studies are typically conducted to provide evidence for the validity of the developers' assessments, rather than for the purpose of researching factors that contribute to students' academic achievement. Therefore, an examination of studies conducted by researchers and institutions is necessary as these focus on how to support students' academic achievement. Such an examination would also likely be of use for reading comprehension

assessment developers as it may provide converging evidence to support their reported validity statistics.

Potential Moderators

The association between reading comprehension and college academic achievement may vary, depending on the assessment used and year of publication. Namely, the assessment used is key, given that assessments vary in their purpose and structure. Related to this, the year of publication needs to be considered as assessments are often updated. Moreover, the strength of the association between reading comprehension and academic achievement could be affected by year due to changes in grading practices by college faculty. Namely, grade point averages have been increasing in the U.S. for many reasons (i.e., *grade inflation*; Denning et al., 2021; Stroebe, 2020), which could subsequently attenuate any potential association between reading comprehension and grades. In addition, college-level reading assignments have changed based on reports that faculty assign less reading and more multimedia resources currently than in the past (Baron & Mangen, 2021). Moreover, there are concerns that current college students are reading less overall than previous generations of students (Schnee, 2018). Therefore, it is possible that the role of reading comprehension skills in college achievement has changed across time.

First semester college grades may be particularly informative when considering the importance of reading comprehension skills in college achievement. First semester grades are a key predictor of successful college degree completion even when controlling for composite ACT scores and demographic characteristics (Gershenfeld et al., 2016). In addition, the first semester typically involves challenging transitions that can be stressful for students as they acclimate to their new roles and environments (Bowman et al., 2019). As students adjust to the reading rigors

of college coursework, their reading comprehension skills may be particularly important in informing their academic grades.

The type of institution may also moderate the association between reading comprehension and college achievement. The completion rate for associate degree-seeking students is lower than that of bachelor's degree-seeking students (National Center for Higher Education Management Systems, 2020). This could be for many reasons such as two-year college students being more likely to have more financial challenges, and students who attend two-year colleges being more likely to be the first in their families to go to college than four-year college students (Horn et al., 2006; Nazmi et al., 2019). Given these challenges, having strong reading comprehension skills could potentially be an important compensatory factor for college achievement for students at two-year institutions. Moreover, although literacy in general is important across disciplines (Gregory & Bean, 2021), reading courses in community colleges may not be well aligned for career and technical education students' needs (Armstrong et al., in-press). This lack of preparation for career and technical education literacy demands could lead to students in these fields needing stronger reading comprehension skills to meet their discipline's literacy demands.

The type of dissemination (whether published or unpublished) could also be a moderator. Statistically significant findings with robust effect sizes are more likely to be published in peer-reviewed journals and are subsequently easier to locate in systematic reviews and meta-analyses (Kicinski et al., 2015). This publication bias can skew the findings of a meta-analysis if unpublished findings are not included (Lin & Chu, 2018; Sutton et al., 2000). For these reasons, "grey literature" that is not disseminated through journal articles, such as dissertations and white papers, should be included to improve the validity of meta-analyses (Ziai et al., 2017). It is also

possible that, due to publication bias, stronger associations between reading comprehension and college achievement would be noted in journal articles than in other sources. For this reason, type of dissemination is considered as a moderator in analyses.

The Current Study

Given the stakes placed on reading comprehension assessments in college acceptance and course placement, coupled with the numerous studies conducted, there is a need to synthesize the existing findings. Two research questions guide this study:

1. What is the overall association between performance on reading comprehension assessments and college grades?
2. How does the association vary based on year of publication, type of assessment, type of grades (first semester or other), type of institution (two year or four year), and type of dissemination (published journal article or other)?

Methods

Inclusion criteria for relevant studies were 1) the participants were college students, 2) associations between scores on reading comprehension assessments and college grades were examined, 3) statistics necessary for the meta-analysis were reported or provided upon sending a request to the author, 4) the reports were in English. Only assessments that focused on reading comprehension were included (e.g., the SAT-Verbal prior to 2005 was not included because it also contained analogies) (Zwick, 2013).

Systematic reviews involve multiple steps in order to have an exhaustive and thorough search of the literature. In this study, the first step to find relevant studies was to search the literature in the databases ERIC, Web of Science, APA PsychInfo, Proquest Dissertations and Theses, Academic Source Complete, and Taylor & Francis. This identified 2,101 citations of

which 562 were duplicates and were thus deleted. The remaining 1,539 citations were double screened using Abstrackr (Wallace et al., 2012) with conflicts resolved by the first author. Next, the full texts of 101 reports were examined for further consideration. Of these, 23 reports were determined to be relevant based on eligibility criteria (i.e., reporting at least one correlation between reading comprehension assessment scores and college grades; see Figure 1). For each of these 23 reports, backwards searches of the references and forward searches of citing literature using Google Scholar were conducted. From these searches, an additional 3 relevant reports were identified for a total 26 relevant reports. This process was concluded in May of 2021. A flow chart illustrating this process is in Figure 1.

Coding

To describe the articles and extract data for analyses, relevant reports were coded. The coding included the basic bibliographic information such as year of publication, author(s), title, and type of dissemination. Research design information such as reading assessment used, grades examined, sample size, and institution (two or four year) were also coded. See Table 1 for coding of each study.

Correlation coefficients were used to calculate effect sizes that measure the magnitudes of associations between reading comprehension assessment scores and college grades. Effect sizes and their variances were calculated using Comprehensive Meta-Analysis software (version 3; Biostat). A positive correlation coefficient indicates that reading scores and grades directly covary, that is, as reading scores increase, grades tend to increase. Because some studies involved multiple dependent effect sizes, robust variance estimation (RVE) was used with an assumed correlation between dependent effect sizes of .8. RVE accounts for dependencies within studies without aggregating or violating rule assumptions of independence (Tanner-Smith et al.,

2016). Given the variation of sample sizes, small sample size correction was used in analyses (Tipton & Pustejovsky, 2015). The package "robumeta" in the R software environment was used (Fisher & Tipton, 2014).

Results

Based on the RVE analyses of 26 studies with 57 effect sizes and a total of 25,090 students, there was a significant positive association between performance on reading comprehension assessments and college grades $r = .29$, SE = .02, 95% CI [.25, .33], $p < .001$. There was substantial heterogeneity with an I^2 of 84.22. See Table 2 for a table of individual effect sizes. A sensitivity test was conducted with varying levels of assumed correlations among dependent effect sizes. As can be seen in Table 3, varying the assumed correlations did not vary the aggregated association between reading comprehension performance and grades.

Because the I^2 was over 50%, an outlier analysis was warranted. An outlier analysis was conducted using the “dmetar” package in R (Harrer et al., 2019). Outliers are effect sizes that are outside the confidence intervals of the overall effect and may skew results. Based on the analyses, 7 effect sizes were outliers. Conducting RVE analyses of the remaining 23 studies and 50 effect sizes yielded similar results, $r = .32$, SE = .01, 95% CI [.29, .35], $p < .001$, with lower heterogeneity, $I^2 = 32.46$.

Publication bias is typically assessed through a funnel plot and Egger’s test of the intercept. A funnel plot is a visual representation in which the studies are plotted based on their effect sizes on the x-axis and study size on the y-axis (smaller studies towards the bottom). An asymmetrical distribution along with smaller studies being farther from the mean than larger studies are indicative of publication bias. Based on the funnel plot in Figure 2, the distribution is somewhat asymmetrical, but the smaller studies do not appear to be farther away from the mean

than the larger studies based on visual inspection. Egger's test of the intercept was significant, which is indicative of asymmetry, $t = 2.99$, $p = .004$. The possibility of publication bias is further examined in moderator analyses with type of dissemination as a potential moderator.

Moderator analyses were conducted to examine how year of publication, publication bias, type of assessment, and type of grades (first semester or other) moderated the association between performance on reading comprehension assessments and college grades. A meta-regression model with coefficients for the four moderators was conducted. Year of publication was a continuous moderator. Publication bias was coded 0 if the study was reported in a peer-reviewed journal article and 1 if it was not (e.g., dissertation, institutional report), type of assessment (0 for ACCUPLACER, 1 for ACT Reading, 2 for Nelson-Denny, and 3 for COMPASS), and type of grades (0 for first semester GPA, 1 for other grades). As can be seen in Table 4, none of the moderators were significant. Because the type of dissemination did not moderate the association, it is unlikely there was publication bias.

Discussion

The purpose of this meta-analysis was to examine the association between reading comprehension and college achievement. Based on the findings, there was a small association between performance on reading comprehension assessments and college grades ($r = .29$; $r = .32$ without outliers). The characterization of small is based on traditional guidelines (Cohen, 1988); however, interpreting effect sizes varies by field. To put this effect size into context with other correlations with college achievement, the association between reading comprehension and college achievement is similar to that of critical thinking and college achievement (Fong et al., 2017). The effect size between high school grades and college grades was $r = .47$ (Westrick et al., 2015). In terms of behaviors, procrastination's association with college grades was $r = -.22$

and with time management was r = .22 (Richardson et al., 2012). Taken together, the findings from the current meta-analysis indicate that reading comprehension skills are an important factor in college achievement. None of the proposed moderators varied the results.

The asymmetry of the funnel plot raised concerns about publication bias in which only significant and sizeable effects are published in academic journals. In other words, there may have been studies conducted that were not found during the systematic search. The search for relevant studies in this meta-analysis included investigations beyond academic journal articles (known as the grey literature) such as dissertations and theses as well as forward searches of what had cited relevant studies. Given these investigations as well as type of dissemination (journal article or other) not varying the effect, publication bias likely did not skew the results (Winters & Weir, 2017).

Despite concerns that students are reading less than before, there was no indication that reading comprehension skills have changed in importance across the years of this study. This was based on year of publication not being a significant moderator in the analyses. Moreover, changes in assessments in terms of texts and items by year appeared to have not varied the association between reading comprehension and college achievement. There was a broad range of years of publication; therefore, it is unlikely that restriction of range would explain the null effects. This would indicate that the importance of reading comprehension for college achievement was relatively enduring across time. However, it should be noted that the most recent year of publication was 2018, which was three years prior to the systematic search. Analyses with more recent data should be considered to address this issue.

The type of assessment was not found to moderate the relationship. By examining individual effect sizes from the studies, it does appear that ACCUPLACER's correlation with

college achievement was not as strong as that of the Nelson-Denny or ACT Reading. There was also only one study using COMPASS, so it is difficult to discern its predictive validity. Because most of the studies used ACT Reading or the Nelson-Denny, there may have been insufficient power to note differences across assessments. However, without studies reporting multiple measures of reading comprehension with large sample sizes (see Lottes-Bishop, 2015, for an exception), it is difficult to truly compare the predictive validity of various assessments. It should be noted that all effect sizes were positive, indicating that there was at least some predictive validity for each assessment. Moreover, the importance of reading comprehension in college achievement appears to be robust across both different types of assessments and versions of the same assessment (e.g., assessments change across years).

There did not appear to be differences in findings based on whether the institution was two or four year. It was anticipated that the association between reading comprehension skills and college achievement may be more important for two-year college students than for four-year college students. This was because two-year college students, on average, have lower degree completion rates and more challenging circumstances than four-year students, and subsequently reading comprehension skills may be particularly important to compensate for these difficulties. However, the categorization of institutions was coarse, and simply breaking down by two and four year may have been insufficient to capture differences in student populations. A more refined approach focused on demographic characteristics (such as gender, race/ethnicity, socioeconomic status), or institutional selectivity may have yielded varying effects. For example, students who have less financial support from their families may be more reliant on reading skills for college achievement because they need to work to support themselves.

The type of grades examined did not vary the association between reading comprehension skills and college achievement. The moderator analyses specifically focused on first semester grade point average because of previous findings suggesting it strongly predicts successful completion of a degree (Gershenfeld et al., 2016). However, reviewing the results in Table 2, reading comprehension skills were positive predictors of college achievement across grades. It is important to note that reading comprehension skills were positively associated across different types of courses including English, social sciences, and hard sciences. These findings illustrate the importance of literacy skills across academic disciplines and the need for effective reading instruction throughout all college courses (But & Brown, 2020).

The overall findings generally converged with technical reports by assessment developers reporting predictive validity with grades. For example, the ACT composite's correlation with first year grade point average is r = .38 (ACT, 2020), which is similar to what was found in this meta-analysis focusing on the reading measure. It is difficult to directly compare ACT reading specific metrics as they are reported in terms of the likelihood of C or B grade point averages (ACT, 2020). This is similar with ACCUPLACER and COMPASS. For example, there was a .34 correlation of a B or higher with ACCUPLACER reading comprehension scores (College Board, 2015). However, across the reports, there is the finding that reading comprehension measures positively predict college achievement.

Although the reading assessments in this study had generally good predictive validity for college achievement, there is still opportunity for improvement. There is a critique that assessments such as the Nelson-Denny do not assess the skills necessary in authentic college reading (Perin & Holschuh, 2019). For example, more of a critical thinking approach may be useful given that college instructors expect students to critique their texts (Leist et al., 2012). In

addition, college students need to comprehend and synthesize multiple documents (Armstrong & Newman, 2011; Hynd et al., 2004; Linderholm et al., 2014), which is not addressed in reading comprehension assessments.

Given that the findings of this meta-analysis indicated that reading comprehension skills are important in college achievement, methods of improving college student reading comprehension skills should be developed and expanded. Much of the research conducted on instruction to improve reading comprehension has been examined in the K–12 context rather than postsecondary education (Perin & Holshuh, 2019), but there is evidence of effective practices for college students. For example, reading strategy instruction improved both reading skills as well as grades in a reading-intensive course (Caverly et al., 2004). Reading taught in the context of skills needed for future academic and occupational literacy demands also appears to be effective (Perin, 2011). Course instructors can scaffold their student's comprehension of content-specific text through graphic organizers, discussion, and reading guides (Lieu et al., 2017; West, 2018). There are also supports for students with learning disabilities such as text structure instruction, assistive technology, and tutoring (Zeng et al., 2018).

Limitations

There are limitations with this study that need to be acknowledged. The findings are correlational and, as such, causal claims cannot be made. It is possible there is a third variable that fosters both reading comprehension skills and college achievement that may explain the results, rendering the findings noted in this study spurious. Moreover, because of the variables examined, the studies were all from the United States. Subsequently, claims about global generalizability cannot be made. Finally, the relationship between reading and academic

achievement would likely vary depending on the reading demands of the course, but there was insufficient detail about the courses to consider that possibility in this meta-analysis.

There are weaknesses with the use of college grades as a measure of college achievement. College grading practices are subjective and susceptible to numerous biases such as prior performance and gender (Krawczyk, 2018; Malouff, 2008; Malouff et al., 2013) as well as the leniency of the instructor (Carpenter et al., 2020). In addition, grade inflation has changed the meaningful value of grades throughout time (Denning et al., 2021). In terms of reliability, annual and semester grade point averages, which were examined in many of the studies in the meta-analysis, do not have strong reliability (Westrick, 2017). Despite these limitations, college grades are strong predictors of degree completion (Barbera et al., 2020; Millea et al., 2018). In addition, college grades are used by employers and graduate schools in hiring and admissions decisions (Freire-Seoane et al., 2019; Kondo & Fair, 2017; Michel et al., 2019). Taken together, grades needed to be examined given their ubiquity and application, but future studies should incorporate more measures of college success such as retention and graduation.

Reading comprehension assessment scores are used in course placement and for advising students. It was beyond the scope of this study to examine the effectiveness of these assessments for course placement. However, students are frequently misplaced in postsecondary courses, and it is unclear how to improve course placement (Cullinan et al., 2018; Leeds & Mokher, 2020). Moreover, it would be helpful to better understand how reading comprehension assessment scores are used in advising given the positive relationship between effective advising and college grades (Mu & Fosnacht, 2018). For these reasons, an important area of future research would be to examine reading comprehension assessments' validity in course placement and utility in advising.

Conclusion

Both instructors and students view reading comprehension skills as critical for college success (Desa et al., 2020; Gregory & Bean, 2021; Howard et al., 2018). However, services available to support college students in their reading comprehension skills may be limited due to budget constraints (Butrymowicz & D'amato, 2020; DuPaul et al., 2017; Mitchell et al., 2016). Based on the findings from this meta-analysis, reading comprehension skills are clearly important for college achievement in terms of grades. This was found across different assessments as well as institutions. Removing outliers yielded similar results. Overall, the findings indicate that reading comprehension's association with college achievement is clear and robust across contexts.

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Table 1

Descriptions of studies included in meta-analysis

Author(s), year	Type of dissemination	Sample size	Type of institution	Reading comprehension assessment	Type of grades
Allen, 2014	Dissertation	29	Two-year	ACCUPLACER	Term GPA
Brophy, 1984	Dissertation	1,760	Two-year	Nelson-Denny	First year GPA
Carney & Geis, 1981	Article	490	Four-year	Nelson-Denny	First semester GPA
Cole et al., 1998	Article	2,149	Two-year	ACCUPLACER	First year GPA
Cook, 2007	Dissertation	43	Four-year	Nelson-Denny	First semester GPA (nursing and science)
Fina, 2018	Article	1,814	Four-year	ACT – Reading	First year GPA
Geis, 1978	Conference	453	Four-year	Nelson-Denny	First year GPA
Hartman, 1981	Technical Report	185	Two-year	Nelson-Denny	First semester GPA
Hawaii Univ, 1976	Technical Report	1,339	Two-year	Nelson-Denny	GPA
Heilman, 1991	Article	105	Two-year	Nelson-Denny	Program GPA
Jackson, 2005	Article	384	Four-year	ACT – Reading	College GPA, Ed Psych Grade
Leonard & Niebuhr, 1986	Article	198	Four-year	Nelson-Denny	Anatomy & Physiology Grade
Leroy & Hall, 1978	Conference	525	Two-year	Nelson-Denny	Cumulative GPA, English grade, First semester GPA

Levin et al., 1976	Technical Report	816	Two-year	Nelson-Denny	Course Grade
Lottes-Bishop, 2015	Dissertation	54	Four-year	ACT – Reading COMPASS	First semester GPA
Lowrance, 1997	Dissertation	67	Two-year	ACT - Reading	First year GPA
Meier, 1975	Conference	139	Two-year	Nelson-Denny	First semester GPA
Mutchler, 1978	Technical Report	152	Four-year	Nelson-Denny	First year GPA
Myers & Pyles, 1992	Article	420	Four-year	ACT – Reading	First semester GPA
Parker & Argenti, 1977	Technical Report	152	Two-year	Nelson-Denny	College GPA
Pedrini & Pedrini, 1975	Article	120	Four-year	Nelson-Denny	Course grade (personality psych)
Tomaszewski, 2018	Article	2,772	Two-year	ACCUPLACER	English course grade
Webb, 1984	Technical Report	96	Two-year	Nelson-Denny	First year GPA
Wood, 1982	Article	1,598	Two-year	Nelson-Denny	Course GPA, First year GPA, College GPA
Wood, 1990	Technical Report	7635	Four-year	Nelson-Denny	College GPA
Yamagahi & Gillmore, 1980	Technical Report	376	Four-year	Nelson-Denny	College GPA, First year GPA

Note. Nelson-Denny Reading Comprehension Subscale scores used, unless otherwise noted; GPA = Grade Point Average.

Table 2

Individual effect sizes

Author(s), year, achievement measure, subgroup (if applicable)	**Assessment**	**Effect size, *r***	**Standard error**	**Variance**	**Sample size**
Allen, 2014, term GPA	ACCUPLACER	0.12	0.19	0.04	29
Brophy, 1984, first year GPA	ND	0.32	0.02	0.00	1760
Carney & Geis, 1981, first semester GPA	ND	0.35	0.04	0.00	490
Cole et al., 1998, first year GPA, Under 20	ACCUPLACER	0.11	0.04	0.00	565
20-24	ACCUPLACER	0.22	0.04	0.00	589
25-29	ACCUPLACER	0.31	0.04	0.00	343
30-49	ACCUPLACER	0.40	0.03	0.00	599
50 and over	ACCUPLACER	0.47	0.11	0.01	53
Cook, 2007 Nursing GPA	ND	0.33	0.14	0.02	43
Science GPA	ND	0.24	0.15	0.02	43
Fina, 2018, first year GPA	ACT Reading	0.31	0.02	0.00	1814
Geis, 1978, first year GPA, Business majors	ND	0.41	0.07	0.01	133
Communication majors	ND	0.21	0.16	0.03	38
Education majors	ND	0.41	0.14	0.02	37
Engineering majors	ND	0.41	0.11	0.01	57
Natural sciences majors	ND	0.29	0.20	0.04	23
No major	ND	0.20	0.12	0.01	68
Physical sciences majors	ND	0.44	0.20	0.04	19

Social sciences majors	ND	0.31	0.16	0.03	35
Fine arts majors	ND	0.27	0.20	0.04	24
Health professions majors	ND	0.09	0.25	0.06	19
Hartman, 1981, first semester GPA	ND	0.42	0.06	0.00	185
Heilman, 1991, program GPA	ND	0.42	0.08	0.01	105
Jackson, 2005 College GPA	ACT Reading	0.20	0.07	0.00	193
Educational psychology course grade	ACT Reading	0.19	0.07	0.00	191
Leonard & Niebuhr, 1986, Course grade (Anatomy & Physiology)	ND	0.28	0.07	0.00	198
Leroy & Hall, 1978, cumulative GPA	ND	0.33	0.04	0.00	525
English course grade	ND	0.21	0.04	0.00	525
First semester GPA	ND	0.34	0.04	0.00	525
Levin, 1976 English 101 course grade	ND	0.34	0.07	0.00	176
English 102 course grade	ND	0.26	0.08	0.01	128
English 111 course grade	ND	0.27	0.07	0.00	177
English 112 course grade	ND	0.36	0.08	0.01	136
Psychology 201 course grade	ND	0.61	0.08	0.01	61
Psychology 202 course grade	ND	0.47	0.10	0.01	69
Psychology 203 course grade	ND	0.46	0.10	0.01	69

Lottes-Bishop, 2015, first semester GPA	ACT Reading	0.24	0.13	0.02	54
	COMPASS	0.18	0.14	0.02	54
Lowrance, 1997, first year GPA	ACT Reading	0.28	0.12	0.01	67
Meier, 1975, first semester GPA	ND	0.28	0.08	0.01	139
Mutchler, 1978, first year GPA	ND	0.45	0.07	0.00	152
Myers & Pyles, 1992, first semester GPA	ACT Reading	0.39	0.04	0.00	420
Parker, 1977, college GPA	ND	0.39	0.07	0.00	152
Pedrini & Pedrini, 1975, Personality psychology course grade	ND	0.29	0.08	0.01	120
Tomaszewski, 2018, English course grade	ACCUPLACER	0.14	0.02	0.00	2772
Univ. of Hawaii, 1976, college GPA	ND	0.11	0.03	0.00	1339
Webb, 1984, first year GPA	Nelson-Denny total	0.32	0.09	0.01	96
Wood, 1982 Fall GPA	ND	0.26	0.02	0.00	1598
Winter GPA	ND	0.26	0.02	0.00	1598
Spring GPA	ND	0.29	0.03	0.00	1598
English writing course grade	ND	0.20	0.03	0.00	919
Psychology course grade	ND	0.33	0.03	0.00	738
Sociology course grade	ND	0.26	0.03	0.00	899
Speech course grade	ND	0.23	0.04	0.00	719
Wood, 1990 College GPA	ND	0.20	0.01	0.00	7635
Yamagashi & Gillmore, 1980,	ND	0.09	0.07	0.00	207

College GPA					
First year GPA	ND	0.20	0.07	0.01	169

Note: ND = Nelson-Denny Subtest of Reading Comprehension

Table 3

Sensitivity analysis with varying levels of assumed correlations among dependent effect sizes

	Rho = 0	Rho = 0.2	Rho = 0.4	Rho = 0.6	Rho = 0.8	Rho = 1
Effect size	0.29	0.29	0.29	0.29	0.29	0.29
SE	0.02	0.02	0.02	0.02	0.02	0.02

Note: SE = standard error of effect size

Table 4

Meta-regression results

	Beta	SE	*t*	Dfs	*p*	95% CI Lower	95% CI Upper
Intercept	3.28	4.72	0.70	6.50	.51	-8.06	14.63
Year	0.00	0.00	-0.63	6.50	.55	-0.01	0.00
Dissemination	-0.02	0.05	-0.38	10.68	.71	-0.13	0.09
First semester	-0.05	0.04	-1.32	10.34	.22	-0.13	0.03
Institution	-0.03	0.06	-0.50	9.10	.63	-0.17	0.11
Assessment	0.01	0.05	0.25	6.74	.81	-0.10	0.13

Note. $k = 26$. Year = year of publication. Dissemination = journal article (coded 0) or other (coded 1). First semester = first semester grade point average (coded 0) or other grade (coded 1). Institution = two year (coded 0) or four year (coded 1). Assessment = type of assessment (0 = Accuplacer, 1 = ACT Reading, 2 = Nelson-Denny, 3 = COMPASS). SE = standard error. *t* = t-test value. Dfs = degrees of freedom. 95% CI Lower = 95% confidence interval lower limit. 95% CI Upper = 95% confidence interval upper limit.

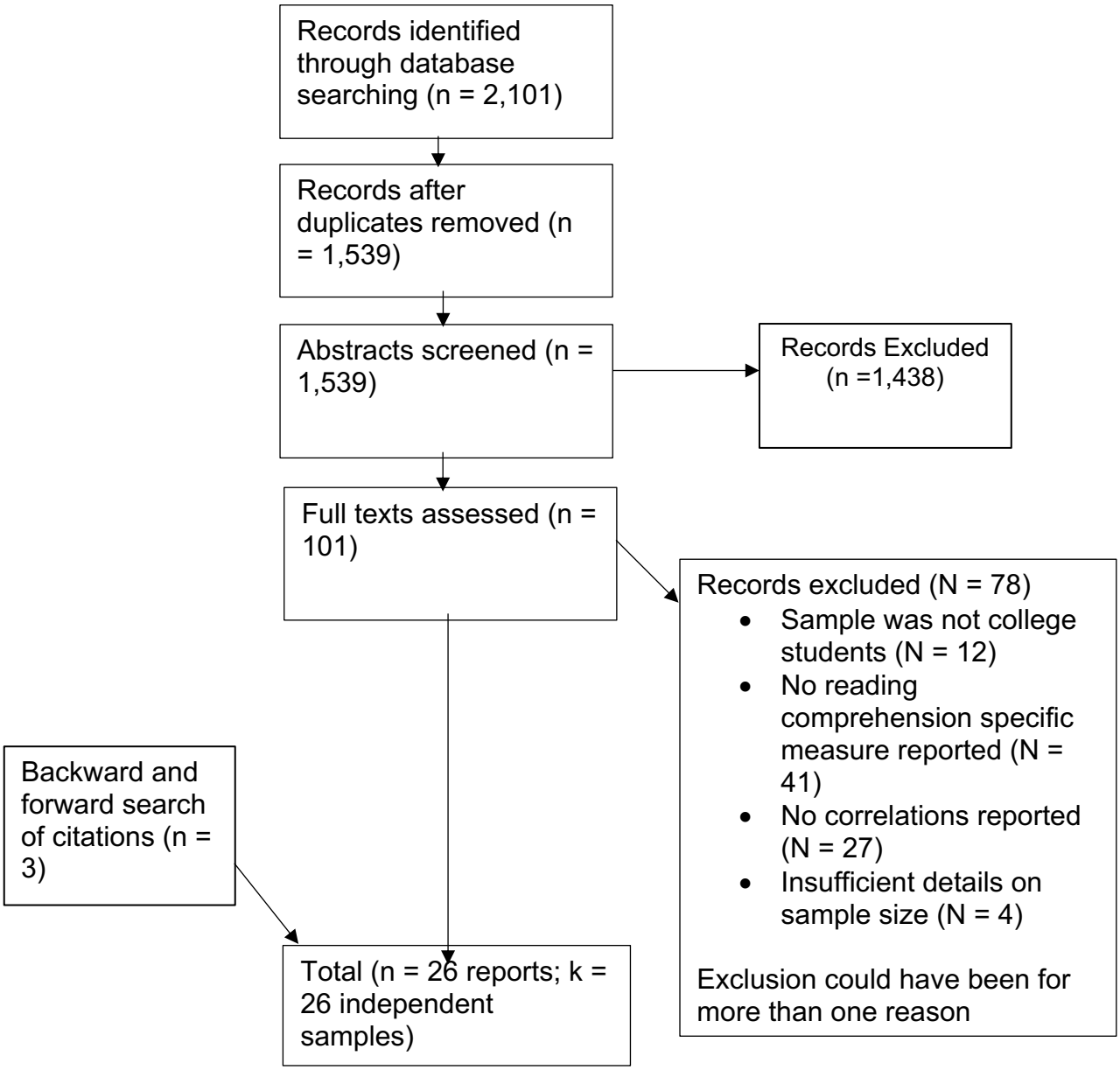

Figure 1. Flow diagram of the systematic review process

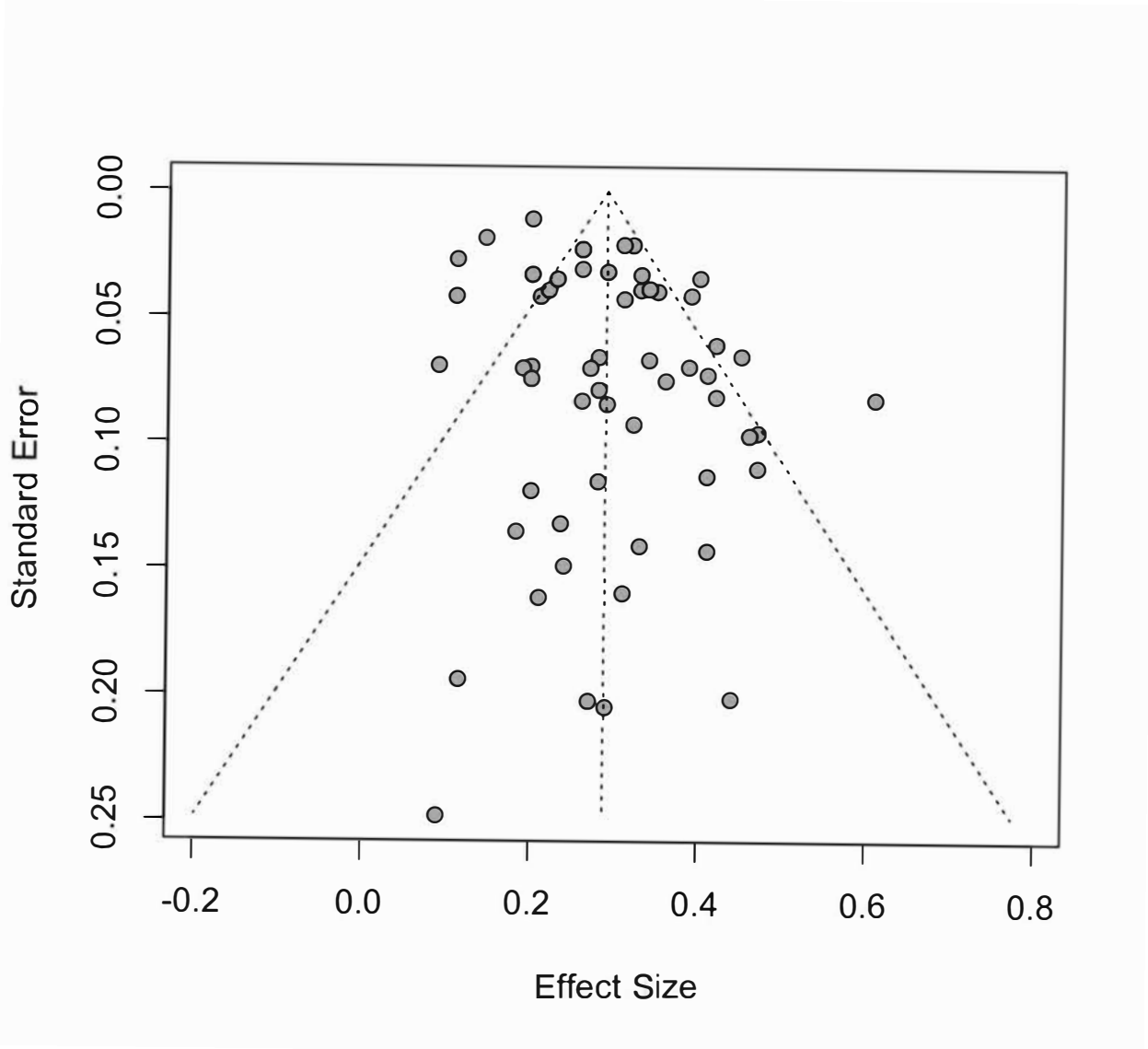

Figure 2. Funnel plot of reading comprehension correlated with college achievement studies