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LDbase project page with open materials

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Overview/aim of the study

The goal of this study is to determine if there is a significant association between reading anxiety and reading achievement. To do so we are conducting a meta-analysis by first identifying all existing studies that contain a correlation between reading anxiety and reading achievement and then with those calculating what is the best estimate of the average correlational effect size. We will also be investigating several potential moderators of this association, listed later in this preregistration.

Background

Reading anxiety is a quickly growing area of research, with much of the research focused of determining if there is an association between reading anxiety and reading achievement. Reading anxiety is defined as a fear of reading (Zbornik, 2001). It is a anxiety specific to reading, conceptualized to be separate from, but associated with, other forms of anxiety (Jalongo & Hirsh, 2010; Piccolo et al., 2017; Macdonald et al., 2021; Pollack et al., 2021).

Existing past meta-analyses

There is a history of meta-analyses finding significant correlations between reading achievement and various types of positive reading affect, including motivation (r = .22; Toste et al., 2020), attitudes toward reading (Petscher, 2010), and engagement (*r* = 0.24; Lindström et al., 2021). In other meta-analyses, anxiety (a form of negative affect) has been found to be associated with academic achievement, including in math anxiety (*r* = -0.28; Barroso et al., 2021), general anxiety (*d*= 0.41; Francis et al., 2019), and foreign language reading anxiety (FLRA) (*r*= −0.28; Li, 2022). However, there is currently no meta-analysis on reading anxiety.

Research Questions:

1. What is the strength of the overall effect size correlation between reading anxiety and reading achievement across all studies that have investigated this association?
2. Does the strength of this correlation differ depending on any moderators?

This study is designed to follow the recommendations of the PRISMA checklist for systematic reviews (Page et al., 2021)

\*Much of the structure and questions in this preregistration are borrowed from PROSPERO (an International prospective register of systematic reviews)

**Stage of review at time of this preregistration submission**

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| --- | --- |
| Preliminary searches | Complete |
| Piloting of the study selection process | Complete |
| Full searches | Started |
| Formal screening of search results against eligibility criteria | Started |
| Data extraction | Started |
| Risk of bias (quality) assessment | Preliminary (with subset of studies) |
| Data analysis | Preliminary (with subset of studies) |

A smaller preliminary version of this meta-analysis was done as part of a class project to learn how to do meta-analysis. Now we are preregistering the official project we plan to carry out all the way. But this means that certain parts of this project had been started before submitting this preregistration. In latter pages of this preregistration, we at greater length describe what the whole plan is for each of these stages. Here we describe which parts has already been completed.

We have finished the preliminary searches, which entailed looking in the literature databases to see if it looked like there were enough papers to constitute a meta-analysis. We have piloted the study selection process, which means we have already tested and officially determined what our study search strategy and selection criteria will be.

Thus far we have done parts of the full search and formal screening of search results against the eligibility criteria. We have completed both for round 1 (a detailed description of each round can be found latter in the document). Round 3 has been started for some of the studies to see if this process of searching would be effective but is far from complete. For the class project, 10 of the studies from round 1 were selected to be used in a practice class project. For these 10 studies they received data extraction, risk of bias assessment, and their data was analyzed (the only moderators analyzed were: year of publication, age of participants, reliability of reading anxiety measure, and reading domain).

**Search Strategy**

To be included in this meta-analysis the study must include

a measure of (and correlation between) reading anxiety and reading achievement.

Inclusion/exclusion criteria:

* Language requirements
  + There must be a measure of both reading anxiety and reading achievement in the participants’ first language
    - Measures of foreign language reading anxiety (FLRA) will not be considered to be the same as reading anxiety
  + No restriction on what country or language the participants read in as long as there is a measure in their first language
  + We must be able to read to study (therefore there must be an English version of the manuscript available)
    - If it is not written in English, we will put the abstract through google translate. Then we will email the authors to ask if there is an English translated version of the manuscript.
* From any year
* No age restrictions for participants
* Does not need to be published
  + E.g., dissertations, preprints, and unpublished raw data will be included
* Must be measuring reading achievement specifically
  + This will include: reading fluency, reading comprehension, reading accuracy (decoding), letter knowledge, and composite measures of reading achievement.
  + This will not include reading related measures that we consider not reading achievement (e.g., rapid automatized naming, phonological awareness, vocabulary, and oral comprehension)
  + Could not be participant self-report of reading abilities (e.g., reading self-concept) in which reading ability was not directly measured
* Must be a measure of reading anxiety (a fear of reading)
  + Cannot be a combined measure of academic anxiety (e.g., a measure of both math and reading anxiety)
  + Cannot be a measure of combined reading affect (e.g., a combined measure of self-concept and reading anxiety called “reading affect”)
  + This can be a measure of heart rate while reading, but only if in the paper they are referring to that measure as reading anxiety that they are measuring.
* Must have quantitative data on reading anxiety and reading achievement
  + Purely qualitative reports and review papers will be excluded. (mixed methods papers with quantitative measures of reading anxiety and reading achievement will be allowed)

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| --- | --- |
| Search Terms:  These can appear anywhere in the text | (“reading anxiety”) OR (“anxiety in reading”) OR  (“anxiety about reading”) OR (“anxiety towards reading”) |
| Sources to be searched: | PubMed, PsycINFO, ERIC,  OSF preprints, PsyArXiv Preprints, & EdArXiv Preprints |

All potential studies will be first housed in Zotero. Then they will be all moved to Covidence for housing, managing, screening, sorting, and selection.

For organizational purposes, the search was conceptualized as occurring in overlapping rounds

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| --- | --- | --- |
| Round 0 | Preliminary search | Completed |
| Round 1 | Initial search | Completed |
| Round 2 | Gray literature | Not started |
| Round 3 | Forward & backward search | Started |
| Round 4 | Missing correlations | Not started |

Round 0 (Preliminary search)

This round was all done before doing any of the official searching for studies to include. This started by doing an informal search in the literature to see if there was enough research on reading anxiety to constitute a meta-analysis. Then 5 key studies were identified that needed to be included in the final meta-analysis. Then we tested out different search terms to find the best combination that would result in capturing the reading anxiety literature without going too broad that it would become unwieldy beyond the topic. With each tested search we checked that these 5 key studies were captured by the search strategy.

Procedure for screening studies against inclusion requirements

All studies will be screened for inclusion against the previously listed inclusion/exclusion requirements. There will be three people screening (referred to as coders). Before the start of each round of the search, an in-person training will be conducted with the three coders. In such training the inclusion/exclusion will be gone over and any questions that come up will be discussed. Every paper will be screened by two coders individually for reliability. In any cases of conflict, in which one coder elects to include the study and the other coder elects to exclude it, a meeting will be had between the two coders to resolve the conflict. In such meetings the coders will meet in person, sitting in the same room separately screening the study again and then compared what conclusion they came to and explain to the other why they came to that conclusion. After such, a final mutual decision will be made as to include or exclude the study.

Round 1 (Initial search)

Using the previously listed search terms, a search was conducted in the following databases: PubMed, PsychINFO, and ERIC. PsychINFO and ERIC were done through the ProQuest platform. All studies populated by this database search then compared against the previously listed inclusion/exclusion criteria but selecting “yes” or “no” for inclusion. First, all these studies had their titles and abstracts screened for inclusion. Remaining studies were then subject to full-text screening. Whenever a study was excluded at this stage, the reason for which the study was excluded was noted. These reasons for exclusion were: FLRA without a control group, no reading outcomes, no reading anxiety, or not quantitative.

\*After rounds 0 and 1, rounds 2-4 will not be done sequentially. Instead, they will be done continuously and simultaneously, keeping track of by which method (round) each new study is identified. Identifying of a study by one of the 2-4 round will result in new search searches needing to be done in the other rounds 2-4. So, rounds 2-4 will continue until studies stop being found to be screened.

Round 2 (Gray literature)

The goal of this round will be to target any papers that would be missed by the other rounds (gray literature). No part of this round has been started at this time. First, we will search through preprints. Specifically, we will (using the same search terms as before) search the following preprint databases: OSF preprints, EdArXiv Preprints, & PsyArXiv Preprints. OSF preprints search engine covers/searches through many other preprint databases. The next parts of round 2 will include contacting research asking for any unpublished data. First this will include directly emailing any researchers that our authors have reason to think that researcher have unpublished reading anxiety data. Those contacted will include those who are known to do research in reading anxiety are thus considered be of higher likely of having unpublished data. If an existing paper cites or makes reference to any unpublished studies/data collections (or future planned data collections) on reading anxiety, the authors of those unpublished studies will be emailed. The third part of round 2 will include a public call for any unpublished data including reading anxiety. This will include a public post we will make to Twitter and then attempt to get shared as widely as we can achieve. Next email will be sent out to listservs in the field. This will include an email to the cogdevsoc listserv and the listserv of the motivation special interest group of AERA.

Round 3 (Forward & backward search)

The full protocol of round 3 (both the forward search and backward search) will be done for every study selected for official inclusion in the analytic sample of the meta-analysis. For the backward search we will look for any missed studies on reading anxiety by reading through the whole paper for in-text citations that mention reading anxiety and we will read through the study titles in the reference list. For the forward search, we will search through all the studies that cite any of the studies included in the meta-analysis. The procedures of this round have been started on some of the studies included but is not complete.

Round 4 (Missing correlations)

Round 4 will involve emailing the authors any paper that is missing needed information for inclusion in the meta-analysis, but we have reason to believe that needed information exits. First this will include emailing the authors of any paper that we are unable to get access to the full-text of. Second, we want to try our best to include papers from any language or country, however in order to be included in the meta-analysis we need to be able to read the paper. If a paper is not written in English, we will email the authors to see if there is an English version of the manuscript or if there is a way for us to obtain information on the study in a format we can read. Third, to be included in this meta-analysis each study we will need a Pearson correlation between reading anxiety and reading achievement. Every study identified as to be included in the meta-analysis will be sorted into those that did and did not report their correlations. Emails will be sent to the authors of studies that are missing Pearson correlations and have not provided enough information for a conversion to a Pearson correlation to occur (i.e. raw data or a *t*-test and *n*). For every author that is emailed for any of these reasons, we will email each author three times (emails spaced at least 1 week apart).

**Data extraction**

All studies will be coded (extracted) by 2 coders (the same 2 coders for all studies).

All coding will be done in Covidence

Training of coders

Coders will be trained using Stock’s 8 Steps (Stock, 1994) via in-person training meetings.

1. An overview of the goal and plan for the meta-analysis will be provided
2. Coders will be provided an overview of the whole coding process, including what is done for coding and in what order, in addition to how to fill in the coding forms.
3. Each item on the coding form will be gone over.
4. Three studies will be chosen for practice coding.
5. Both coders will code all three of those three selected practice studies on their own during the week.
6. The 2 coders will get together and compared our coding.
7. If needed we will revise the coding sheet or procedures
8. If low agreement in coding across coders we will code another practice study. We will repeated this until there is agreement in how we are coding the studies.

Interrater reliability

Each study will be extracted by each of the coders separately. The two coders will meet to resolve each piece of information recorded on each study that there as discrepancies between what is reported by the coders. In these instances, similar to the procedure for conflicts when sorting, while sitting the same room each study will each individually look back over the study and determine what they feel should be the reported information and then describe to the other why they came to that conclusion. Then together 2 coders will come to what they agree is the correct information.

The agreement rate will be calculated for the reported correlation between reading anxiety and reading achievement by each of the coders on each effect size. To do so we will perform an intraclass correlation using two-way random effects.

Information extracted

For a complete list what all was collected/coded for each study included the specific questions, a blank version of the preregistered coding sheet to be used is currently (at time of preregistration) available on this project’s page on LDbase.

* At the end of the project the final dataset containing the information extracted from each study will be posted for public access on the project’s page on LDbase. There will be two datasets posted

1. The dataset with all of the information extracted from every study
2. The dataset that has been restricted to how the data will be analyses and only contain the specific variables that we are including in the paper.

* A final coding sheet will be posted to LDbase that will serve as a codebook with the corresponding variables names to the datasets.

Main effect

The Pearson correlation between reading anxiety and reading achievement will be reported.

Moderators

We will investigate if the strength of the correlation between reading anxiety and reading achievement is moderated by any of the following

For each of the moderator analyses, the only studies included in each moderator analysis will be those that reported such information. If such information is not reported those studies will be coded as NA and left out of that moderator analysis.

Age of participants

We will be using the mean age of participants in each sample as a continuous measure to be used as a moderator. If grade is reported but not age, the average grade level will be converted to the best corresponding age (e.g., grade 2 = age 7.5 and grade 8 = age 13.5).

Each study sample was categorized into one of the following: preschool, early elementary school (grades K-2), late elementary school (grades 3-5), middle school (grades 6-8), high school (grade 9-12), college (young adult), adult. Dummy coding will be used to conduct certain pairwise comparisons across. Specifically, we will compare 1) preschool vs early elementary school, 2) early elementary school vs late elementary school, 3) late elementary school vs middle school, 4) middle school vs high school, 5) high school vs young adult, 6) college vs adult. Each of these pairwise comparisons will only be done if there are at least 3 studies in that age category and the two age categories are not drastically unbalanced in their number of studies.

Reading domain

We will look at the reading domains of reading comprehension, reading accuracy, reading fluency, and letter knowledge.

First, we will provide what the correlation is between reading anxiety and reading achievement in each of the reading domains separately. Then dummy coding will be used to conduct pairwise comparisons across these reading domains. If one of the reading domains includes under 3 studies, then it will not be included in moderator analyses. Any combined “other” domain measures of reading achievement will not be included in moderator analyses.

Gender  
For this variable we will be using the percentage of the sample in each study that is boys. This will be treated as a continuous variable to use as a moderator.

Disability status

For studies that report it, the percentage of the sample that has a learning disability will be used as a continuous moderator. The same will be done for the percentage of each sample that is considered struggling readers. Each of these moderator analyses will only be done if at least 3 studies report this information.

Study quality

We will assess each study on 14 quality indictors selected from a list by (Protogerou & Hagger, 2020). On each of the 14 quality indicators will be scored a 1 (yes met the quality indicator), 0.5 (partial credit), or 0 (no, they did not meet the quality indicator). Then a sum score (range 0 – 14) will be calculated for each study on their level of study quality. This will be treated then a continuous measure of study quality to be used as a moderator.

Reliability of the reading anxiety measure

The Cronbach’s alpha of the reading anxiety measure use in each study will be used as a continuous moderator by the reliability of the reading anxiety measure used.

Creation of the reading anxiety measure

How the authors of each study came up with their reading measure will be recorded (i.e., existing measure, newly created measure, adapted existing measure). Dummy codes will be used to conduct pairwise comparisons across the three.

Who read the reading anxiety questions

We will compare between studies who had the participant read the reading anxiety questions and studies who had someone else read the questions to the participant.

If less than seven studies had the participant read the question and less than seven of the studies had the someone else read the questions to the participant, then this will just be used as a descriptor.

Number of items in the reading anxiety measure

The number of items in each study’s measure of reading anxiety will be included as a continuous moderator.

Year of publication

This will be treated as a continuous measure for a moderator.

Publication status

Each study will be binary coded as published or unpublished, which will then be used to see if that moderates the result.

Desciptors to be included in final report

We will collect this information on each study, but we will only provide a description of what these things look like generally across the studies. We will not be using these as moderators. These are things that we think are interesting just for the purpose of knowing what the common practices are across studies on reading anxiety. For all of these we will only be reporting these in the form of frequencies.

* Who reported reading anxiety
  + Percentage of studies that were: self-report, teacher-repot or parent-report
* How the final reading anxiety score was calculated
  + Percentage of studies that used: sum score, average score, or factor score
* Country the study was conducted in
  + Percentage of studies done in each country represented
* Language reading achievement and reading anxiety was measured in
  + Percentage of studies done in each language represented

Information we will be coding, but won’t be analyzing or reporting

These are things that we wanted to know about each study just to note. This information will not be discussed or analyzed in the final manuscript. This information will be available in the complete dataset online.

* Name/citation of the reading anxiety measure
* Participant race/ethnicity
* Socioeconomic status (SES)
* Study design (e.g., correlational or experimental)
* In what form it was (un)published (e.g., journal publication, preprint, or dissertation)

**Analytic Plan**

All analyses will be conducted in R statistical software

Pearson’s r correlation coefficient will be used as the effect size in this meta-analysis. If there is a paper with a different type of correlation (e.g., Spearman’s correlations) we would have emailed the authors for the Pearson correlations using the same protocol outlined in round 4 of the search strategy. For the purposes of the analysis, the Pearson correlations will be converted to Fisher’s z scores.

At this time, we are expecting that the effect sizes that will be included in this meta-analysis are not from one single population but instead that there are a range of effect sizes in the population. If that is the case we would use a random effects model. We will first investigate the amount of between-study heterogeneity using the *Q* statistic, *I*2 statistic, and *Tau*2 statistic. If we reject the *Q* statistic null (*p* < .05) that would support our planed use of a random effects model. If we fail to reject the *Q* statistic null (*p* > .05) we will use a fixed effects model.

We expect that our meta-analysis will include many studies with multiple effect sizes correlation coefficients to be included in the analyses (dependent effect sizes). To account for the expected nested dependent nature of the effect sizes included we will thus conduct a multilevel meta-analysis. To do so we will use the metafor package in R statistical software with restricted maximum likelihood estimation and will then adjust using clubSandwich. This will give us the main effect and if *p* < .05 then we will consider the main effect to be significant.

Moderators

The same method as described above for the main analysis will be used to investigate if the effect differs by any of the moderators previously listed. For each moderator we will report *QE* and *QM*. However, we will need to keep in mind that *QM* does not take into account dependent effect sizes. We will then adjust using clubSandwich to account for dependent effect sizes. If the resulting *z* estimate is significant (*p* < .05) then that will inform us that moderator is significant.

Publication Bias

We will do our best to cover the gray literature in round 2 of searching for studies to include, but we will also check statistically for publication bias. There would be evidence of potential publication bias if there are very few studies with small sample sizes and small effect sizes. First, we will see if publication status is a moderator using the analytic plan previously described for the publication status moderator. We will then create a visualization of publication biases in the form in a funnel plot. If there is no publication bias this will look like a normal bell shaped curve. There will be concern for potential publication bias if the funnel plot is lopsided and sparce in the lower left (studies with small effect sizes and small samples). Second, we will perform an Egger test. If through the Egger test we find statistically significant asymmetry in the distribution of effect sizes (*p* < .05) then we will assume there is publication bias. Finally, we will make a forest plot to visualize this.

Sensitivity Analysis

We will perform 3 sensitivity analyses to check that we would have gotten the same result had we made different decisions throughout this meta-analysis.

1. We will perform a trim-and-fill. If this results in finding that there were missing studies, for one this would mean that there was publication bias. Then we would add in what those missing study effect sizes would be and calculate a new estimate of the average effect size and report that. If the trim-and-fill reports there are no missing studies then we will assume there is no publication bias and our estimate of the average effect size will be unchanged because no studies will be added.
2. We will perform a Fail-Safe-N to determine how many “file drawer” papers (unpunished papers with small insignificant effect sizes) would need to exist in order for the effect size determined in the current meta-analysis to be insignificant and there to be truly no association between reading anxiety and reading achievement. This will give us a sensitivity analysis of how well we covered the gray literature and if we are likely missing studies in our analysis.
3. We will run both a random effects model and a fixed effects model. Then we will look to see if the results we get for each are about the same. This will tell us if we had made a different decision to use the other model (the fixed effects model instead of the random effects model) if we would have gotten different results.

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