


Does reading anxiety impact on academic achievement in higher education students?

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Poor readers have lower academic achievement and increased anxiety, including reading anxiety, which may perpetuate lower academic achievement. We explored reading anxiety in university students, investigating whether the association between reading ability and academic achievement is mediated by reading anxiety (independent of general anxiety). Participants were students ($n = 169$, 69% female, age = 20.70) at an Australian university who completed an online reading assessment (decoding skills, phonological awareness, orthographical knowledge and comprehension), and a survey examining reading anxiety, trait anxiety and self-reported reading history. Academic achievement was based on university grades. Two reading anxiety factors (social and non-social) were identified; both factors were distinct from trait anxiety. Reading ability was negatively correlated with reading anxiety and positively correlated with academic achievement. Reading anxiety was not correlated with academic achievement and it did not mediate the relationship between reading ability and academic achievement as expected. As this was the first study to explore reading anxiety in adults, further research is required to determine the impact reading anxiety may have on university students beyond academic achievement.

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KEYWORDS

academic achievement, reading ability, reading anxiety

Poor readers are individuals who perform at the low end of the reading ability continuum for their age (Seidenberg et al., 1986).¹ Reading is an essential skill for most individuals (Halldórsdóttir, 2017), especially university students, who are required to read constantly due to the large academic workload (Quick, 2013). As such, relative to typical readers, poor readers perform less well at university (Pirttimaa et al., 2015). Poor readers earn lower grade point averages (GPAs: 2.84 vs. 3.03 across all faculties), achieve fewer credit points (i.e., on average, 27 of an attempted 30 vs. 30 out of attempted 30) and are more likely to withdraw from or fail courses (i.e., an average of one course per year vs. none) or not complete their degree (Bergey et al., 2017; Richardson & Wydell, 2003). Poor reading is considered a 'threat' to academic achievement (Arnbak, 2004), and although a heavy reliance on reading seems to lead to poor readers struggling at university, worrying about reading potentially compounds the issue (Piccolo et al., 2017). Therefore, this study explored the impact of reading anxiety on the relationship between reading ability and university academic achievement.

Reading is a process performed to increase understanding of a topic (McKee, 2012). Reading comprises two main skills: word recognition and comprehension. Therefore, there are three routes to being a poor reader: word recognition issues, comprehension issues, or a combination of both (Gough & Tunmer, 1986). Word recognition encompasses the tools used to make sense of written words, with subcomponents of phonological decoding and orthographic knowledge (Konstam & Neuhaus, 2011). In contrast, comprehension is understanding the message conveyed in the text (McKee, 2012). To construct meaning from a text, mental representations of the situation described by the text are created, allowing inference beyond what is explicitly stated (i.e., situation model; Zwaan & Radvansky, 1998). The ability to decode, identify and analyse words forms the basis of this complex mental model, with relevant information from the text as well as background knowledge being integrated into this model to allow the process of retrieving, inferring and monitoring the meaning of the text (Castles et al., 2018). As such, poor performance on comprehension tasks could reflect a variety of difficulties, including difficulties with word-level literacy or working memory. Interestingly, compared with typical readers, adults with dyslexia demonstrate large deficits in word- and pseudo-word reading, spelling and text reading tasks; in contrast, the deficit is least pronounced in comprehension tasks (Reis et al., 2020). However, when separating listening and reading comprehension, individuals with dyslexia appear to demonstrate larger deficits in reading as compared with listening comprehension (Georgiou et al., 2022).

Decoding and comprehension are important in understanding reading ability at university (Gough & Tunmer, 1986) and hence have the potential to impact academic achievement. At university, comprehension dominates, with better comprehenders showing better academic achievement (La Paro & Pianta, 2000). Even amongst poor readers those with poor comprehension face increasing likelihood of poor academic achievement (Arnbak, 2004). The typical compensations made by poor readers (i.e., reading more slowly, pausing, looking back and re-reading; i.e., compensatory-encoding theory: Walczyk & Griffith-Ross, 2007) are restricted at university by time and performance pressures, frequently resulting in poorer compensation and comprehension (e.g., Deacon et al., 2012).

In addition to reading abilities, mental health may also impact academic achievement (Boyes et al., 2016). For example, amongst children who are poor readers, increased anxiety is associated with reduced academic performance over time (Hossain et al., 2021). Anxiety can impair academic achievement by eliciting task-irrelevant thoughts (Pekrun et al., 2002) and reducing concentration and retention of information (Everson et al., 1994; Eysenck et al., 2007; Humphreys, 1984; Sarason, 1988), highlighting the importance of considering the role of anxiety in academic difficulties.

Alongside experiencing elevated anxiety as compared with typical readers (Francis et al., 2019), the importance of reading ability in academic achievement may result in poor readers experiencing emotional difficulties specifically surrounding their academic ability and performance (McNulty, 2003). As such, it appears that poor readers experience negative self-perceptions specific to their experienced difficulties, such as reading, writing, spelling, literacy, and academic self-concept (Gibby-Leversuch et al., 2021; McArthur et al., 2020). Consistent with this, university students with a history of reading difficulties report higher academic anxiety than those without (Elgendi et al., 2021). As seen with academic self-concept, this academic anxiety may be further localised to specific anxiety regarding reading known as reading anxiety—a specific situational subtype of anxiety experienced by poor readers (Zbornik, 1988; Zbornik & Wallbrown, 1991)—that is considered distinct from general anxiety, an emotion involving apprehension towards anticipated misfortune, danger, or catastrophe (American Psychiatric Association, 2020).

Individuals with reading anxiety experience an unpleasant emotional response to reading (Piccolo et al., 2017) involving apprehension towards situations requiring reading (Ramirez et al., 2019). This apprehension in reading anxiety can range from low motivation to read through to avoidance (Zbornik, 1988, 2002). Hence, its relationship with reading ability is likely bi-directional: both causing and being caused by poor reading (Piccolo et al., 2017; Ramirez et al., 2019). This may set up a vicious cycle: Poor reading causes anxiety, promoting avoidance (see Damico et al., 2008, 2011), and less practice of reading stifles progress, resulting in the student viewing poor reading as an ongoing failure, resulting in more anxiety (Bradley & Thalgot, 1987).

Reading anxiety research has mostly focused on children (Katzir et al., 2018; Ramirez et al., 2019), with surprisingly little research on adults. Considering that reading anxiety negatively impacts students' grades in primary school—more so than general anxiety or motivation (Yamac & Sezgin, 2018; Zbornik & Wallbrown, 1991), it is essential to examine the role of reading anxiety at university to better understand and ultimately support learning at this level. Although stronger effects may be present in individuals who attend lower levels of education, it is important to explore the extent of reading anxiety-poor reading connection within higher education as well given the established negative impact of reading ability on academic achievement (Bergey et al., 2017).

In this study, we explored whether reading anxiety mediates the relationship between reading ability and academic achievement, as depicted in Figure 1. As discussed above, all components of the proposed mediation model have been linked in previous research, but this is the first study to examine all three elements in a mediation model.

We hypothesised that reading anxiety would partially mediate the relationship between reading ability and academic achievement and expected that the presence of reading anxiety would further decrease academic achievement in poor readers. Furthermore, we hypothesised that reading anxiety would be distinct from general anxiety.

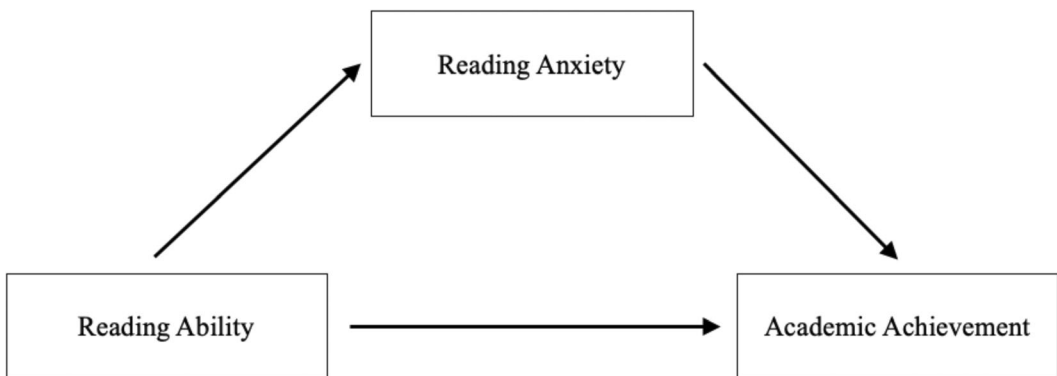


FIGURE 1 Mediation model of the relationship between reading ability (predictor variable) and academic achievement (outcome variable), mediated by reading anxiety (mediator variable).

1 | METHOD

1.1 | Participants

Participants were students recruited through a research participation system. Data from 252 participants were collected, with a final sample of 169, with English as their first language and normal or corrected vision; age: $M = 20.70$ ($SD = 4.35$) years, $range = 18-57$; 117 identified as female, the remainder as male. The large drop in participants resulted from removing incomplete data sets and excluding participants who did not consent for their grades to be accessed or not selecting English as their written or spoken language of preference.

For participation in the study, 202 of the original 252 participants received course credit and 50 participants were paid \$15. Of the final 169 participants, 44 were paid participants. Paid participants performed better in terms of their grades and reading comprehension ability and reported less history of reading difficulties compared with the course credit participants. Masters and Doctorate students made up the paid participants, potentially explaining this difference. Despite the disparity between the groups, the story was the same when controlling for the two groups as a covariate in the analyses. Therefore, the paid and course credit participants were analysed together.

The sample included students from the following courses: Bachelors of Science (25.9%), Arts (21%), Biomedical Science (13.8%), Commerce (7.6%), and Philosophy (Honours) (2.7%), Diploma in Science (0.4%), Masters of Information Technology (0.9%), Applied Finance (0.9%), Science Communication (0.4%), and Clinical Exercise Physiology (0.4%), and Doctors of Medicine (0.4%), Juridical Science (0.4%), and Dental Medicine (0.4%).

1.2 | Materials

Participants were assessed on reading ability, reading anxiety, trait anxiety and academic achievement. Reading ability was assessed online through phonological decoding, orthographical knowledge, reading comprehension and reading history.

1.2.1 | Reading ability

Phonological decoding

Phonological decoding was assessed online using the pseudo-word reading phonological choice task (i.e., PCT: Parrila & Turgeon, 2012). This task assessed phonological decoding: the ability to sound out words. Participants were instructed to read 20 pairs of nonsense words and indicate which sounded like a real word. For example, 'anser' versus 'amsor' where the former is correct, as it sounds like 'answer'. Internal reliability is reported in 'Scoring' below.

Orthographical abilities

Orthographical abilities were assessed online using two sight word reading tasks: orthographic choice task (i.e., OCT: Parrila & Turgeon, 2012) and test of orthographic choice (i.e., TOC: Kohnen et al., 2012). For both tasks, participants were presented with a pair of phonologically equivalent words (OCT $n = 49$ pairs, TOC $n = 30$ pairs) and were instructed to select the correctly spelled word from the pair. For example, 'reciept' and 'receipt', where the latter is correct. Participants' performance on the two tasks was statistically significantly correlated, $r(167) = 0.459$, $p < 0.001$ --a large effect (Gignac & Szodorai, 2016)--indicating high levels of construct validity. Internal reliability is reported in 'Scoring'.

Scoring

For the PCT, OCT and TOC items, responses were scored one for correct or zero for incorrect and response times (RTs) were recorded for each item. Participants with accuracy at or below chance (i.e., $\leq 50\%$) were dropped from

the analyses ($n = 11$). Responses in this range were checked for systematic errors. We concluded that these individuals misunderstood the task rather than being poor readers.

Participants were expected to have high accuracy, but poor readers were expected to make slower decisions (see Reis et al., 2020). This corresponds with the ceiling effects found across the accuracy scores of the word-choice tasks. Due to the data being non-normally distributed, the RTs were log-transformed to base 10 (Curran-Everett, 2018). These RTs were standardised through transformation into z-scores to be summed into a total score. The median RTs for the PCT, OCT and TOC standardised scores were taken as an estimate of RT. The internal reliability for all items was $\alpha = 0.948$, above the commonly accepted threshold of 0.70 (Taber, 2018)—internal reliability was calculated by placing all the z-scored RTs from all three tasks into a reliability analysis, rather than the PCT, OCT and TOC total scores being placed in the reliability analysis.

Reading comprehension

Reading comprehension was measured online using the reading comprehension subtest of the York Adult Assessment Battery-Revised (i.e., YAA-R: Warmington et al., 2013). Participants were instructed to read a 492-word passage (this was timed, see Table 1). The passage was then re-presented (for reference) with 15 questions: seven assessed knowledge (e.g., ‘What formed the foundation of the first solid chocolate bar?’), four assessed vocabulary (e.g., ‘In the context of paragraph 2, what does apathy mean?’) and four assessed inference-making (e.g., ‘How do you think Columbus felt about the King and Queen’s reaction?’). Participants responded in short-answer format.

Questions were automatically scored using a custom R script based on the standard guide (Warmington et al., 2013). Accuracy was based on the presence of certain words or strings of words (specified in the scoring instructions), allowing for a small margin of spelling error (‘max distance = 0.2’, using the `agrepl` function). Accuracy was checked manually. The automated and adjusted scores were highly correlated, $r(167) = 0.710$, $p < 0.001$. On average, scores were adjusted by an absolute value of 1.34 ($SD = 1.88$) points. Potential scores ranged from 0 to 15: higher scores indicated better comprehension. Participants who scored a total of zero were removed from the analyses ($n = 8$), exploration of the responses indicating misunderstanding or nonsense responses. The mean score for our sample ($M = 9.40$, $SD = 2.25$) was comparative to the university student normative sample ($M = 9.74$, $SD = 2.30$, Warmington et al., 2013), with 31.4% of our participants scoring below average (i.e., total score ≤ 8); see Tables 2, 3 for further details of the score distribution.

This task had low internal reliability ($\alpha = 0.453$), similar to previous work (Warmington et al., 2013). This likely reflects the combination of sub-components (i.e., knowledge, vocabulary and inference-making), known to reduce Cronbach’s alpha (Taber, 2018). Given the test is reliable in discriminating those with and without reading difficulties (Warmington et al., 2013), it was used as is.

Reading history

Reading history was examined using the Adult Reading History Questionnaire-Revised (i.e., ARHQ-R: Parrila et al., 2003), a revision of the Adult Reading History Questionnaire (Lefly & Pennington, 2000). Both questionnaires measure participants’ reading experiences. The questionnaire includes a general information section covering participants’ language and writing preferences, level of education, and family reading and spelling history. The remaining three sections cover spelling and reading ability and speed, personal and parental attitudes towards reading and

TABLE 1 Time spent on reading comprehension task (minutes).

Section	Median (SD)	Minimum	Maximum	Inter-quartile range
Passage	1.77 (1.31)	0.04	15.09	1.33–2.23
Questions	10.18 (13.50)	2.95	152.69	7.79–15.94

Note: The maximum time potentially reflected an individual who left the questionnaire open, with that participant’s overall time spent on the survey being 25 h.

TABLE 2 Distribution of reading comprehension total scores.

Score	<i>n</i>	Cumulative %
1.00	1	0.6
4.00	5	3.6
5.00	3	5.3
6.00	8	10.1
7.00	14	18.3
8.00	22	31.4
9.00	27	47.3
10.00	36	68.6
11.00	21	81.1
12.00	20	92.9
13.00	12	100.0

TABLE 3 Distribution of reading comprehension subscale scores.

Score	Knowledge subscale		Vocabulary subscale		Inference-making subscale	
	<i>n</i>	Cumulative %	<i>n</i>	Cumulative %	<i>n</i>	Cumulative %
0	0	0	1	0.6	14	8.3
1	4	2.4	10	6.5	40	32.0
2	9	7.7	33	26.0	53	63.3
3	20	19.5	64	63.9	49	92.3
4	61	55.6	61	100.0	13	100.0
5	49	84.6				
6	22	97.6				
7	4	100.0				

Note: Minimum score for all subscales = 0, maximum score on knowledge subscale = 7, maximum score for vocabulary and inference-making subscales = 4.

school, repetition of grades or courses, additional reading or spelling assistance received, the effort required to succeed, and exposure to reading materials (Parrila et al., 2019). Participants responded on a five-point Likert scale, ranging from 0 to 4; labels differing between questions. The three sections include:

1. primary school ($n = 15$ questions; e.g., 'How much difficulty did you have learning to read in primary school?' -- response labels range: 'None' to 'A great deal'),
2. high school ($n = 19$ questions; e.g., 'How would you compare your reading skill to that of others in your high school classes?' -- response labels range: 'Above average' to 'Below average'), and
3. current reading experiences ($n = 22$ questions, e.g., 'How much difficulty do you currently have with reading?' -- response labels range: 'None' to 'A great deal').

Ratings for the three sections were summed independently and then collectively to provide a single total score. Raw scores were preferred over standardised scores; raw scores allowed an examination of the scores in terms of the total possible score for the whole questionnaire rather than just examining it in terms of other scores within our

TABLE 4 Bivariate Pearson correlations between the primary school, high school and current reading history questionnaire sections.

Questionnaire section	High school	Current
Primary school	0.608**	0.472**
High school	–	0.761**

Note: $Df = 167$, ** indicates $p < 0.001$.

sample. A standardised score of the three sections was combined into a standardised total score, which was not statistically different from the raw total score.

The collective total score was based on statistically significant correlations between sub-sections (>0.472 , see Table 4; all large effect sizes based on Gignac & Szodorai, 2016 guidelines). Potential scores ranged from 0 to 280, higher scores indicated greater reading difficulty or less engagement with reading activities. The questionnaire had high internal reliability ($\alpha = 0.923$; internal reliability based on all items, irrespective of section), consistent with previous work in students without learning difficulties (i.e., 0.793; Fichten et al., 2014).

Reading history was considered another index of 'reading' as it reflects a subjective measure of students' current reading experiences. Furthermore, a history of reading difficulties has previously been associated with poor academic achievement (Bergey et al., 2017) and higher academic anxiety (Elgendi et al., 2021) amongst university students, supporting its consideration in the mediation model.

1.2.2 | Reading anxiety

RAT-A

Reading anxiety was measured using the novel Reading Anxiety Test for Adults (i.e., RAT-A; Francis et al., 2020a) adapted from the Reading Anxiety Test for Children (i.e., RAT-C; Francis et al., 2020b). The RAT-A contains 42 questions on current reading anxiety. Participants responded on a five-point Likert scale ranging from 'Never' (score = 1) to 'Always' (score = 4), including 'I don't understand' as the fifth option (scored as zero as it did not reflect reading anxiety levels; note: no participant used the 0 option). Higher scores indicated higher reading anxiety. Figure 2 displays the distribution of the reading anxiety total scores; most people scored on the lower end of the distribution, with some participants demonstrating elevated levels of reading anxiety. The questionnaire had high internal reliability ($\alpha = 0.961$).

As mentioned, the RAT-A was adapted from the RAT-C. The RAT-C was created by combining a thesis questionnaire (Maddox & Nation, 2018)—which assessed reading, maths, and general anxiety—with inspiration from Spence Children's Anxiety Scale (Spence, 1998). Based on relationships in children between poor reading and social anxiety (Tysinger et al., 2010), generalised anxiety, and somatic complaints (Arnold et al., 2005), the RAT-C was created with the intention of measuring three factors (D. Francis personal communication, 9 March 2020):

1. social reading anxiety: anxiety surrounding reading aloud, and other's perceptions of your reading abilities and effort (e.g., 'I worry everyone will see me shaking when I read aloud'),
2. non-social reading anxiety: personal expectations of reading ability, and the long-term impact this has (e.g., 'I feel afraid when I have to read because I'm not as good as I want to be'), and
3. physical anxiety symptoms related to reading (e.g., 'I feel sweaty when I have to read').

Despite the proposed three factors, no research has been conducted on the RAT-C measure, so the three-factor structure is yet to be confirmed. As we adapted this task for adults, an exploratory factor analysis (EFA) was run (see: Supporting Information for details). The EFA suggested two factors, which we interpreted and labelled as:

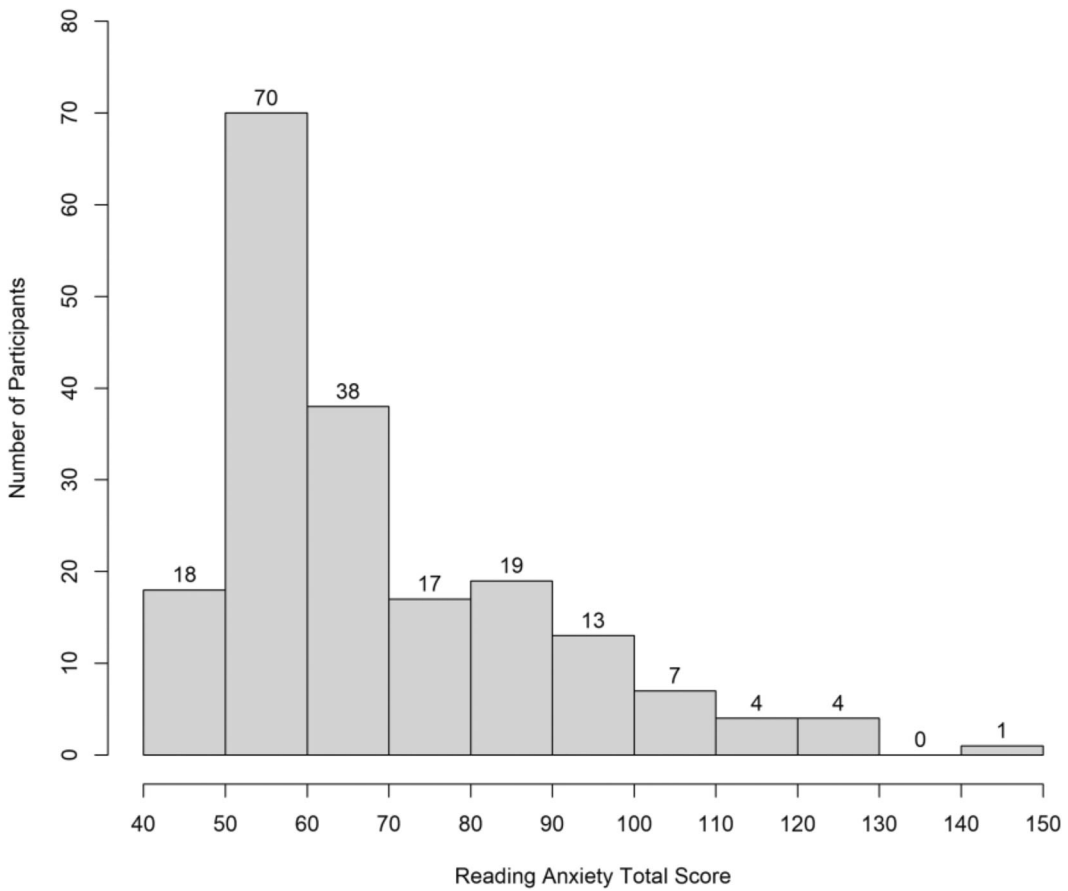


FIGURE 2 Distribution of the reading anxiety total scores. Possible scores ranged from 42 to 168.

1. social reading anxiety (e.g., 'I feel worried when I have to read aloud in front of people because it's embarrassing') and
2. non-social reading anxiety (e.g., I worry I will not get a good job in the future because of my reading).

Both factors had high levels of internal reliability (Factor 1 $\alpha = 0.950$, Factor 2 $\alpha = 0.943$)--internal reliability was based on all the items from each factor in an EFA, forcing a one factor solution, and then calculating reliability using the total eigenvalue for that factor as per Armor (1973).

1.2.3 | Trait anxiety

Trait anxiety is a stable form of anxiety (Gidron, 2013) assessing how you feel 'generally'. Trait anxiety was measured using the trait anxiety scale (Spielberger et al., 1983), which measures proneness to anxiety. This measure was included to assess whether reading anxiety differentiated from general anxiety and whether any links from reading anxiety to reading ability and academic achievement are specific to reading anxiety. Participants respond to statements such as 'I feel nervous and restless', indicating how they generally felt on a four-point Likert scale ranging from 'Almost Never' to 'Almost Always'. Potential scores range from 20 to 80; higher scores indicated higher levels of trait anxiety. The items were summed into a total score. The scale has good construct and concurrent validity

(American Psychiatric Association, 2011). Our internal reliability was high ($\alpha = 0.938$), consistent with previous work (range = 0.86–0.95; American Psychiatric Association, 2011).

1.2.4 | Academic achievement

Academic achievement was measured using the participants' university grades via their academic transcript at the end of Semester Two, 2020. Weighted average marks (WAMs) were extracted automatically via the host software (i.e., Callista). A WAM reflects an average percentage mark for all completed units. Higher WAMs represent better academic achievement. Due to COVID-19, students could opt for ungraded passes during the first semester of 2020. Ungraded passes could be applied on all units, excluding dissertation units in Honours or Masters courses or courses with 24 credit points or less. Units with an ungraded pass did not contribute to students' WAMs, aimed to mitigate the impact of COVID-19 on results. In our sample, participants opted for 0.46 ($SD = 0.88$) ungraded passes: 2.61% ($SD = 5.05$) of all grades in the units contributing to our data. Therefore, we feel this had a negligible influence on the current results.

1.3 | Procedure

The experiment was conducted online using Qualtrics Survey Software (Qualtrics, 2005, August 2020 version). Participants completed the survey on their personal devices in the following order: information and consent form, demographics, RAT-A, ARHQ-R, YAA-R reading comprehension test, OCT, PCT, TOC, trait anxiety scale, along with additional questionnaires that formed part of a broader study. The survey was designed to take 45–60 min. The procedures were approved by the University Human Ethics Committee (RA/4/20/6096).

1.4 | Analyses

Analyses were conducted in three stages:

1. Analysis of missing values and data cleaning.
2. Descriptives and Pearson correlations between variables of interest. All correlations in the analyses were evaluated using Gignac and Szodorai's (2016) effect size guidelines of $r = 0.1$ (small), $r = 0.2$ (medium), and $r = 0.3$ (large).
3. Three (i.e., word-choice, comprehension, and history) bootstrapped parallel multiple mediation analyses were conducted using the PROCESS macro for SPSS (Hayes, 2017). Five thousand bootstrapped resampling draws were used in the estimation of all coefficients. As per Hayes' (2017) recommendation, all coefficients were reported in the unstandardised format.

1.4.1 | Outliers and normality

Data plus or minus three SDs from the mean ($n = 3$) were considered possible outliers (Tabachnick & Fidell, 2013). Examination of the data revealed that they did not change the pattern of results and were feasible data points. Therefore, they were maintained in the analysis. Violations of normality were less of an issue in our analyses—Pearson correlation (Havlicek & Peterson, 1976) and bootstrapped mediation analysis (Hayes, 2017)—as they do not assume normality.

TABLE 5 Descriptive statistics for the variables ($N = 169$).

Variables	Mean (SD)	Minimum	Maximum	Possible range	Skewness	Kurtosis
PCT accuracy	19.05 (1.92)	11.00	20.00	0–20	–2.71	7.44
PCT median RT	–0.12 (0.50)	–2.22	1.09	–	–0.34	0.97
OCT accuracy	44.14 (2.88)	35.00	49.00	0–49	–0.48	–0.30
OCT median RT	–0.18 (0.41)	–1.00	1.41	–	0.78	1.18
TOC accuracy	29.31 (1.04)	25.00	30.00	0–30	–1.75	3.09
TOC median RT	–0.17 (0.48)	–1.14	2.03	–	1.25	3.62
Word-choice RT total	–0.46	–2.88	3.14	–	0.46	0.24
Reading comprehension	9.40 (2.25)	1.00	13.00	0–15	–0.63	0.55
Reading history	78.40 (25.31)	1.00	171.00	0–280	0.42	1.14
Social reading anxiety	n/a	–1.24	2.87	–	0.78	–0.39
Non-social reading anxiety	n/a	–0.82	5.24	–	2.98	9.91
Trait anxiety	46.25 (11.02)	20.00	77.00	20–80	0.24	–0.22
WAM	71.37 (9.92)	9.33	88.50	0–100	–1.86	8.60

Note: Chance performance: PCT accuracy = 0–10, OCT accuracy = 0–24.5, TOC accuracy = 0–15. N/a represents variables using z-scores; therefore, measurements of mean and standard deviation were uninformative.

Abbreviations: PCT, phonological choice task; OCT, orthographic choice test; RT, reaction time; TOC, test of orthographic choice; WAM, weighted average mark.

2 | RESULTS

2.1 | Descriptives

Table 5 details the descriptive statistics for the tasks. The PCT accuracy had a slight violation of the skew threshold, and non-social reading anxiety slightly violated the skew and kurtosis thresholds of $|2|$ and $|9|$, respectively (Gignac, 2019); this not being a concern as our analyses did not assume normality.

2.2 | Correlations

Table 6 details the bivariate Pearson correlations between all measures and the partial correlations between reading history and the reading anxiety factors, controlling for trait anxiety. The reading measures showed small to medium intercorrelations, and the reading anxiety factors were largely intercorrelated, as well as having positive relationships with trait anxiety. Better reading comprehension was associated with lower reading anxiety, and a history of reading difficulties was associated with greater reading anxiety. Better reading comprehension moderately correlated with greater WAM outcomes.

To test whether reading anxiety was distinct from trait anxiety, partial correlations were conducted between reading anxiety factors and reading measures, controlling for trait anxiety (see Table 6). For reading history and reading comprehension, the correlations were large and statistically significant. This indicates that the variance reading anxiety shares with reading history and comprehension is not shared with trait anxiety, that is, they are independent predictors.

2.3 | Mediation analyses

We conducted two mediation analyses: (1) reading comprehension and (2) reading history; each with WAM as the outcome variable, and social reading anxiety and non-social reading anxiety as the mediator variables, controlling for

TABLE 6 Pearson correlations between measures and partial correlations controlling for trait anxiety.

Variables	1	2	3	4	5	6	7
1. Word-choice RT total	-	-	-	0.058	-0.022	-	-
2. Reading comprehension	-0.031	-	-	-0.161	-0.314**	-	-
3. Reading history	0.130	-0.236*	-	0.343**	0.485**	-	-
4. Social reading anxiety	0.073	-0.110	0.420**	-	-	-	-
5. Non-social reading anxiety	-0.015	-0.302**	0.501**	0.523**	-	-	-
6. Trait anxiety	0.045	0.057	0.267**	0.503**	0.146	-	-
7. WAM	-0.080	0.260**	-0.143	-0.103	-0.118	-0.013	-

Note: $DF = 167$. Underlined coefficients signify partial correlations, controlling for trait anxiety.

Abbreviations: RT, reaction time; WAM, Weighted Average Mark.

* $p \leq 0.05$; ** $p \leq 0.001$.

the covariate variable trait anxiety (the Word-Choice RT Mediation not included due to non-significant correlations). The unstandardised beta weights are displayed in Figures 3, 4, the total effects in Table 7, and the indirect effects in Table 8.

In the comprehension model (1), both paths from comprehension to reading anxiety factors and the path between comprehension and WAM were statistically significant. In the reading history model (2), both paths from history to reading anxiety factors were statistically significant. As seen in Table 7, the total effect path between comprehension and WAM was statistically significant. As seen in Table 8, none of the indirect effects were statistically significant. Overall, no evidence of mediation was found.

3 | DISCUSSION

We explored the mediation of reading anxiety on the relationship between reading ability and academic achievement at university, hypothesising that reading anxiety would reduce academic achievement in poor readers. Our hypothesis was not supported. We found that both poor comprehension and a history of reading difficulties were related to higher reported reading anxiety, consistent with previous research in children (Piccolo et al., 2017; Ramirez et al., 2019). The relationships between the reading anxiety factors (social and non-social, discussed in detail below) and participants' reading history are consistent with the idea that reading anxiety stems from previous reading difficulties (Zbornik, 1988, 2002; Zbornik & Wallbrown, 1991). In terms of comprehension, previous research in children indicated that poor comprehension was associated with higher levels of reading anxiety (Katrancı & Kuşdemir, 2016). We found this relationship with non-social reading anxiety but not with social reading anxiety.

In terms of academic achievement, we found that poorer comprehension was related to lower academic achievement, consistent with previous work (Koli-Vrhovec et al., 2011). This fits with reading comprehension as the end point of the reading process, which is particularly important for academic achievement (Jackson, 2005). In contrast, basic word reading skills (phonological and orthographic) and a history of reading difficulties were not related to academic achievement. The basic word reading result is consistent with previous work (Jackson, 2005), whereas the reading history result contrasts with Bergey et al. (2017). Both our study and Bergey et al.'s used the ARHQ-R (Parrila et al., 2003); Bergey et al. only used the primary school section, which in our study was not related to academic achievement, as the relationship between the primary school section of the ARHQ-R and academic achievement was not statistically significant, $r(167) = -0.089$, $p = 0.251$. There was also a potential difference in the samples, with Bergey et al.'s sample being those who responded to an invite sent to all incoming students into the university, perhaps resulting in more variability than our sample recruited from research participation schemes.

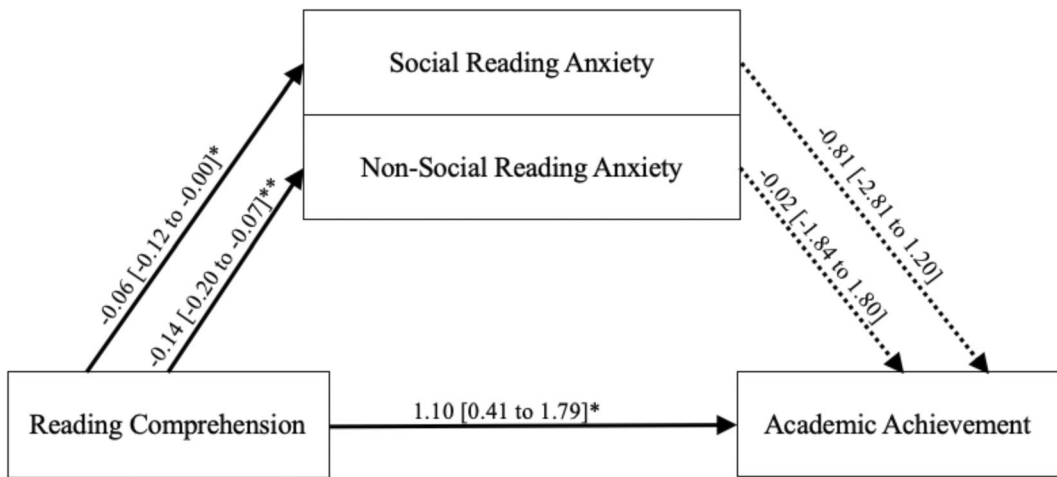


FIGURE 3 Parallel multiple mediation model between reading comprehension, social reading anxiety, non-social reading anxiety and academic achievement, controlling for trait anxiety. Coefficients represent unstandardised beta weights, with 95% confidence intervals. * $p < 0.05$, ** $p < 0.001$.

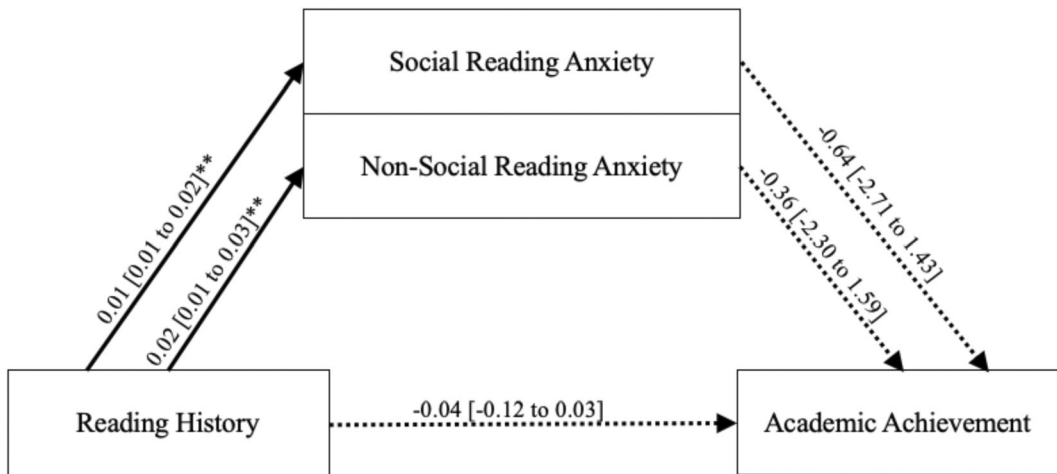


FIGURE 4 Parallel multiple mediation model between reading history, social reading anxiety, non-social reading anxiety and academic achievement, controlling for trait anxiety. Coefficients represent unstandardised beta weights, with 95% confidence intervals. * $p < 0.05$, ** $p < 0.001$.

TABLE 7 Total Effects of the mediation models tested.

Reading measure	Beta-weight	95% CI
Comprehension	1.10	[0.50, 1.81]*
Reading history	-0.06	[-0.12, 0.00]

Note: The outcome variable for all mediation analyses was WAM (i.e., academic achievement).

* $p < 0.05$.

TABLE 8 Indirect effects for the mediation models tested.

Reading measure	Indirect effect path	Beta-weight	95% CI
Comprehension	Social	0.05	[-0.01, 0.02]
	Non-social	0.00	[-0.03, 0.03]
Reading history	Social	-0.01	[-0.03, 0.01]
	Non-social	-0.01	[-0.05, 0.04]

Note: The outcome variable for all mediation analyses was WAM (i.e., academic achievement).

The reading anxiety factors were not related to academic achievement, contrasting research in children, where reading anxiety negatively impacted academic achievement (Zbornik & Wallbrown, 1991). This may reflect a lack of variability within our study. Alternatively, this may highlight a difference between children and adults, potentially reassuring for university students with reading anxiety.

Overall, we found students with a history of reading difficulties had higher levels of reading anxiety; however, neither a history of reading difficulties nor reading anxiety were related to academic achievement. Therefore, students with a history of reading difficulties were anxious about their reading ability and its impact, despite it not being related to their academic achievement. Anxiety includes anticipation of negative future events (MacLeod & Byrne, 1996), hence, if someone is aware of their reading difficulties—past or present—and are faced with reading-focused learning at university, this could create anticipatory anxiety about the impact of their reading difficulties on their current and future academic achievement.

Poor comprehension was associated with increased non-social reading anxiety and poorer academic achievement, however, was unrelated to social reading anxiety. The lack of relationship with social reading anxiety could reflect the limited focus on reading aloud in higher education, reducing the exposure to negative evaluation from peers regarding their reading ability. The experiences of non-social anxiety seem backed by evidence that reading ability impacts academic achievement. Therefore, students with poor comprehension should be identified due to the associated mental and academic difficulties. Concerningly previous research found that school students are unaware of their comprehension difficulties (Miller & Yochum, 1991). This lack of awareness may prevent students from seeking accommodations. This contrasts with those who report—and hence are aware of—a history of reading difficulties, enabling them to seek accommodations and develop compensatory behaviours and strategies (Deacon et al., 2012), potentially explaining the lack of relationship between a history of reading difficulties and academic achievement.

Our reading anxiety measure is a major element in interpreting the lack of mediation of reading anxiety on the relationship between reading and academic achievement. The RAT-A comprised two factors: (1) social reading anxiety and (2) non-social reading anxiety. The first factor reflected anxiety regarding others' perceptions of your reading ability and effort and the ridicule that coincides with this. The second factor reflected anxiety regarding the impact of reading ability on education and employment, as well as anxiety stemming from personal expectations of reading ability. The physical symptoms loaded across social and non-social reading anxiety rather than being its own factor as suggested by D. Francis (personal communication, 9 March 2020). Importantly, both factors were distinct from trait anxiety, supporting the hypothesised distinction.

3.1 | Implications for higher education

Although individuals with reading difficulties may face challenges entering higher education, it cannot be assumed that all individuals with reading difficulties would not enter higher education, particularly at the first year level (see Richardson & Wydell, 2003). Hence it is important to understand the challenges faced within higher education to

allow the provision of relevant supports that would enable neurodiversity to be maintained within the university population.

We found that amongst university students reading anxiety is a distinct sub-type of anxiety that is comprised of both social and non-social anxiety and both of these anxieties are distinct from trait anxiety. A history of reading difficulties was related to trait anxiety, but it demonstrated stronger relationships with reading anxiety factors even after trait anxiety was controlled for. Furthermore, poor comprehension was not associated with trait anxiety, but it was related to non-social reading anxiety. As such it appears that above and beyond some poor readers being generally anxious, there is a specific anxiety surrounding their ability to perform due to their reading difficulties. This finding is consistent with previous findings in which poor readers demonstrated reading-, literacy- and academic-related negative self-concept (Gibby-Leversuch et al., 2021; McArthur et al., 2020). Taken together, it appears that screening for general well-being in this population would be insufficient, exemplifying the need to screen for these specific anxieties when poor readers enter higher education. Such screening would enable targeted support for their mental well-being.

Students with a history of reading difficulties were anxious about the social and academic impact of their reading ability, even though their history of reading difficulties was unrelated to academic achievement. Previous research has indicated that poor readers at university perceived that their literacy difficulties would have negative academic and mental health (incl. anxiety) consequences, which was not fully accounted for by their literacy difficulties when measured objectively (Bazen et al., 2022). As such, it appears that there is a discrepancy between the perceived and actual impact of reading difficulties amongst poor readers. Although reading anxiety was unrelated to academic achievement, it could affect the well-being of poor readers at university, and this negative impact could be alleviated with the knowledge that according to existing studies, a history of reading difficulties is not associated with poorer academic achievement.

Poor reading comprehension was associated with lower academic achievement and higher non-social reading anxiety. Although reading anxiety did not mediate the relationship between reading comprehension and academic achievement, assisting university students in identifying and alleviating comprehension difficulties, alongside providing support to reduce their reading anxiety would be beneficial from an academic perspective. Furthermore, given that their anxiety is centred around the impact of their reading ability, it is possible that increasing their comprehension ability may alleviate their reading anxiety.

Previous research examining comprehension at university found that of 32 students with poor comprehension, only four were receiving specialised supports, and only eight reported experiencing difficulties with comprehension (Georgiou & Das, 2014). Knowledge of their difficulties may motivate students to seek compensatory mechanisms (e.g., reading more slowly, pausing, looking back and re-reading) to allow comprehension (Walczyk & Griffith-Ross, 2007). Additionally, screening university applicants for comprehension difficulties would assist with identification to allow for the provision of relevant supports; however, improving comprehension skills is not typically a focus at university where remediation of reading difficulties is less common than attempts at accommodation (Shaywitz, 1998). Despite this, interventions have successfully increased post-secondary students' comprehension skills through integration of reading comprehension strategies in course assessments (Anderson & Kim, 2011).

At university, potential accommodations could include additional time in examinations and providing options for multimodal learning, including visual aids and face-to-face teaching (MacCullagh et al., 2017; Quick, 2013). Surprisingly, even those aware of their difficulties have a low uptake of university accommodations (MacCullagh, 2014), most developing situation-specific compensatory behaviours and strategies (MacCullagh et al., 2017). Given the evidence that poor academic outcomes are associated with poor reading ability in higher education (e.g., Bergey et al., 2017; Richardson & Wydell, 2003), it is recommended that poor readers seek special considerations and potentially remediation, where possible, to maximise their achievement. Identifying and supporting poor readers would encourage neurodiversity within the university population.

4 | LIMITATIONS

Reading anxiety did not mediate the relationship between reading ability and academic achievement, suggesting that reading anxiety does not influence the academic achievement of poor readers at university. However, these conclusions must be tempered in the context of limitations.

In our study, word-choice RTs were unrelated to academic achievement, reading anxiety or other measures of reading ability, that is, reading comprehension and reading history. Consistent with our study, Jackson (2005) found word decoding accuracy and comprehension were not associated in university students. Conversely, a meta-analysis indicated strong associations between decoding skills (as measured in our study by word-choice tasks) and comprehension across all ages (García & Cain, 2014). Therefore, the lack of relationship between word-choice RTs and comprehension in our study may suggest that the word-choice measures did not reflect the aspects of word recognition ability that matter for comprehension. Notably, although our comprehension task was timed, the time allowed to complete the task was unlimited, and research indicates that when poor readers are given an untimed comprehension task, they perform equivalently to those who are not poor readers (Simmons & Singleton, 2000). This may have affected the relationship between word-choice RTs and comprehension (there was a small correlation between the word-choice RT total, and the time spent on the comprehension passage, $r(167) = 0.159$, $p < 0.05$, supporting the idea that time was used to compensate for poor reading).

Our study adapted the PCT (Parrila & Turgeon, 2012), OCT (Parrila & Turgeon, 2012) and TOC (Kohnen et al., 2012) to an online format. Future studies should examine the relationship between online and in-person PCT, OCT and TOC tasks. The other reading measures included in this study were also adapted to an online format, thus also requiring validation.

Our measure of academic achievement was limited by COVID-related compensations, allowing students to take ungraded passes for their units (for more details, see Methods). Although minimal (affecting 2.61%, $SD = 5.05$ of units for those in the sample), this may have (a) inflated grades but (b) also minimised the impact of reading difficulties on grades. Hence, it is possible that their WAM did not fully reflect their current academic achievement. Additionally, the COVID-19 pandemic reportedly increased students' anxiety levels (Dartmouth College, 2020). This may have differentially influenced our general and reading anxiety measures and possibly affected the magnitude of the relationships observed. Therefore, replicating the study in students commencing post-2020 during more typical student conditions would be desirable.

Another limitation of our study is the sample size ($n = 169$), particularly regarding the mediation analyses. To obtain power of 0.80 in the bootstrapped mediation analysis--based on the observed effect sizes of the mediation paths--a sample size of 385–462 is recommended (Fritz & MacKinnon, 2007). Therefore, our study is underpowered, potentially impeding the detection of a mediation effect. Furthermore, due to the nature of our general university sample and the lack of diagnostic information available, no interpretations can be made about anxiety in individuals with diagnosed literacy disorders, such as dyslexia, and this being outside the scope of our study.

Lastly, our study did not demonstrate a relationship between reading anxiety and academic achievement. Our reading anxiety measure is self-report, and future research may benefit from conducting in-person interviews to obtain a deeper understanding of students' anxiety.

5 | FUTURE RESEARCH DIRECTIONS

Given the limitations associated with the general nature of our population, further research is required to understand reading anxiety and its impact at university amongst those with diagnosed literacy disorders. It would be important to explore the impact of reading anxiety on the university experience beyond academic achievement. Hence, we recommend that future research investigates the relationship of reading anxiety and other potential impacts of reading anxiety at university, for example, university drop-out and application rates.

Given the disparity in findings between poor comprehension ability and a history of reading difficulties in relation to academic achievement, it is important to explore how these various individuals are coping in the university setting to better understand why a history of reading difficulties is not impacting their ability to achieve academically. This could include exploring use of compensation methods, but also exploring rates of special consideration uptake.

6 | CONCLUSION

Our study is the first to explore reading anxiety in adults and suggests that reading anxiety in adults differs from that in children in terms of structure and its relationships with other variables. Non-social reading anxiety amongst university students appeared backed by evidence--in relation to reading comprehension--as their reading ability negatively impacted academic achievement. A lack of access to university accommodations may explain the relationship between reading comprehension and academic achievement. Overall, students with reading difficulties and reading anxiety should be identified for the provision of support and accommodations to maximise academic achievement.

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CONFLICT OF INTEREST STATEMENT

The authors declare that they have no conflicts of interest.

DATA AVAILABILITY STATEMENT

The data that support the results of this study are openly available in Open Science Framework at <http://doi.org/10.17605/OSF.IO/DMBNC>.

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ENDNOTE

¹ This study assumes that reading ability exists along a continuum (Siegel, 2006). This study does not refer to individuals with a diagnosis of dyslexia--that is, persistently poor word-level reading accuracy and fluency despite adequate instruction (Rose, 2009)--however, based on reading performance, individuals with dyslexia could be classed as poor readers.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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