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Development and Score-Validation of the Research Anxiety Rating Scale

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Abstract

Most graduate students enrolled in programs within colleges of education are required to complete one or more research methodology courses as a necessary part of their degrees. Unfortunately, it appears that these courses are exceedingly difficult for many students, who typically experience underachievement. Many students experience high levels of anxiety in these classes. Onwuegbuzie (1997) theorized that the anxiety experienced in research methodology classes, termed research anxiety, represents a multidimensional phenomenon. Based on this conceptualization, the Research Anxiety Rating Scale (RARS) was developed. Thus, the purpose of this study was to describe the development of the RARS, as well as to delineate the psychometric properties of this scale. The RARS was administered to a sample of 262 graduate students (Study 2). Evidence of construct-related validity of the RARS was provided via an exploratory factor analysis, using a varimax rotation, in which seven specific factors were identified, explaining 57.1% of the variance in RARS scores. These seven factors were (a) fear of libraries, (b) fear of writing, (c) fear of statistics, (d) fear of conducting research, (e) fear of research language, (f) fear of research courses, and (g) perceived utility and competence. Evidence of criterion-related validity (i.e., concurrent validity) was established via statistically significant correlations between scores on the RARS and scores on the Statistical Anxiety Rating Scale (STARS), the Library anxiety Scale (LAS), and the Writing Apprehension Test (WAT). No gender differences were found with respect to the RARS total scale or subscales. The implications are discussed.

Keywords:

Research anxiety; research anxiety rating scale; statistics anxiety; library anxiety; writing apprehension

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Development and Score-Validation of the Research Anxiety Rating Scale

Most graduate students enrolled in programs within colleges of education are required to complete one or more research methodology courses as a necessary part of their degrees (Leech & Goodwin, 2008). Indced, Leech and Goodwin (2008), who investigated the qualitative, quantitative, and mixed methods course requirements of 100 schools of education across the United States, reported that the mean number of required methods courses was 4.48, with some schools of education requiring as many as 11 methods courses. Unfortunately, it appears that these courses are exceedingly difficult for many students, who typically attain lower levels of performance in these courses than in their other graduate-level classes. Many students delay enrolling in research methodology courses for as long as possible. Those who do enroll often experience high levels of anxiety, making these classes an extremely negative experience for a high proportion of students (Onwuegbuzie, 1997).

Onwuegbuzie (1997) theorized that the anxiety experienced in research methodology classes, termed *research anxiety*, represents a multidimensional phenomenon. Specifically, using quantitative and qualitative analyses, Onwuegbuzie (1997) found that the anxiety experienced by students when they are engaged in developing a research proposal (i.e., *Research Proposal Writing Anxiety*) comprises the following four components: (a) *library anxiety* (comprising Interpersonal Anxiety, Perceived Library Competence, Perceived Comfort with the Library, Location Anxiety, Mechanical Anxiety, and Resource Anxiety); (b) *statistics anxiety* (consisting of Perceived Usefulness of Statistics, Fear of Statistical Language, Fear of Application of Statistics Knowledge, and Interpersonal Anxiety); (c) *composition anxiety* (comprising Content Anxiety, Format and Organizational Anxiety, Mechanical Anxiety, and Fear of Negative Evaluation); and (d) *research process anxiety* (consisting of Fear of Research Language, Fear of Application of Research Knowledge, and Interpersonal Anxiety).

Based on this conceptualization, the Research Anxiety Rating Scale (RARS) was developed. Specifically, the RARS was developed for four main reasons: (a) to help researchers, instructors, students, and academic advisors to understand better the construct of anxiety as it relates to research methodology courses; (b) to provide a tool for identifying situations in which students experience research anxiety; (c) to provide a means of identifying students who are at-risk with respect to research anxiety; and (d) to provide diagnostic insight into the needs of anxious students. In developing the RARS, in-depth reviews of the literature were undertaken in the areas of academic-related anxiety (e.g., test anxiety, statistics anxiety, library anxiety, and composition anxiety), learning styles, self-esteem, self-efficacy, metacognition, and the like. Following these reviews, and incorporating Onwuegbuzie's (1997) framework, items were developed to form an instrument.

The purpose of the present article was to report on the development and score-validation of the RARS. Given the prevalence of anxiety in research methodology classes (Jiao & Onwuegbuzie, 1999a, 1999b, 1999c; Onwuegbuzie, 1998, 1999; Onwuegbuzie & Daley, 1996; Onwuegbuzie & Jiao, 2004), and the apparent pervasiveness of this construct with respect to the learning process (Onwuegbuzie & Jiao, 1998; Onwuegbuzie, Slate, & Schwartz, 2001), it is surprising that until this point, no instrument appeared to exist which assessed levels of research anxiety. What follows represents both a brief history of the development of the instrument and findings based on the latest version of the scale.

RARS Development

Initially, a total of 121 statements were written that represented situations which were either found or hypothesized to induce research anxiety. Some of the items were negatively worded; the remaining items were positively worded. The large number of initial statements insured that an adequate number would be retained after analysis. For all items, the RARS scale consisted of a 5-point Likert-format scale anchored at both ends and in the middle (i.e., 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree). The items were sent to experts for examination, leading to a form of Delphi technique. These experts represented other instructors of research methodology courses. Items were subsequently edited to reflect their comments. The items that exhibited the greatest consensus (i.e., at least 80% agreement) were retained. This resulted in a scale comprising 45 items.

Study 1

Method

Participants and Procedure

Participants were 112 graduate students (83.0% female) from a number of disciplines who were enrolled in five sections of an introductory-level research methodology course at a university in a mid-southern region of the United States. Participation was voluntary. In order to participate, students were required to give their consent by signing an informed consent document. Participants, who received extra course credit, were administered the pilot version of the RARS. This version contained 45 Likert-type items.

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Results

Construct-related Validity

Validity is the extent to which an instrument measures what it is supposed to measure. Furthermore, construct-related validity is the extent to which an instrument can be interpreted as a meaningful measure of some characteristic or quality. An exploratory factor analysis was used to assess the construct-related validity (i.e., structural validity; cf. Messick, 1989, 1995; Onwuegbuzie, Daniel, & Collins, 2009) of the RARS. Specifically, a principal components analysis was used to determine the number of factors underlying the RARS. The extracted components were rotated using varimax techniques. Varimax rotation involves obtaining a factor structure such that variables load significantly on no more than one factor, and every variable loads on a factor with other items measuring similar aspects of research anxiety. An items was deemed to have loaded significantly on a factor if its pattern/structure coefficient was .3 or greater, as recommended by Lambert and Durand (1975). This analysis revealed four factors, which were labelled as "library anxiety," "statistics anxiety," "composition anxiety," and "research process anxiety." These factors explained 43.8% of the total variance. Loadings of items on each factor ranged from .33 to .86. However, some of the items loaded on more than one factor (i.e., cross-loadings). This occurrence was deemed possibly to be the result of the relatively small sample size. Thus, the instrument was administered to a larger sample.

Study 2

Method

Participants and Procedure

Participants were 262 graduate students (84.4% female) from a number of disciplines, who were enrolled in five sections of an introductory-level research methodology course at a university in a mid-southern region of the United States. Participation was voluntary, requiring the signing of an informed consent document. Participants, who received extra course credit, were administered the RARS.

Instruments

In addition to the RARS, participants were administered the following instruments: the Statistics Anxiety Rating Scale (STARS), the Library Anxiety Scale, the Writing Apprehension Test (WAT) and the Background Demographic Form (BDF). The STARS was developed by Cruise and Wilkins (1980). STARS is a 51-item, 5-point Likert-format instrument that assesses statistics anxiety in a wide variety of academic situations. The STARS has six subscales, namely, *worth of statistics*, *interpretation anxiety*, *test and class anxiety*, *computation self-concept*, *fear of asking for help*, and *fear of the statistics instructor*. According to its authors, *Worth of statistics* refers to students' perceptions of the relevance of statistics. *Interpretation anxiety* concerns the anxiety experienced when students are faced with making a decision from or interpreting statistical data. *Test and class anxiety* pertains to the anxiety involved when taking a statistics class or test. *Computational self-concept* involves the anxiety experienced when attempting to solve mathematical problems, as well as students' perceptions of their ability to understand mathematics. *Fear of asking for help* measures the anxiety experienced when asking a fellow student or professor for help in understanding the material covered in class or any type of statistical data, such as an article or a printout. Finally, *fear of statistics teachers* is concerned with students' perceptions of the statistics instructor. A high score on any subscale represents high anxiety in this area. Normative data have been gathered for this instrument. Cruise, Cash, and Bolton (1985) reported evidence of construct-related validity based on a factor analysis using 1,150 participants in which six specific factors were identified after a varimax rotation. Pattern/structure coefficients for these factors ranged from .48 to .86. Score reliability of these factors, as measured by coefficient alpha, ranged from .68 to .94 (median = .88). In addition, Cruise et al. (1985), using a sample of 161 students, reported 5-week test-retest score reliability coefficients for each factor, which ranged from .67 to .83 (median = .76).

The LAS, developed by Bostick (1992), is a 43-item, 5-point Likert-format instrument that assesses level of library anxiety. The instrument has five subscales, namely, "barriers with staff," "affective barriers," "comfort with the library," "knowledge of the library," and "mechanical barriers." *Barriers with staff* refers to the perception of students that librarians and other library staff are intimidating, unapproachable, and too busy to provide assistance in using the library. *Affective barriers* stem from students' feelings of inadequacy about using the library. *Comfort with the library* deals with how safe, welcoming, and non-threatening students perceive the library to be. *Knowledge of the library* refers to how familiar with the library students feel they are. Finally, *mechanical barriers* refer to feelings that emerge as a result of students' reliance on mechanical library equipment, including computer printers, copy machines, and change machines. A Cronbach's alpha reliability of .80 and a 3-week test-retest reliability of .74 for the total scale scores were reported by the author (Bostick, 1992; see also Onwuegbuzie, Jiao, & Bostick, 2004).

The WAT, developed by Daly and Miller (1975), is a 26-item, 5-point Likert-format instrument that assesses the degree to which individuals associate writing with apprehension, anxiety, and failure. Scores for the total scale range from 26 to 130, with high scores representing high levels of writing anxiety. A Cronbach's alpha reliability of .94 has been reported for WAT scores (Daly & Miller, 1975).

Finally, the BDF, developed specifically for this study, extracted relevant demographic information. Such information included age and gender.

ISSN:2278-7690

Results

Construct-Related Validity

A principal component analysis again was used to assess the construct-related validity of the RARS. Examination of the sizes of the eigenvalues revealed 13 factors with eigenvalues greater than 1 (Kaiser, 1958). However, this factor structure was conceptually weak, because a few of these factors were univariate (i.e., contained only one item). Thus, it was decided to test various combinations of potential items and factors to see if a more interpretable factor structure could be determined. Specifically, a series of factor analyses was performed, each time specifying a different number of factors. For each factor analysis, the scree plot was examined, as was the residual correlation matrix. The scree plot represents a plot of eigenvalues against factors (Cattell, 1966; Zwick & Velicer, 1986). In this plot, factors are arranged in descending order along the abscissa with eigenvalues as the ordinate (cf. Kieffer, 1999). Typically, the scree plot is negatively decreasing. That is, the eigenvalue is highest for the first factor and moderate but decreasing for the next few factors until it reaches relatively small values for the last few factors. Interpretation of the scree plot involves looking for the point where a line drawn through the points changes slope. Despite the fact that the scree test involves the analyst's judgment of where the discontinuity in eigenvalues occurs, the scree test often is accurate to within one or two factors (Cattell, 1966).

The residual correlation matrix is obtained by subtracting the reproduced correlation matrix from the observed correlation matrix. The values in the residual correlation matrix represent partial correlations between pairs of variables with the factors removed. Small residual values indicate an appropriate factor structure, whereas several moderate residuals (e.g., between .05 and .10) or a few large residuals (e.g., larger than .10) suggest the presence of one or more other factors.

Using the above criteria, the most interpretable structure was yielded by the varimax rotation of seven factors using all 45 items. In addition, a parallel analysis was conducted as a validity check to the K1 and scree test. Parallel analysis is superior to K1 and scree test and typically yield optimal solutions (Zwick & Velicer, 1982, 1986). Indeed, Thompson (2004) stated that "parallel analysis appears to be among the best methods for deciding how many factors to extract or retain" (p. 34). Parallel analysis involves extracting eigenvalues from random data sets that *parallel* the actual data set with respect to the sample size and number of variables. For the current data of 262 participants and 45 items, a series of (i.e., n = 1,000) random data matrices of size 262 x 45 was generated, and eigenvalues were computed for the correlation matrices for the original data and for each of the 1,000 random data sets. The eigenvalues derived from the actual data then were compared to the eigenvalues derived from the random data, in order to identify the number of components that account for more variance than do the components derived from random data. More specifically, as recommended by many factor analysts (Cota, Longman, Holden, Fekken, & Xinaris, 1993; Glorfeld, 1995), the eigenvalues that corresponded to the 95th percentile of the distribution of random data eigenvalues were generated. Factors or components were retained providing that the *i*th eigenvalue from the actual observed data was greater than was the *i*th eigenvalue from the random data. Using the syntax written for SPSS by O'Connor (2000), the parallel analysis also suggested retaining seven factors.

These seven factors explained 57.1% of the variance in RARS scores. These seven factors were labelled as (a) *fear of libraries*, (b) *fear of writing*, (c) *fear of statistics*, (d) *fear of the field of research*, (e) *fear of research language*, (f) *fear of research courses*, and (g) *perceived utility and competence*. Factor loadings for the items are shown in Table 1. Below is a description of each of the factors, together with a delineation of the items contained.

Table 1: ***Item Pattern/Structure Coefficients and Coefficient Alpha Values for Seven-factor Principal Component Analysis (N= 262)***

Factor/Item	Pattern/Structure Coefficient*	Coefficient Alpha Value
Fear of Libraries:		.57
3	.69	
14	.41	
Fear of Writing:		.76
1	.64	
9	.39	
13	.49	
20	.87	
26	.39	

Fear of Statistics:		.70
2	.66	
15	.66	
22	.74	
28	.52	
Fear of Conducting Research:		.78
4	.52	
7	.69	
21	.41	
30	.49	
33	.36	
Fear of Research Language:		.80
5	.50	
18	.78	
25	.61	
31	.66	
36	.66	
39	.43	
44	.57	
Fear of Research Courses:		.76
6	.51	
11	.31	
16	.33	
23	.57	
32	.32	
34	.72	
37	.31	
41	.47	
Perceived utility and competence:		.90
8	.40	
10	.47	
12	.30	
17	.39	
19	.49	
24	.52	
27	.46	
29	.41	
35	.41	
38	.76	
40	.67	
42	.73	
43	.67	
45	.60	

% of total variance accounted for by the solution = 57.1; * All pattern/structure coefficients had large effect sizes, using a cutoff loading of 0.3 recommended by Lambert and Durand (1975).

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Factor Description and Items

Factor 1: Fear of Libraries

This factor deals with the anxiety involved when a student contemplates or is in the process of using the library.

Item Number	Item
3	I am looking forward to conducting research in the library.
14	I am confident in using the library to undertake research projects.

Factor 2: Fear of Writing

This factor involves the anxiety that is experienced when a student is engaging in the formal writing process. For example, when writing a research proposal, a student might experience anxiety at any stage of the writing process—from initiation to final proof-reading.

Item Number	Item
1	I am a competent writer.
9	Writing a research proposal scares me.
13	I love to write papers.
20	I have a good command of the English language.
26	Writing a research proposal is too difficult for me.

Factor 3: Fear of Statistics

This factor involves the anxiety that occurs as a result of students' perceptions of the importance of statistics in conducting research, as well as the extent to which they enjoy statistics.

Item Number	Item
2	Knowledge of computers is an essential part of research.
15	Statistics is the most important component of research.
22	A good researcher must be competent at statistics.
28	Since I do not like statistics, I do/will not enjoy research methods.

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Factor 4: Fear of Conducting Research

This factor refers to the anxiety experienced when a student is contemplating or in the process of conducting research.

Item Number	Item
4	I have many research problems I would like to research.
7	Research is a challenging and stimulating discipline.
21	Conducting research takes up too much time.
30	I would like to get a research article published in a journal.
33	I enjoy undertaking research.

Factor 5: Fear of the Research Language

This factor pertains to anxiety experienced when a student is attempting to understand the terminology, notation, and symbols used by researchers. This anxiety can occur when students are reading and listening to research literature, as well as when they are attempting to understand research concepts.

Item Number	Item
5	There is too much material to be learned in research methods.
18	The language used in research methods is confusing.
25	Researchers intimidate me.
31	Taking a course in research methods is similar to learning another language.
36	Research methods textbooks are difficult to understand.
39	I like to read research articles in my field.
44	Research methods is the most difficult course in my program.

Factor 6: Fear of the Research Course

This factor pertains to anxiety experienced when a student actually is enrolled in a research methodology course. A student scoring high on this factor might experience great anxiety when enrolling in or undertaking an assignment.

Item Number	Item
6	I feel comfortable evaluating published research articles.
11	Research methods makes me feel stupid.
16	Taking a course in research methods frightens me.
23	I would not have taken a course in research methods if it were not required.
32	Research methods should be taken as late as possible in a student's program of study.
34	I am terrified by the prospect of orally presenting a research proposal.
37	The word "research" scares me.
41	I know many people who have had a negative experience in research methods courses.

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Factor 7: Perceived Utility and Competence

This factor pertains to anxiety experienced as a result of students' perceptions of the relevance of research and of their competence in undertaking research. Students scoring high on this factor do not deem research to be an integral part of their fields and, as such, do not think that they should be compelled to take a research methodology course. In addition, these students do not perceive themselves as being competent researchers.

Item Number	Item
8	Research methods should be left to the "experts".
10	I can never formulate a research problem.
12	I am confident of my ability to interpret research findings.
17	Students should not be forced to take research methods.
19	I can't conduct research on my own.
24	Research skills are important for graduate students.
27	I will never be a good researcher.
29	Research is interesting.
35	I do not have the aptitude to master research methods.
38	Developing research skills is an important part of my professional development.
40	I am determined to become a competent researcher.
42	Research methods is relevant for my field.
43	Knowledge of research methods can be applied in everyday life.
45	Research meetings/conventions intimidate me.

Criterion-Related Validity

Criterion-related validity estimates how well scores on an instrument predict either future performance (i.e., predictive validity) or estimate current performance on some valued measure other than the instrument itself (i.e., concurrent validity). This evidence of validity is determined by relating performance on a test to performance on another criterion (Messick, 1989, 1995; Onwuegbuzie et al., 2009). Evidence of concurrent validity was established in the present study via statistically significant correlations between scores on the RARS and scores on the STARS, the LAS, and the WAT. These correlations are presented in Table 2. In particular, it can be seen that the RARS total scores correlated statistically significantly with each subscale of the STARS, the LAS, and the WAT. Additionally, the fear of libraries subscale correlated statistically significantly with each of the five subscales of the LAS; the fear of writing subscale correlated statistically significantly with the WAS; and the fear of statistics subscale correlated statistically significantly with each of the six subscales of the STARS.

Table 2: Pearson Product-Moment Correlations Between the RARS Subscales and the STARS, LAS, and WAT Subscales (N= 262)

RARS	1	2	3	4	5	6	7	Total
STARS:								

Worth of Statistics	.33***	.27***	,24***	.50***	.47***	.54***	.65***	.63***
Interpretation Anxiety	.27***	.39***	.15*	.34***	.52***	.54***	.48***	.56***
Test and Class Anxiety	.25***	.25***	.17*	.31***	.45***	.49***	.40***	.48***
Computation Self-concept	.29***	.27***	.23***	.44***	.51***	.54***	.52***	.57***
Fear of Asking for Help	.19**	.33***	.16*	.25***	.37***	.38***	.42***	.44***
Fear of Statistics Teachers	.26***	.27***	.21***	.35***	.43***	.49***	.50***	.52***
LAS: Barriers With Staff	.45***	.31***	.16*	.40***	.28***	.35***	.37***	.44***
Affective Barriers	.61***	.44***	.16*	.43***	.46***	.49***	.48***	.58***
Comfort with the Library	.47***	.34***	.24***	.44***	.35***	.41***	.44***	.51***
Knowledge of the Library	.36***	.33***	.17*	.50***	.31***	.42***	.49***	.52***
Mechanical Barriers	.26***	.27***	.11	.31***	.20**	.27***	.27***	.32***
WAT: Total WAT Scale	.29**	.77***	.09	.46***	.39***	.54***	.45***	.60***

* p < .05, ** p < .01, *** p < .001

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1 = Fear of Libraries

2 = Fear of Writing

3 = Fear of Statistics

4 = Fear of Conducting Research

5 = Fear of Research Language

6 = Fear of Research Courses

7 = Perceived Utility and Competence

STARS = Statistical Anxiety Rating Scale

LAS = Library Anxiety Scale

WAT = Writing Apprehension Test

Reliability

Reliability is the extent to which scores that are generated from an instrument demonstrate consistency. Cronbach's Coefficient Alpha, a measure of score reliability, was determined for each subscale. Coefficient alpha provides information about the degree to which the items in a factor measure similar characteristics. The coefficient alphas also are presented in Table 1. It can be seen from this table that, with the exception of the fear of libraries subscale, the coefficient alphas are .70 or higher. The perceived utility and competence subscale generated the highest reliability estimate, followed by fear of the research language. The low internal consistency value associated with the fear of libraries subscale is probably reflective of the fact that it contained only two items. Nevertheless, the coefficient alpha for the total scale was .84.

Invariance of Scales

Descriptive statistics were computed for each subscale. The mean and standard deviation of each scale are presented in

Table 3.

Table 3: Mean and Standard Deviation of each of the RARS Subscales (N= 262)

Subscale	M	SD
Fear of Libraries	5.88	1.74
Fear of Writing	14.59	3.48
Fear of Statistics	10.04	1.90
Fear of Conducting Research	18.84	3.99
Fear of Research Language	21.70	4.63
Fear of Research Courses	20.60	4.83

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Perceived Utility and Competence	33.90	7.43
Total	123.26	21.51

An independent samples t test revealed no statistically significant gender differences with respect to fear of libraries ($t = 0.66$, $p > .05$), fear of writing ($t = -0.50$, $p > .05$), fear of statistics ($t = -1.44$, $p > .05$), fear of conducting research ($t = 0.05$, $p > .05$), fear of research language ($t = 0.53$, $p > .05$), fear of research courses ($t = 0.98$, $p > .05$), and perceived utility and competence ($t = 0.34$, $p > .05$). Furthermore, no gender differences were found with respect to the RARS total scale ($t = 0.33$, $p > .05$). Age was not found to be statistically significantly related to fear of libraries ($r = 0.09$, $p > .05$), fear of writing ($r = 0.01$, $p > .05$), fear of conducting research ($r = 0.07$, $p > .05$), fear of research language ($r = 0.11$, $p > .05$), fear of research courses ($r = 0.02$, $p > .05$), perceived utility and competence ($r = 0.05$, $p > .05$), or the total scale ($r = 0.05$, $p > .05$). Interestingly, however, a statistically significant relationship was found between age and fear of statistics ($r = -0.19$, $p < .05$), representing a small-to-moderate effect size (Cohen, 1988), and suggesting that younger students, to a small-to=moderate degree, were more anxious about the role of statistics in research and the extent to which they enjoy utilizing statistics.

Discussion

Overall, the RARS, which was developed to measure levels of research anxiety, was found to possess adequate psychometric properties. Evidence of construct-related validity was established via factor analysis, which revealed seven specific factors, explaining a large proportion of the variance in research anxiety. Evidence of criterion-related validity, specifically, concurrent validity, was provided via statistically significant positive correlations between (a) total scores on the RARS and scores on the STARS, the LAS, and the WAT; (b) scores on the fear of libraries subscale and each of the five subscales of the LAS; (c) scores on the fear of writing subscale and scores on the WAS; and (d) scores on the fear of statistics subscale and the six subscales of the STARS.

With the exception of the fear of libraries subscale, the RARS subscales appear to generate scores that are at least moderately reliable. That is, for six of the seven subscales, the Cronbach coefficients indicate that the items contained in them are homogeneous. Interestingly, all seven scales were found to be invariant with respect to gender. Furthermore, with the exception of fear of statistics, age was not related to the dimensions of research anxiety.

Despite the evidence of score reliability and score validity provided in this study, caution should be exercised in using the subscales until the existence of all these subscales has been validated using much larger samples. In particular, the *fear of libraries* subscale needs to come under extremely close scrutiny. Indeed, it is not surprising that the *fear of libraries* subscale provides the least evidence of score reliability, because it contains only two items. The author is presently attempting to increase the score reliability of this subscale by developing additional items. Until the existence and score reliability of the aforementioned subscales have been established further, it is recommended that researchers who intend to use the RARS use and interpret only scores that are generated from the total scale.

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