THE MATHEMATICS ANXIETY RATING SCALE:
PSYCHOMETRIC DATA

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Normative, reliability, and validity data are reported for the Mathematics Anxiety Rating Scale (MARS), a measure of mathematics anxiety for use in treatment and research. Normative data were collected on a sample of 397 college students. The instrument has high test-retest and internal consistency reliability. Evidence for validity comes from three studies in which MARS scores showed expected decreases following behavior therapy for mathematics anxiety, and a separate validity study in which MARS scores were found to correlate negatively with scores on a mathematics test. Possible uses of the instrument in treatment and research are discussed.

Current research and theoretical developments make it evident that the development of special measures of anxiety has both potential heuristic and practical value. Studies emphasizing the identification of specific types of anxiety have found that different kinds of anxiety lead to different effects on intellectual performance (Sarason, 1957; Suinn, 1965). Some investigations of the outcomes of desensitization therapy have been concerned with the possibility that treatment for one type of anxiety or anxiety problem may affect the level of different types of anxiety or other anxiety problems (Ihli & Garlington, 1969; Mitchell & Ingham, 1969; Suinn & Richardson, 1971; Willihnganz, 1970). Assessment instruments are available that provide measures of single forms of anxiety, such as test taking or examination anxiety (Alpert & Haber, 1960; Sarason, 1957; Suinn, 1969) and social anxiety (Watson & Friend, 1969; Williams, 1967). Recently, it has been demonstrated that mathematics anxiety exists among many individuals who do not ordinarily suffer from any other tensions. Over one-third of the students responding to a

behavior therapy program offered through a university counseling center indicated that their problem centered around mathematics anxiety (Suinn, 1970). The Mathematics Anxiety Rating Scale (MARS) was constructed to provide a measure of anxiety associated with the single area of the manipulation of numbers and the use of mathematical concepts. The development of a scale of this type is supported by evidence that anxiety scales that limit their items to specific situations have higher predictive value for those situations than tests with a more diverse content (Endler & Hunt, 1966).

Mathematics anxiety involves feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations. Mathematics anxiety may prevent a student from passing fundamental mathematics courses or prevent his pursuing advanced courses in mathematics or the sciences. We have found that a number of volunteers for mathematics anxiety treatment are graduate students who have difficulty with the relatively small but significant number of mathematical formulations in their area of specialization, such as zoology or business. Among nonstudents, mathematics anxiety may be a contributor to tensions during routine or everyday activities, such

as handling money, balancing bank accounts, evaluating sales prices, or dividing work loads.

A reliable measure of mathematics anxiety would prove useful in a number of ways: (a) Mathematics anxiety is a fairly common problem in a college population and such an instrument could serve as a diagnostic tool, (b) the instrument could be used in research to determine the relative effectiveness of different treatment approaches to anxiety problems, (c) for desensitization treatment purposes the test could serve as an aid in the development of the anxiety hierarchy used in such treatment, (d) normative data on changes in test scores occurring without treatment would prove useful in evaluating the results of studies where a control group is lacking and in evaluating the progress of individual clinic cases. In general, the study of mathematics anxiety, like test anxiety and snake phobia, may serve for research proposes as a useful analog to more complex clinical cases. The MARS was developed to provide such an instrument, and the present article reports on normative, reliability, and validity data that have been gathered on it.

METHOD

The Scale

The MARS is a 98-item scale composed of brief descriptions of behavioral situations, for example, "adding two three-digit numbers while someone looks over your shoulder," that may arouse different levels of anxiety in clients. A very wide variety of situations are included to permit its application to a diverse group of clients, including both students and nonstudents. A total mathematics anxiety score is calculated by assigning a value of from 1 to 5 corresponding to the level of anxiety checked (with 1 assigned to "not at all" anxious and 5 reflecting "very much" anxious), and then summing all the values. High scores reflect high levels of mathematics anxiety.

Subjects

Normative data were collected on a sample of 397 students enrolled in a large state university in Missouri. The students were all freshmen or sophomores in beginning education classes. About 80% of these subjects were females, but analysis of the data showed no significant diffrence between the mean scores or standard deviations for males and females. Cooperation was encouraged by as-

suring subjects that their scores would remain completely anonymous and informing them that the purpose of the testing was to gain information about the test, not about themselves as individuals. Reliability data were obtained by retesting two of these classes ($n = 35$) 7 weeks later, with instructions to describe themselves as they currently felt.

The treatment subjects in the studies referred to in the section on validity were all volunteer students who responded to announcements of a behavior therapy treatment program for mathematics anxiety at either a large state university in Missouri ($n = 10$) or one in Colorado ($n = 37$). These subjects applied for desensitization therapy and were admitted to treatment following an intake interview to verify the nature of their anxiety problem. Intake decisions were made independent of the MARS results.

The subjects who participated in the separate validity study described below, in which MARS scores were correlated with performance on a mathematics test, were 30 junior and senior students, about equally divided between males and females, enrolled in an advanced undergraduate psychology course at the University in Missouri.

RESULTS

Normative Data

The mean score for the Missouri sample was 215.38, with a standard deviation of 65.29. Percentile ranks for raw scores are as follows: 5%–123; 20%–156; 25%–165; 40%–189; 50%–215; 60%–228; 75%–255; 80%–267; and 95%–325.

Reliability

A test–retest reliability coefficient for the MARS was calculated from the scores of two complete classes ($n = 35$) of students from the original large Missouri sample who were retested 7 weeks later. The mean MARS score on the first testing was 235.08 ($SD = 51.26$); the mean score was 232.97 ($SD = 56.46$) at the second testing. The Pearson product-moment coefficient between these two sets of scores was .85. This reliability coefficient compares favorably with reliabilities over relatively short periods of time of .78 and .68 for measures of social anxiety (Watson & Friend, 1969), .80 for the Taylor Manifest Anxiety Scale (Suinn, 1968), and .78 for the Test Anxiety Scale (Sarason, 1958).

An internal consistency reliability coeffi-

cient, coefficient alpha (Nunnally, 1967) was .97 ($n = 397$). This shows that the average intercorrelation of the items in the test is high. It confirms that the test is highly reliable and indicates that the test items are heavily dominated by a single homogeneous factor, presumbly mathematics anxiety. Item-total correlations for all items also were calculated and over half of the correlations were greater than .50.

Validity

Evidence concerning the validity of the MARS comes from two types of information. First of all, in three recent studies (Richardson & Suinn, 1971; Suinn, Edie, & Spinelli, 1970; Suinn & Richardson, 1971), scores on the MARS showed expected decreases following behavior therapy for mathematics anxiety. In the first study, involving 10 Missouri students, MARS scores declined from a pretherapy mean of 238.73 to a posttherapy mean of 179.12. In the second study, conducted in Colorado, the mean score for 13 treated subjects dropped from 2.84.09 to 185.58. In the third study, the mean score for 24 Colorado students went from 256.87 before treatment to 193.29 following treatment. For all three studies the pre- to posttherapy changes were statistically significant. The study by Richardson and Suinn (1971) included a no-treatment control group of subjects whose mean MARS scores did not decline significantly at posttesting. Assuming that the treatment programs in these studies did in fact reduce the level of mathematics anxiety, the corresponding reduction in MARS scores may be viewed as providing construct validity for the test.·

Second, strong evidence of validity comes from data collected in a separate validity study conducted in Missouri. Thirty junior and senior students enrolled in an advanced undergraduate psychology class, about equally divided between males and females, completed the MARS and then were administered the mathematics form of the Differential Aptitude Test under special instructions to work on the test for 10 minutes. The Differential Aptitude Test is a commonly used test made up of mathematical problems that range from simple to increasingly complex. The Pearson product-moment correlation coefficient between subjects' scores on the two instruments was $-.64$ ($p < .01$), indicating that high MARS scores are associated with poor performance on the mathematics test. Since high anxiety interferes with performance, and poor performance produces anxiety, this result provides evidence that the MARS does measure mathematics anxiety.

Discussion

The MARS is a scale that may be used in treatment or research. The therapist may use the scale for screening clients with severe mathematics anxiety by comparing their scores with the normative data. If desensitization behavior therapy is used, a mathematics anxiety hierarchy may be constructed directly from the MARS since the MARS requires the client to check the level of anxiety associated with each item, and he is basically ranking the items in hierarchical manner.

The MARS may be a valuable assessment instrument for those who wish to do research on psychotherapy in general or mathematics anxiety in particular. Often it is desired to test the effectiveness of an innovative treatment approach with additional anxiety problems or to replicate the results of a research investigation with another problem area. Mathematics-anxious subjects are readily available, and the MARS permits the assessment of this phobia for research purposes.

Psychologists may be reasonably sure that any significant reduction in MARS scores following a treatment intervention is not due to the effects of retesting with the same instrument or the influence of intervening events. The test–retest reliability group of the present study showed only a negligible reduction in mean scores, from 235.08 to 232.97. This lack of change is striking in view of the fact that these subjects were largely freshman students who were tested near the beginning of their first semester in school and then retested 7 weeks later.

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