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COURSES IN PSYCHOLOGY AND STUDENTS' ATTITUDES TOWARD MENTAL ILLNESS

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In an earlier study of attitudes toward mental illness, Costin and Kerr (1962) demonstrated that a course in abnormal psychology brought about more favorable attitudes of students toward mental illness and mentally ill people, as measured on the Opinions About Mental Illness Scale (OMI; Cohen & Struening, 1959). As their results differed from those reported by Cohen and Struening for a sample of hospital employees (1959), they suggested the futility of certain educational programs in mental hygiene. Doubting the effect of short indoctrinational programs in producing attitude changes, these investigators suggested that programs be subjected to "rigorous research scrutiny" before they are employed.

The purpose of the present study was to compare OMI scores of students with different major areas of study while enrolled in psychology courses. The scale was administered to students in six different classes in child development, adolescence, and mental hygiene. The 167 underclassmen were classified then into five major groups (Nursing, $N = 19$; Grammar Education, $N = 37$; Science, $N = 24$; Social Studies, $N = 20$; and Primary Education, $N = 67$) and an analysis of covariance of the post-course scores with the pre-course scores as a covariant was performed to discover changes in attitudes of members in different psychology classes as well as changes in attitudes of students majoring in various academic fields.

The mean differences (t tests) suggest that courses in psychology bring about some favorable changes in students' attitudes toward mental illness. Nursing majors' scores indicated greater post-course authoritarianism ($p < .05$); a high score for this attitude indicates that mentally ill people are stigmatized, dangerous, and immoral. Grammar Education ($p < .05$), Science ($p < .05$), and Social Studies majors demonstrated favorable changes in Mental Hygiene Ideology ($p < .01$), suggesting that the mentally ill be treated with paternalism. Primary Education majors' scores indicated favorable changes in Interpersonal Etiology ($p < .01$), suggesting that early love deprivation is the forerunner of mental illness. Change scores of one class in adolescent psychology indicated greater post-course authoritarianism ($p < .05$). Two classes, child ($p < .05$) and adolescent ($p < .01$) psychology, demonstrated favorable changes in Mental Hygiene Ideology, reflecting a belief in the mental hygiene movement and the successful treatment of mental illness. Two classes, child ($p < .01$) and mental hygiene ($p < .05$), showed favorable changes in Interpersonal Etiology.

Later interviews with instructors indicated that the changes in attitudes were more closely related to the teacher's position than to the material covered in the text. For instance, students who began the course with a strong authoritarian attitude and were taught by an authoritative instructor retained their authoritative attitude while, at the same time, changing their attitude in a desirable direction toward mental illness and the mentally ill. Further indication of the teacher's effect on students' attitude change was demonstrated by the classes in child psychology and mental hygiene where emphasis was placed upon the interrelationship of early deprivation and mental illness. It is conceivable then that the observed changes are related to the activities of an instructor rather than to the content of the text.

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DEPENDENCE OF RELIABILITY OF MULTIPLE-CHOICE TESTS UPON NUMBER OF CHOICES PER ITEM: PREDICTION FROM THE SPEARMAN-BROWN FORMULA[1]

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Summary.—An equation is derived which expresses test reliability as a function of number of item alternatives for the case in which only error due to guessing is present. This result is compared with the modified Spearman-Brown equation given by H. H. Remmers and his associates. Reliability coefficients predicted by these equations are compared with coefficients generated by a computer simulation method.

It has been known for some time that the reliability of multiple-choice tests is influenced by the number of choices per item (Remmers, Karslake & Gage, 1940; Lord, 1944; Carroll, 1945; Plumlee, 1952). Since the probability of chance success on an item is $1/a$, where a is the number of choices per item, it is to be expected that error variance introduced by chance success is a decreasing function of number of choices and test reliability is an increasing function of number of choices.

Remmers and his associates suggested the relationship could be described by the Spearman-Brown formula, which is known to indicate increase in reliability with increase in test length. The formula is

$$r_{noo} = nr_{oo}/[1 + (n-1)r_{oo}] , \qquad [1]$$

where r_{oo} is the original reliability, r_{noo} is the reliability of the test of increased length, and n is the number of times the test is increased in length. Remmers showed empirically that the reliability of various tests is approximated by this function, when n refers to increase in number of choices instead of test length. It has been pointed out, however, that there is no theoretical basis for predicting this result (Lord, 1944; Guilford, 1950; Gulliksen, 1950).

Computer Simulated Results

In a previous paper (Zimmerman & Williams, 1965) a computer program was used to simulate guessing error in multiple-choice tests. Distributions of assumed true scores were prepared, and error scores were generated on the basis of the probabilities to be expected from chance success due to guessing. The error scores were added to true scores to obtain observed scores. Finally, product-moment correlations between different sets of observed scores obtained by repeating the procedure several times gave an indication of test reliability.

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The results of this procedure for tests differing in length and number of choices are shown in Table 1. The data in this table can be used to examine the effect of increased test length, as well as increased number of choices, upon reliability. Apparently, there is an interaction between the effects of test length and number of choices. For short tests ($N = 10$) reliability increases greatly with increase in number of choices (.44 to .74). For long tests ($N = 100$) reliability increases slightly with number of choices (.89 to .97). Also, for 2 choices, reliability increases greatly with test length (.44 to .89). And for 5 choices reliability increases to a lesser degree with test length (.74 to .97).

TABLE 1

COMPUTER SIMULATED RESULTS FOR RELIABILITY

	$N = 10$ $a = 2$	$N = 10$ $a = 5$	$N = 100$ $a = 2$	$N = 100$ $a = 5$
r_{oo}*	.44	.74	.89	.97
r_{oo}**			.89	.97
r_{oo}***		.76		.97
r_{oo}****		.66		.95

*Reliability given by computer program.
**Reliability given by substituting .44 or .74 in Equation [1].
***Reliability given by substituting .44 or .89 in Equation [5].
****Reliability given by substituting .44 or .89 in Equation [1], where $n = 2.5$.

From the table it is seen that the Spearman-Brown formula describes the increase in reliability with increase in test length for both the 2-choice test and the 5-choice test (Zimmerman & Williams, in press). Consider, now, Remmers' suggestion that the same formula describes increase in reliability with increase in number of choices. The results in the table show that there is a greater discrepancy, although the predicted value for the longer test is close to that indicated by the program.

INCREASED RELIABILITY AS A FUNCTION OF INCREASED NUMBER OF CHOICES

It is possible to derive a simple equation showing the effect of increasing the number of choices upon reliability for the case in which only error due to guessing is present. Reliability is given by

$$r_{oo} = [(a-1)s_t^2]/[(a-1)s_t^2 + N - \overline{T}] \,, \qquad [2]$$

where a is the number of choices, s_t^2 is the variance of true scores, N is the number of items, and $\overline{T}$ is the mean of true scores. This equation gives the value which is approximated by the computer simulation method described above (Burkheimer, 1965; Burkheimer, Zimmerman, & Williams, in press). When the number of choices is increased, we can write

$$r_{oo}' = [(a' - 1)s_t^2]/[(a' - 1)s_t^2 + N - \overline{T}] \ , \quad [3]$$

where r_{oo}' is the reliability for the test with increased number of choices, a is the original number of choices, a' is the increased number of choices, and the other symbols are as defined above. Solving [2] for s_t^2 gives

$$s_t^2 = [(N - \overline{T})\ r_{oo}]/[(a - 1)\ (1 - r_{oo})] \ . \quad [4]$$

Substituting this result in (3) and simplifying, we have

$$r_{oo}' = [(a' - 1)r_{oo}]/[(a' - 1) + (a - a')r_{oo}] \ . \quad [5]$$

The data presented in Table 1 show that substitution in this equation yields results close to those indicated by the computer program. The accuracy is greater than that obtained by using [1] and of the same order as that obtained by using [1] for increased test length.

If the method employed by Remmers were valid, the ratio a'/a would be comparable to n in [1], which could be written in this form:

$$r_{oo}' = [(a'/a)r_{oo}]/\{1 + [(a'/a) - 1]r_{oo}\} \ . \quad [6]$$

Simplifying, we obtain the following result

$$r_{oo}' = a'r_{oo}/[a + (a' - a)r_{oo}] \ , \quad [7]$$

which can be compared to [5]. It is seen, therefore, that equation [5] differs from the modification of the Spearman-Brown formula suggested by Remmers only by subtraction of 1 from the a' factor in the numerator and the a term in the denominator. If both a' and a were large [1] and [5] would give nearly the same results. For multiple-choice tests, however, a' and a are relatively small, and some discrepancy can be expected.

Dividing both numerator and denominator of [5] by $a - 1$ gives

$$r_{oo}' = [(a' - 1)/(a - 1)r_{oo}]/\{[(a - 1)/(a - 1)] + [(a' - a)/(a - 1)]r_{oo}\} \ . \quad [8]$$

If, now, we define A as the ratio $(a' - 1)/(a - 1)$ and simplify, we have

$$r_{oo}' = Ar_{oo}/[1 + (A - 1)r_{oo}] \ , \quad [9]$$

which has the same form as the Spearman-Brown formula. In other words, Remmers' suggestion is valid if we employ the ratio $(a' - 1)/(a - 1)$ in the Spearman-Brown formula, but not if we employ the ratio a'/a. It should be noted that the above equations apply only to the case in which differences in reliability result from chance success due to guessing.

Dependence of Correlation Between Error Scores on Parallel Forms Upon Number of Choices

It is of interest that an equation showing the dependence of the correlation between error scores on parallel forms of a test upon number of choices can also be derived. This quantity has been assumed to be zero in the classical theory of mental tests. However, when chance success due to guessing is present, as in the case of most multiple-choice tests, it can be shown that it is positive in value, that it decreases with number of choices, and that the relationship is indicated by an equation similar to [5].

Correlation between error scores on parallel forms is in fact given by the following equation:

$$r_{ee} = s_t^2/[s_t^2 + (a-1)(N-\overline{T})] \, , \qquad [10]$$

where the symbols are as defined above (Burkheimer, 1965; Burheimer, Zimmerman, & Williams, in press). When number of choices is increased, we can write

$$r_{ee}' = s_t^2/[s_t^2 + (a'-1)(N-\overline{T})] \, . \qquad [11]$$

Solving [10] for s_t^2 gives

$$s_t^2 = [r_{ee}\,(a-1)(N-\overline{T})]/(1-r_{ee}) \, . \qquad [12]$$

Substituting [12] in [11] and simplifying leads to this result:

$$r_{ee}' = (a-1)r_{ee}/[(a'-1) - (a'-a)r_{ee}] \, . \qquad [13]$$

Dividing both numerator and denominator of [13] by $a' - 1$ gives

$$r_{ee}' = [(a-1)\,(a'-1)r_{ee}]/\{[(a'-1)/(a'-1)] + [(a'-a)/(a'-1)]r_{ee}\} \, . \qquad [14]$$

If we define $B = 1/A = (a-1)/(a'-1)$ and simplify, we have

$$r_{ee}' = Br_{ee}/[1 + (B-1)r_{ee}] \, , \qquad [15]$$

which, again, has the same form as the Spearman-Brown formula. There exists no analogue of this equation in the classical theory of mental tests. From [13] and [15] it is clear that the degree of correlation between error scores on parallel forms decreases with increase in the number of choices.

The results given by the computer program for r_{ee} are shown in Table 2. Equation [13] predicts accurately the effect of increasing number of choices upon r_{ee}. Another fact of interest shown in the table is that, if r_{ee} is treated as a reliability coefficient, the Spearman-Brown formula indicates accurately the change in its value with change in test length (Zimmerman & Williams, in press). For longer tests the correlation between error scores on parallel forms

TABLE 2
COMPUTER SIMULATED RESULTS FOR CORRELATION BETWEEN ERROR SCORES ON PARALLEL FORMS

	$N=10$ $a=2$	$N=10$ $a=5$	$N=100$ $a=2$	$N=100$ $a=5$
r_{ee}*	.46	.17	.89	.65
r_{ee}**			.90	.67
r_{ee}***		.18		.66

*Value given by computer program.
**Value given by substituting .46 or .17 in Equation [1].
***Value given by substituting .46 or .89 in Equation [13].

becomes higher in value, and the degree of change is indicated by the Spearman-Brown formula.

When chance success due to guessing is the only source of error in a multiple-choice test, the following can be concluded. (1) Increase in reliability with increase in number of choices is indicated only approximately by the Spearman-Brown formula. (2) Increase in reliability with increase in number of choices is indicated to a higher degree of accuracy by Equations [5] and [9]. (3) Increase in reliability with increase in test length is indicated accurately by the Spearman-Brown formula. (4) Increase in correlation between error scores on parallel forms with increase in test length is indicated accurately by substituting this quantity in place of the reliability coefficent in the Spearman-Brown formula. (5) Increase in correlation between error scores on parallel forms with increase in number of choices is given by Equations [13] and [15].

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