*INDIVIDUAL DIFFERENCES IN SUSCEPTIBILITY TO HYPNOSIS**

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While all investigators report wide individual differences in susceptibility to hypnosis, the form of the distribution is a matter of some uncertainty. Some years ago Hull[1] concluded that "susceptibility to hypnotic suggestion is fairly evenly distributed over the range from no susceptibility whatever to the most profound susceptibility." In a more recent review Weitzenhoffer[2] has shown a summary tendency toward a skewed distribution, a larger fraction of the subjects yielding scores of low susceptibility than of high susceptibility. There are occasional findings of bimodality, with scores in the middle range being fewer than those at the extremes.[3] Because of these uncertainties it appeared desirable to repeat hypnotic susceptibility measures on a randomly selected population, and to determine the form of the distribution with more than one type of score.

Subjects and Hypnotic Procedure.—The experimental subjects were 74 undergraduate students, 40 men and 34 women, from an introductory psychology course. They volunteered for an experiment on attention, reported elsewhere.[4] At the end of this experiment they were invited to participate in an experiment involving hypnosis. Because 74 of the 78 subjects accepted the invitation, we believe that we have avoided most of the bias that would have resulted, had the students been asked in the first place to volunteer for an experiment on hypnosis.

The procedure for inducing hypnosis followed closely that proposed by Friedlander and Sarbin.[5] The subject was introduced to suggestion by experiencing the waking suggestion of falling backward from a standing position. The hypnotic procedure proper then followed. Seated in a comfortable upholstered armchair, he gazed upward at a small bright object (thumbtack) on the ceiling and received suggestions of relaxation and eye closure. After the eyes were closed (either through accepting the suggestion or by direct instruction), a number of acts were suggested, each followed by a challenge, e. g., "Your eyes are tightly shut. You cannot open them. Try to open them." By scoring successes and failures on the various performances, a score of susceptibility to hypnosis can be computed. The scoring scales used are indicated in Table 1.[6]

TABLE 1

SCORING SCALES FOR HYPNOTIC SUSCEPTIBILITY

	Test Item	Possible Score: Original Scale	Possible Score: Revised Scale
1.	Eye closure	0–5	0–1
2.	Eye catalepsy	0–1	0–1
3.	Arm catalepsy	0–1	0–1
4.	Arm rigidity	0–1	0–1
5.	Hand lock	0–1	0–1
6.	Verbal inhibition	0–1	0–1
7.	Fly hallucination*	0–2	0–1
8.	Posthypnotic suggestion	0–5	0–1
9.	Amnesia	0–5	0–1
	Total	0–22	0–9

* This is the only item not in the original Friedlander-Sardin scale.

Distribution of Susceptibility Based on Original Scale.—Data are also available from a University of Michigan sample of 202 subjects, previously tested on the same scale by the Weitzenhoffers.[7] The distributions for the Michigan sample and the Stanford sample are alike in their skewness, though the Stanford group proved somewhat more susceptible (Fig. 1). The reasons for the group differences cannot be ascertained but may lie in the circumstances of experimentation rather than in any differences in the population from which the samples are drawn. These results are entirely consistent with those originally presented by Friedlander and Sarbin.[5]

The Revised Scale.—The original scoring scale (Table 1) was arbitrarily weighted. It appeared to us that a study of the internal consistency of the items might suggest some less arbitrary weights. The first step was to dichotomize each of the items entering into the scale so that it could be scored on a "pass-fail" basis. It was then possible to compute tetrachoric correlations between each of the items. These are presented in Table 2. The intercorrelations are remarkably high, varying from

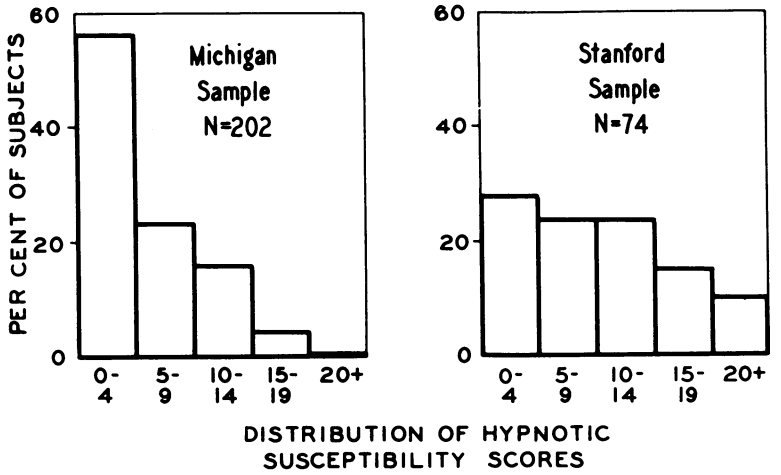

FIG. 1.

0.35 to 0.98, with a median of 0.80. A scale constructed of such items will necessarily have a high reliability. As estimated by the Kuder-Richardson formula,[8] the reliability is $r = 0.92$. Its retest reliability has to be separately determined, and was not studied in this investigation.

TABLE 2

INTERCORRELATIONS OF ITEMS ON HYPNOTIC SUSCEPTIBILITY SCALE ($N = 74$)

		Eye Clos. 1	Eye Catal. 2	Arm Catal. 3	Arm Rig. 4	Hand Lock 5	Verbal Inh. 6	Fly Halluc. 7	Post-hyp. 8
1.	Eye closure								
2.	Eye catalepsy	.65							
3.	Arm catalepsy	.78	.94						
4.	Arm rigidity	.74	.88	.95					
5.	Hand lock	.81	.91	.93	.98				
6.	Verbal inhibition	.71	.92	.95	.98	.93			
7.	Fly hallucination	.85	.73	.89	.88	.90	.76		
8.	Posthypnotic Suggestion	.35	.58	.80	.58	.80	.67	.62	
9.	Amnesia	.52	.64	66	.71	.75	.80	.83	.75

Examination of the raw data suggested that the scores might fit a Guttman-type of single-dimension scale.[9] Superficially they do. That is, if the first items are passed, the later items are more likely to be passed; after any failure, the probability of continued failure is high. Using Guttman's criteria, the index of reproducibility varies from 88 to 96 per cent for our 9 items, with a mean of 92 per cent. This is satisfactory as a fit to the Guttman-type scale.

We are very skeptical of this finding, however, in view of the processes involved. That is, if an item in a hypnotic scale is failed (a challenge is met and the suggestion is not accepted), the trance is weakened. Similarly, passing an item probably deepens the trance. Hence later items are less likely to be passed after failure and more likely to be passed after success, thus satisfying the Guttman criteria. This

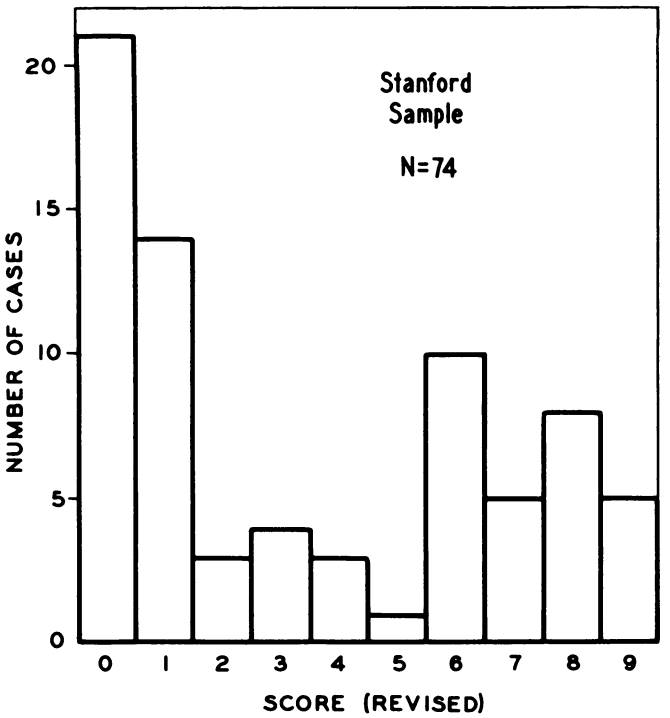

FIG. 2.

inference could be tested by using the items in various permutations. If the dimensionality held regardless of the order in which items were used, the scaling would turn out to be an artifact.

Because of the high internal consistency of the items, there appeared to be no point in assigning differential weights. Therefore, we adopted the simple scale of 1 point per item (the revised scale of Table 1). No appreciable distortion of relative position of the subjects resulted from the new scale, for scores on the original and final scale correlated to the extent of $r = +0.95$.

When the subjects were rescored on the new scale, the distribution of Figure 2 resulted. There is marked biomodality. which could have been predicted from the high intercorrelations of the dichotomized scores entering into the scale.

Sex Differences.—It has often been found that women are slightly more hypnotizable than men, but the differences, usually in the same direction, seldom reach statistical significance.[1, 7]

In our sample the mean score of 34 women on our 9-point scale was 4.6 ± 0.5 and for 40 men 2.4 ± 0.6. The critical ratio of the difference (D/σ_D) is 2.98, yielding a probability of less than 0.003 that this difference would be found if the population means for men and women were alike.

Discussion.—The fact that two sets of scores correlating + 0.95 with each other can yield distributions as different as those in Figures 1 and 2 shows the importance of extreme caution in reporting forms of distribution when the nature of the scale is unknown.

We believe that the bimodal scores of Figure 2 represent our data better than does the more orderly skewed curve of Figure 1, but we are not prepared to assert that hypnotic susceptibility is bimodally distributed. The very features that may have produced what we believe to be a spurious Guttman-type scale may also have produced the bimodality in our scores. In order to correct for this possible difficulty, a new set of instructions has been prepared in which failure is less likely to weaken the trance. Experimentation is now proceeding with this new scale. Until these data are in, we cannot be confident about the form of the distribution of susceptibility.

Summary.—1. Hypnotic induction was attempted with 40 men and 34 women who had originally volunteered for another kind of experiment.

2. The original scoring procedure, following the practice of Friedlander and Sarbin, confirmed their finding of a skewed distribution, with more unsusceptible subjects than highly susceptible ones.

3. Item analysis showed a high internal consistency between items and a reliability of $r = 0.92$ for the scale. While meeting the requirements of a Guttman-type scale, it is possible that the fit of the items to this kind of scale is spurious.

4. When a new scoring scale was adopted based on dichotomized scores for each item, a bimodal distribution resulted. While this scale represents the data better than the original scale, it cannot be asserted with assurance that the distribution of hypnotic susceptibility is bimodal. The form of the distribution is open, pending tests with revised hypnotic instructions.

5. A significant sex difference ($p < 0.003$) was found, with women more susceptible than men.

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[1] C. L. Hull, *Hypnosis and Suggestibility* (New York: Appleton-Century-Crofts, 1933), p. 72.

[2] A. M. Weitzenhoffer, *Hypnotism: An Objective Study in Suggestibility* (New York: John Wiley & Sons, 1953), p. 60.

[3] F. Aveling and H. L. Hargreaves, *Brit. J. Psychol.*, **12**, 53, 1921–1922; H. J. Eysenck and W. D. Furneaux, *J. Exptl. Psychol.*, **35**, 485, 1945. While Eysenck and Furneaux argue that bimodality may result in single tests because of scales that are foreshortened at the ends, their argument is not decisive with respect to scores derived by summating dichotomized scores from several tests.

[4] A. M. Weitzenhoffer, J. Landes, and P. Gough, *J. Psychol.*, **47**, 67, 1959.

[5] J. W. Friedlander and T. R. Sarbin, *J. Abnormal Social Psychol.*, **33**, 281, 1938.

[6] The detailed instructions are available upon request but are not presented here because they are now being revised. The hypnotic sessions were conducted by the three authors assisted by Mr. Judah Landes, whose help is here gratefully acknowledged.

[7] A. M. Weitzenhoffer and G. B. Weitzenhoffer, *Am. J. Clin. Hypnosis*, 1, 15, 1958.
[8] G. F. Kuder and M. W. Richardson, *Psychometrika*, 2, 151, 1937.
[9] L. Guttman, in S. A. Stouffer and others, *Measurement and Prediction* (Princeton, N. J.: Princeton University Press, 1950), p. 117.

DIRECT EVIDENCE FOR THE TRANSFER OF MATERIALS FROM SYMBIOTIC ALGAE TO THE TISSUES OF A COELENTERATE

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This paper takes issue with a number of inferences that have been drawn on the subject of animal-algal relationships and seeks to resolve a question that seems not to have been answered well. Specifically, it deals with the subject of unicellular symbiotic algae and their bearing on the bioeconomy of the animals which they inhabit. No attempt will be made here to summarize the literature on the subject. We refer the reader to the reviews of Buchner[1] and Yonge[2] for historical details. Attempts to delineate the role of symbiotic algae from a nutritional standpoint have resulted in a wide range of conclusions. These are (1) the animal digests whole or fragmented algal cells; (2) nutritional substances may diffuse from algae to animal; (3) there is no nutritional role whatever on the part of the algae. These conclusions are not based on direct experimental evidence; rather, they are largely drawn from circumstantial or negative evidence.

Ignoring for the present time the other important features of a balanced mutualistic association such as the exchange of gases and minerals, we have investigated the possibility that the algae do have a nutritional role and have sought to demonstrate this with direct experimental evidence. These investigations received impetus from the recent studies on coral-algal relationships by Odum and Odum[3] at Eniwetok. Their conclusions stand out in sharp contrast with those drawn by Yonge and Nicholls[4] in their now classical studies carried out on the Great Barrier Reef. Yonge and Nicholls state that "there is no evidence whatsoever of any . . . transference of material from the plants to the tissues of the animal." Contrary to this, the Odums[3] have found that, unless the nutrition of corals is regarded as partly herbivorous, the trophic structure of the coral reef community cannot be resolved. In any event, neither opinion is supported by direct evidence. A further inference in support of the Odums' viewpoint can be drawn from such studies as those of Krogh, Lange, and Smith.[5] They find that certain algae may yield up to 10 per cent of their synthesized organic matter to the external medium, which, in the instance of the coral-algal association, would be the cells of the animal. Krogh, Lange, and Smith[5] also warn that losses of organic matter to the medium may be the result of dead and decaying algal cells. More recently, Allen[6] has shown that 10–45 per cent of the organic material formed by cultures of *Chlamydomonas* appears in soluble form in the culture medium.

In considering these opposing points of view, it seemed to us that, by the use of radioisotopes and standard autoradiographic techniques, it should be possible to