

SOCIAL SCIENCES

A STUDY OF THE INTER-RELATIONS OF SPEED, ACCURACY, AND DIFFICULTY*

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THE PROBLEM

THE RELATION of speed and accuracy within the individual, the variability or constancy of relative standing in speed and accuracy at different levels of difficulty, and the exact change in speed with variation in difficulty constitute the chief problems of the study. The following definite formulation may be given to these problems:

1. Do individuals maintain at different levels of difficulty the same relative standing in speed?
2. Do individuals maintain at different levels of difficulty the same relative standing in accuracy?
3. On the average, does the fast individual tend to be low, average, or high in accuracy?
4. Does the level of difficulty affect the relation between speed and accuracy?
5. What changes occur in speed as the difficulty is increased?

THE EXPERIMENT

The subjects were 75 college students, and the material employed was 665 spelling words selected from a variety of sources to represent degrees of difficulty from very easy to very difficult. The words were presented to each subject individually by dictation, and he wrote them at his own rate. The time was taken by means of a stop watch, in the case of each word, from the end of the pronunciation of it until the completion of its spelling. Accuracy was determined in terms of the number of words misspelled, and the difficulty of a word was determined from the results by the total number of times it was misspelled in the records of all subjects.

RESULTS AND INTERPRETATION

1. *The Relative Standing in Speed at Different Levels of Difficulty.*

Three lists of words were compiled from the records, one of very low difficulty, another of medium difficulty, and a third of very high difficulty. The average number of letters per word for the three lists is approximately the same. The correlation coefficients between standings in speed for the easy and the medium words, for the easy and the difficult words, and for the medium and the difficult words were found and corrected for attenuation. The coefficients are as follows: (1) for easy and medium words .820, (2) for easy and difficult words .762, and (3) for medium and difficult words .936. In all cases there is high correlation between the relative standings in speed.

In order to carry further the study of the constancy of standing in speed, eleven lists of words were formed from the records, ranging from very

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easy to very difficult. The standings in speed on the easiest list were correlated with standings in speed on each of the more difficult lists. The coefficient for the easiest list with the next easiest list is .936 and for the easiest list with the most difficult list is .745. With a single exception the other coefficients are distributed fairly regularly between these extremes. The degree of correlation is high with a tendency to decrease slightly as the words correlated become further separated in degree of difficulty. Relative speed is, therefore, not greatly altered at different levels of difficulty. The individual who is fast upon easy spelling material will likely, though not certainly, have approximately equal standing in speed on more difficult material.

2. Relative Standing in Accuracy at Different Levels of Difficulty.

Using the same three lists of easy, medium, and difficult words described and used above, correlation coefficients were computed for the relation of standings in accuracy on the easy and the medium lists, on the easy and the difficult lists, and on the medium and the difficult lists. The coefficients for these three relations are, in the order stated, .631, .414, and .669. An individual is thus not quite so likely to hold his place in accuracy as he is in speed, though the coefficients are sufficiently large to indicate a very definite tendency toward this result. The good speller on easy words will probably be a fairly good speller on medium and difficult words.

3. The General Relation of Speed and Accuracy within the Group.

The general speed score for each subject, the general average time per word for each subject, was correlated with his general accuracy stated in terms of the percentage of words misspelled. The coefficient was found to be .346. It is sufficiently large to indicate a tendency for the fast worker to be more accurate than the slow worker in the case of spelling.

For further study, after the subjects were arranged in rank order on the basis of average time per word, they were divided into four groups as nearly equal in size as possible. The average time per word for each of the four groups and the percentage of misspelled words for each group were computed. The average time in seconds for each of the four groups, from fastest to slowest, respectively, is as follows: 3.48, 3.93, 4.53, and 5.50, and corresponding to these, in the same order, is the percentage of misspelled words for each group: 24%, 25%, 26%, and 32%. This shows a positive relation between speed and accuracy. As the average speed decreases the average accuracy also decreases.

4. The Relation of Speed and Accuracy within the Group at the Same and Different Levels of Difficulty.

In order to study the relation of speed and accuracy at the same and different levels of difficulty the correlation coefficients between speed and accuracy were computed for each of the lists of easy, medium, and difficult words. They were computed also for speed on easy words and accuracy on medium words and difficult words and for speed and medium words and accuracy on difficult words. The correlation between speed and accuracy is high for easy words (.631) and decreases as the words become more difficult, reaching zero (-.016) when the words are very difficult. When relative standing in speed at one level and standing accuracy at a higher level are considered, positive coefficients are found, but the highest of them is only .378.

5. Variations in Speed at Different Levels of Difficulty.

The eleven lists of words previously described, ranging from very easy to very difficult, were used here. The average time required by all subjects to spell the words of each list was found. The results plotted show a curve negatively accelerated. While more and more time is used as the words become increasingly difficult, the rate of increase in time becomes less and less.

SUMMARY OF RESULTS

1. In the spelling of words individuals are very likely to maintain at different levels of difficulty approximately the same relative speed. The individual who is fast is likely to remain fast, and the individual who is slow to remain slow whatever the level of difficulty may be. Since, however, the correlation between speeds at different degrees of difficulty varies inversely with the difference in difficulty, the probability of the same relative speed becomes less as the difference in difficulty becomes greater.

2. Similarly for accuracy, individuals tend to keep constant their relative standing in accuracy for the different levels of difficulty. The good speller on easy words will very probably be a good speller on medium and difficult words. The correlation between accuracy at two levels of difficulty is, however, highest for small differences in difficulty.

3. There is a positive correlation of .346 between individual standing in speed and individual standing in accuracy for all words. The fastest speller, on the basis of the general averages, will probably rank fairly high in accuracy of spelling.

4. If the relation of speed and accuracy is considered at the level of easy words, the correlation is high, .631, though this is undoubtedly affected by the relatively large number of zero accuracy scores. The individual who ranks high in speed on easy words will very likely rank high in accuracy on easy words. The nature of the correlation between speed and accuracy with respect to the medium words is the same, but the degree of correlation is much less, .397. At the level of difficult words there appears to be no correlation between speed and accuracy.

5. It is apparent from the statements of the last paragraph that the level of difficulty does very decidedly affect the degree of correlation. The greater the difficulty the less the correlation.

6. Speed of spelling decreases as the degree of difficulty increases, but at a decreasing rate.