

Associability and anagram solution*

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Ten undergraduates solved 11 word anagrams that had been scaled for associability. Partialling out the effect of solution associability, solution time and anagram associability were negatively correlated. Partialling out the effect of anagram associability, solution time and solution associability were positively correlated. These results were replicated in a second experiment in which 10 additional undergraduates solved the 11 word anagrams in the opposite direction. It was concluded that associability mediates the ease with which a solver breaks down a given anagram and conversely, the difficulty with which a solver finds a given solution.

A frequently investigated question in anagram research is whether "the pattern of a word may be more than the sum of letter pairs [Johnson, 1966; p. 375]." Most frequently, this hypothesis has been made operational in terms of a comparison between solution times of word anagrams (e.g., heart to earth) and solution times of nonword anagrams (e.g., threa to earth). If a word is a Gestalt not strictly reducible to the sum of its letter pairs, then word anagrams should resist breakdown and recombination; they should be more difficult to solve than nonword anagrams. Results supporting this prediction have been reported by Devnich (1937), Beilin and Horn (1962), Ekstrand and Dominowski (1965), and Groezinger (1966).

As Johnson (1966) noted, this line of research does not necessarily demand a Gestalt interpretation. Associations to nonword anagrams are series of letters; these facilitate solution. Associations to word anagrams are other words; these do not facilitate solution. From this associationist point of view, it can be predicted that anagrams that are words with many associates would be harder to solve than anagrams with few associates. Similarly, it can be predicted that solution words with many associates would be easier to find than solution words with few associates. The experiments reported here explored these predictions.

METHOD

Using Cieutat's (1963) technique, 24 Ss in two sections of introductory psychology at the University of Colorado rated 22 words on associability. The words comprised 11 pairs of word anagrams (heart-earth, shore-horse, trail-trial, charm-march, broad-board, night-thing, anger-range, tired-tried, wrong-grown, wrote-tower, worth-throw). All words were AA or A in frequency (Thorndike & Lorge, 1944).

An additional 10 Ss from the same S population were given 11 word anagram problems to solve. The higher associability member of each pair was the anagram. Problems were typed in capitals on 3 x 5 index cards. They were presented to Ss in random order, with a 2-min time limit for each problem. Ss were tested individually and gave solutions verbally.

In a second experiment using the same procedure, 10 more Ss

solved the same 11 word anagram problems in the opposite direction.

RESULTS

For each S, two partial correlations were computed. To test the effect of anagram associability on solution times, the correlation of a S's solution times and the anagrams' associabilities was calculated, partialling out the effect of solution associability. To test the effect of solution associability on solution times, the correlation of a S's solution times and the solutions' associabilities were calculated, partialling out the effect of anagram associability. The correlation coefficients were transformed to Z scores. Significance tests were made on the mean Z scores against the null hypothesis that $\bar{Z}_r = 0$. The results are summarized in Table 1.

DISCUSSION

These results oppose the predictions derived from an associationist perspective. The more associates a word anagram has, the easier it is to solve. The more associates a solution word has, the harder it is to find. Because these results were found, regardless of the direction in which the problems were solved, it may be concluded that no obvious confounding was present.

Associability is thought of as a measure of word meaningfulness (Noble, 1952). In keeping with Noble's (1953) conceptual distinction between meaningfulness and familiarity, the results of the present experiments point to an operational distinction between the two constructs. In anagram solution, meaningfulness and familiarity have opposite effects. As the results of the present experiments indicate, anagram meaningfulness facilitates solution, while solution

Table 1
Mean Z Transformations of Partial Correlations

Problem Type	Solution Times and					
	Anagram Associability			Solution Associability		
	M	SD	t_p	M	SD	t_p
High to Low Associability	-.346	.194	5.64†	.223	.262	2.69*
Low to High Associability	-.375	.268	4.42**	.293	.256	3.62**

* $p < .05$

** $p < .01$

† $p < .001$

*Sponsored by Michael Wertheimer, who takes full editorial responsibility for its contents.

meaningfulness hinders it. On the other hand, properties of the anagram which are interpretable as indices of familiarity, such as bigram frequency (Mayzner & Tresselt, 1959), pronounceability (Dominowski, 1969), and (non-)spacing (O'Connell & Duncan, 1961), tend to retard solution as they are increased, while analogous properties of the solution word, such as bigram frequency (Mayzner & Tresselt, 1962), word frequency (Mayzner & Tresselt, 1958), and priming (Dominowski & Ekstrand, 1967), tend to hasten solution as they are increased.

Associability is the number of things or ideas which a word calls to mind. In this sense, high-associability words exist in a more fluid semantic space than low-associability words. In terms of the anagram Gestalt, high-associability words are less bound to a given figure-ground configuration. Associability, at least for the restricted range of words sampled here, is therefore conceptualized as inversely related to the fixedness of the word. The more associates a word anagram has, the easier it is for the anagram solver to break it down and solve it. The more associates a solution word has, the harder it is for the anagram solver to find it and recognize it as the solution.

Returning to the question of Gestalt vs associationist explanations of word anagram/nonword anagram differences, these experiments suggest that these differences are not due to different types of associations to the problems. The effect of associability is in a direction opposite to that predicted by an associationist explanation. For the present, then, the notion of anagram Gestalt seems a better explanation of word anagram/nonword anagram differences.

REFERENCES

- Beilin, H., & Horn, R. Transition probability effects in anagram problem solving. *Journal of Experimental Psychology*, 1962, 63, 514-518.
- Cieutat, V. J. Association indices for 446 randomly selected English monosyllables, bisyllables, and trisyllables. *Journal of Verbal Learning & Verbal Behavior*, 1963, 2, 176-185.
- Devnich, G. E. Words as "Gestalten." *Journal of Experimental Psychology*, 1937, 20, 297-300.
- Dominowski, R. L. The effect of pronunciation practice on anagram difficulty. *Psychonomic Science*, 1969, 16, 99-100.
- Dominowski, R. L., & Ekstrand, B. R. Direct and associative priming in anagram solving. *Journal of Experimental Psychology*, 1967, 74, 84-86.
- Ekstrand, B. R., & Dominowski, R. L. Solving words as anagrams. *Psychonomic Science*, 1965, 2, 239-240.
- Groezinger, J. K. The effect of transition probability and problem-solving methods on anagram problem solving. Unpublished master's thesis, Michigan State University, 1966. Cited by D. M. Johnson, Solution of anagrams. *Psychological Bulletin*, 1966, 66, 371-384.
- Johnson, D. M. Solution of anagrams. *Psychological Bulletin*, 1966, 66, 371-384.
- Mayzner, M. S., & Tresselt, M. E. Anagram solution times: A function of letter order and word frequency. *Journal of Experimental Psychology*, 1958, 56, 376-379.
- Mayzner, M. S., & Tresselt, M. E. Anagram solution times: A function of transition probabilities. *Journal of Psychology*, 1959, 47, 117-125.
- Mayzner, M. S., & Tresselt, M. E. Anagram solution times: A function of word transition probabilities. *Journal of Experimental Psychology*, 1962, 63, 510-513.
- Noble, C. E. An analysis of meaning. *Psychological Review*, 1952, 59, 421-430.
- Noble, C. E. The meaning-familiarity relationship. *Psychological Review*, 1953, 60, 89-98.
- O'Connell, E. J., & Duncan, C. P. Anagram solving as a function of letter spacing. *Psychological Reports*, 1961, 8, 117-118.
- Thorndike, E. L., & Lorge, I. *The teacher's word book of 30,000 words*. New York: Teachers College Columbia University, 1944.

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