Solving words as anagrams[1]

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Abstract

Two experiments investigated the effect of spacing on the solution of word and nonword anagrams. In word problems the five letters already constitute a word and the solution is another unrelated word. The results indicate that word problems are more difficult than nonword problems and that spacing probably does not affect anagram solution.

Problem

Hollingworth (1935, 1938) suggested anagrams should be more difficult if the letters of the anagram already constitute a word (W anagrams) than if they do not form a word (NW anagrams). The reasoning was that W anagrams form a better Gestalt than NW anagrams due to the operation of perceptual forces; as a result, the letters of the W problems should be less susceptible to the manipulations necessary to solve the problem. The Hollingworth studies and others (Nissenson & Sargent, 1941; Sargent, 1940) however, failed to substantiate this hypothesis; while the results of a study by Devnich (1937) did suggest that a difference existed. Recently, Beilin & Horn (1962) using more adequate controls, found that W problems were more difficult than NW problems.

O'Connell & Duncan (1961) showed that 10 spaces between each letter of an anagram facilitated solution. According to these investigators, the wide spacing could have produced its effect by reducing the strength of associations between letters or by reducing the perceptual forces which make the anagram a Gestalt, or both. However, Dominowski & Duncan (1964) were unable to replicate the O'Connell and Duncan findings, suggesting instead that for NW anagrams, spacing has no effect. Nevertheless, assuming that wide spacing reduces the associational or perceptual bonds that might be the cause of the difficulty of W anagrams, spacing should interact with type of anagram, facilitating solution of W problems but not affecting NW solution. It is this interaction which the present study sought to demonstrate.

Method

Design. The design was a 3 x 3 factorial, with three levels of spacing (0, 5, or 10 elite typewriter spaces) and three types of anagrams. The types of anagrams were: (1) word anagrams (W) in which the five letters of the anagram constituted a word and the solution was another word; (2) nonword anagrams (NW) in which the five letters did not form a word, but could be rearranged to make one solution word; and (3) nonword double-solution anagrams (NWD) in which the five letters did not make a word, but proper rearrangements would produce the two words which could be made from the letters of the W anagrams. The NWD problems were an extra control to make sure that the particular solution words of the W problems were not inordinately difficult. Since two solutions are possible in the NWD problems, it is expected that these problems would normally be easiest.

Materials. For each of the types of anagrams, two lists of 15 problems were constructed. For the W problems, one list was simply the "flip-over" version of the other list; that is one half of the W Ss solved in one direction (e.g., froth to forth) and one half solved in the other direction (forth to froth). The NW problems were matched with the W problems such that, averaged across the two lists, the following variables were equated: (1) Thorndike-Lorge frequency of the solution words; (2) initial letter of the solution word; (3) the particular letter moves necessary to solve; (4) the bigram frequency of the anagram; and (5) the bigram frequency of the solution word. The NWD problems were simply the W problems presented in a letter order which did not constitute a word. These problems were matched in letter order with the W and NW problems by the use of two sets of letter orders. Examples of the types of problems follow: W, worth to throw or throw to worth; NW, kcith to thick or teirw to write; and NWD, owrht or htrow to either throw or worth.

Procedure and subjects. For each of the six lists of 15 anagrams, two random presentation orders were used. The 15 problems were typed on one sheet of paper with either 0, 5, or 10 spaces between letters. The Ss were run in groups with each S receiving one sheet of 15 problems representing only one experimental condition, e.g., W problems-5 spaces. Instructions were read preparing Ss for the possibility of W anagrams, following which Ss were given 3 min. to solve as many problems as possible. The Ss (20 per cell) were undergraduate students at Northwestern and DePaul Universities; their service was a course requirement.

Results and Discussion

The means of the number of solutions obtained in 3 min. for the nine conditions are presented in Table 1. Analysis of variance revealed that the linear effect of spacing was significant at the .05 level (F, 1 and 171, = 3.39) as was the main effect of type of problem (F, 2 and 171, = 12.71). However, both the linear and quadratic components of the interaction fell short of significance (Fs, 2 and 171, = .07 and 1.07, respectively). Two of the 15 W problems were found to have more than two solutions; therefore, the data were reanalyzed without these problems and the corresponding NW and NWD

Table 1. Mean Number of Solutions (out of 15)

Spacing	Type of Problem		
	W	NW	NWD
0	5.15	7.20	8.35
5	5.50	6.00	9.10
10	4.30	5.85	7.05

problems. No changes in conclusions were necessary. The results indicate that spacing inhibited problem solving and thus replicate neither O'Connell and Duncan nor Dominowski and Duncan. The findings, however, do replicate those of Beilin and Horn. The W problems were more difficult than NW problems (F, 1 and 171, = 4.65), and the NWD problems were easiest of all.

Experiment II. Since the inhibitory effect of spacing was unexpected, a second experiment was done to extend this finding. The inhibitory effect may have resulted from the whole-list presentation which produced a rather complex array of letters, especially with wide spacing. Therefore, booklets of 15 pages, one problem per page, were employed. Two levels of spacing (0 or 10) were used with one of the sets of NW problems as materials. The Ss (30 per group) were run in groups, however, working time was controlled by E's pacing instructions, such that S could only spend 15 sec. on each problem. The mean number of solutions for the wide spacing group was 6.30 and for the narrow spacing, 7.63; the F (1, 58) = 3.56 which is not significant.

It appears that spacing probably has no effect on anagram solution, either with W or NW anagrams. This conclusion supports the findings of Dominowski and Duncan. If there is an effect of spacing it probably is in the inhibitory direction since, at the very least, more time will be required to perceive the letters especially if they are very widely spread across the page. If there are positive factors in spacing, their net effect may be diminished by this requirement of longer perceptual time.

It is concluded that W anagrams are more difficult than NW anagrams thus replicating the results of Devnich and of Beilin and Horn. This effect is independent of T-L frequency, bigram frequency of both the anagram and the solution word, anagram letter order, and the initial letter of the solution word. Although the effect might be explained by the postulation of perceptual forces which make better Gestalts of the W problems than the NW problems, the failure of spacing to interact with type of anagram makes other interpretations more attractive. Beilin and Horn suggest that Ss may perseverate on the sound or meaning of the W problems (perhaps pronouncing the word several times?). Underwood (in press) has postulated that Ss make two responses to a verbal unit: (1) a representational response (RR) which is the response necessary to perceive the stimulus and (2) an implicit associative response (IAR) which consists of associates of the stimulus. It seems likely that both the RR and IAR would interfere with solution of W problems more than with NW problems. The RR is likely to be a word in the case of W problems; whereas, for NW problems it is likely to consist of a series of letters, a more appropriate response for solving anagrams. For NW problems, the IAR might be associates of the letters, while for W problems it should be associates of the word. Giving word associates to W problems should be inhibitory since the solution word will rarely be among the associates.

References

BEILIN, H., & HORN, R. Transition probability effects in anagram problem solving. J. exp. Psychol., 1962, 63, 514-518.

DEVNICH, G. E. Words as "Gestalten." J. exp. Psychol., 1937, 20, 297-300.

DOMINOWSKI, R. L., & DUNCAN, C. P. Anagram solving as a function of bigram frequency. J. verbal Learn. verbal Behav., 1964, 3, 321-325.

HOLLINGWORTH, H. L. The conditions of verbal configuration. J. exp. Psychol., 1935, 18, 299-306.

HOLLINGWORTH, H. L. Verbal Gestalt experiments with children. J. exp. Psychol., 1938, 23, 90-95.

NISSENSON, M., & SARGENT, S. S. Words as configurations. J. exp. Psychol., 1941, 28, 85-89.

O'CONNELL, E. J., & DUNCAN, C. P. Anagram solving as a function of letter spacing. Psychol. Rep., 1961, 8, 117-118.

SARGENT, S. S. Thinking processes at various levels of difficulty. Arch. Psychol., N. Y., 1940, No. 249.

UNDERWOOD, B. J. False recognition produced by implicit verbal responses. J. exp. Psychol., in press.

Note

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