Incubation effects in anagram solution*

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Forty-eight undergraduates each solved 12 anagrams. Solution procedure was varied between Ss. In the incubation condition, solution time for any given problem was distributed, while in the control condition, solution time for any given problem was massed. Incubated anagram problems were more quickly solved than control problems ($p < .05$). It was concluded that an incubation procedure mitigates a S's fixation on unproductive steps in the anagram solution process.

According to the current conceptualization of the anagram solution process, the solver permutes the letters of the anagram and generates associations to his permutations, checking with the anagram until a solution word fits (Johnson, 1966). The generation of possible solutions is described by the spew hypothesis (Underwood & Shulz, 1960), which states that the more familiar the potential solution word, the sooner it is generated and considered as an answer. The finding that anagrams whose solutions are high-frequency words are more quickly solved than anagrams whose solutions are low-frequency words (Mayzner & Tresselt, 1958) supports the spew hypothesis. Because high-frequency words are more familiar to the anagram solver, anagrams with high-frequency solutions are more quickly solved.

It is obvious, though, that the anagram solver is not an infallible worker. Many times, no solution is found. Failure to solve occurs so often that it is common practice in anagram research to use a S's median solution time rather than his mean solution time to represent the central tendency of his performance (Johnson, 1966). The spew hypothesis describes a probabilistic process, therefore, and not an inevitable one. When a S fails to solve an anagram, he has either not generated the correct solution or not recognized that the generated solution was indeed correct.

If the correct solution has been overlooked by a S, he is not likely to come across it as he generates increasingly unfamiliar words. Unless the anagram solver can start over in the solution process, the problem is destined to remain unsolved. Doubtlessly, much starting over does occur during the solution process, but it is probably hampered by fixation on and interference from unproductive permutations and incorrect potential solutions.

Common sense suggests that this covert starting over can be facilitated by an overt starting over. In everyday life, people solve certain problems in this manner. After an unproductive spell, they cease working and return later in another attempt. In terms of anagram solution, it is possible to manipulate overt starting over on a problem by taking the problem away from a S and presenting it to him again at a later time. If the derivation described above is correct, such an incubation procedure should facilitate solution relative to a nonincubation procedure.

In this experiment, the hypothesis was tested that incubated anagram problems are solved more quickly than nonincubated problems. To minimize the possibility that the experimental Ss might work on a problem while it was not being presented, they were given a set of problems which were cycled through several times; each experimental S was always working on an anagram problem, presumably the one in front of him. To test the generality of the hypothesis across a variable of known effect, solution word frequency was also manipulated in this experiment.

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METHOD

Subjects

Forty-eight Ss from introductory psychology classes at the University of Colorado were employed in the experiment, 24 in each of the two major conditions.

Material

Each S was given 12 five-letter anagrams typed on plain 3 x 5 cards. From the Thorndike-Lorge (1944) tables, six frequent words (occurring more than 100 times per million) and six infrequent words (occurring between 1 and 10 times per million) were chosen. The six frequent words were *sugar, train, judge, admit, lower,* and *given.* The six infrequent words were *liken, caste, usher, covet, farce,* and *cower.* Six 2-move letter orders (24351, 32415, 41523, 51324, 14532, 31254), and six 3-move letter orders (43521, 53421, 35241, 15432, 25314, 45213) were employed (Dominowski, 1966). Word presentation order and letter orders were balanced in a 12 x 12 Greco-Latin square, resulting in 12 different sets of anagram problems.

Design

Ss were assigned randomly to one of two major conditions, the incubation condition or the control condition. Within each condition, each of the 12 different sets of problems was given to two Ss. Because each S was given all 12 problems, solution word frequency was a within-Ss factor. In sum, 24 Ss were given six anagrams having frequent solutions and six anagrams having infrequent solutions to be solved in an incubation procedure. Another 24 Ss were given the same anagrams to be solved in a control (nonincubation) procedure.

Procedure

The Ss were told what an anagram was—a set of scrambled letters which can be arranged to form a word. After being shown an example, Ss were told that they would be given 12 anagrams to solve. Ss in the control group were told that the problems would be given to them one at a time. If solution did not occur in 2 min, then the correct answer would be provided and the next problem given. Ss in the incubation group were told that the problems would be given to them one at a time but that they would have only 20 sec at a time to work on any given problem. After 20 sec, the problem would be removed and the next one given. The set of problems would be cycled through six times, so that a total of 2 min could be spent on each problem. When solution to a problem occurred, that problem was no longer presented to the S. Solutions were given by the S verbally, and solution times were recorded with a stopwatch. All Ss were tested individually by the same E.

RESULTS

For each S, median solution times for the frequent and infrequent words were calculated. The means of these medians in the different conditions were (1) incubation-frequent: 28.98 sec, SD = 21.67, (2) control-frequent: 50.94 sec, SD = 40.48, (3) incubation-infrequent: 74.93 sec, SD = 36.60, (4) control-infrequent: 79.06 sec, SD = 32.77.

Because the particular problem set which a S received influenced his solution times, problem set was considered an additional factor in the analysis of the results. A 2 by 12 by 2 analysis of variance was computed, with solution procedure (incubation or control) and problem set as between-Ss factors and solution word frequency as a within-Ss factor. Incubated problems were solved more quickly than control problems, $F(1,24) = 6.2926$, $p < .05$. Problems with frequent solution words were solved more quickly than problems with infrequent solution words, $F(1,24) = 39.2798$, $p < .001$. The particular set of problems given to a S affected his solution times, $F(11,24) = 4.8244$, $p < .001$. None of the interactions approached significance.

DISCUSSION

The hypothesis that incubated anagram problems would be more quickly solved than nonincubated problems was supported by the results of this experiment. Even when the decisions about when to cease working on a problem and when to return to it were not made by the solver, this procedure led to quicker solution times than the typical procedure of continuous work enforced in most anagram research. It seems reasonable that an overt starting-over facilitates a covert starting-over, a beneficial effect if the solver has somehow overlooked the correct solution and is generating increasingly unfamiliar (and unlikely) solutions. It is not difficult to make the case that an incubation procedure more closely approximates real-life problem solving than does the procedure typically employed in anagram research. Conceptualization of the anagram solution process in probabilistic rather than inevitable terms allowed the derivation of this interpretation. In a more general sense, explicit recognition of the probabilistic nature of problem solving seems a valuable addition to any theoretical description of the process.

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