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PERCEPTUAL CONDITIONS AFFECTING EASE OF ASSOCIATION [1]

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Four experiments replicated Asch's findings in 1969 that perceiving two terms in a unitary relationship facilitates their association. In Exp. I and II, pronouncing a CV-C pair as a monosyllable produced high associative recall of the terminal C to the CV cue, while pronouncing the CV-C as two separate terms caused relatively low associative recall. The result held for both intentional and incidental learning conditions. In Exp. III and IV, *S*s were to associate a color patch to each of 15 geometric figures. Association was high when the figure was the same color as the color patch, low when the figure was a different color than the color patch, and intermediate when the figure was an uncolored, black-on-white outline.

Asch (1969) has emphasized the importance of the relationship between perception and memory. In particular, the perceptual relation between pairs of elements may be expected to substantially influence the ease of associating the pairs. Some earlier pertinent data (Asch, 1962) compared the learning of associations between color responses and geometric figures when these were presented in various perceptual relations. The shape and the color could be shown during the study trial in a "constitutive" or "unitary" relationship in which the shape appears to be composed of the colored material. A solidly colored figure on a white background or a colored-outline contour on a white background exemplify constitutive relationships. Alternatively, the shape-color relationship could be nonunitary, as when the figure was a black-outline contour on a colored background or beside a colored patch. The experimental task was to learn to associate color names to a set of black-on-white outline test figures. Learning was about twice as fast when *S*s had studied the shape-color pairings in a unitary than in a nonunitary relationship.

For generality, Asch (1969) performed a similar experiment using verbal materials. Using an incidental learning paradigm, he found that *S*s seeing and pronouncing two CVC trigrams as a unitary disyllable recalled significantly more second syllables when cued with the first than did *S*s seeing the CVCs as a pair of terms and pronouncing them, separated by a pause.

The present experiments attempt to replicate and add further generality to Asch's findings. Experiments I and II investigate the association between a CV bigram and a terminal consonant when these CV-C pairs are presented under unitary (U) and nonunitary (NU) perceptual conditions in an incidental and in an intentional cued recall paradigm. It is expected that the coherence of the CV and C terms in memory will be partly determined by the way they are perceived as being related. Specifically, those *S*s pronouncing the CV-C as a unitary syllable should recall more terminal Cs than those *S*s pronouncing the CV-C pair as two separate units.

Experiments III and IV inquire whether the shape-color results generalize to a paired-associate recall paradigm, in which both colored and uncolored outline figures are paired with a color patch during study trials. (Asch had used an associative matching or recognition test). A novel issue to be investigated is whether the unitary relation between a figure and its surface color can be used to interfere with learning the correct shape-color association. If the surface color of a figure differs from the response color to be associated with

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the shape, then associative interference and response competition should result.

Experiment I

Method

Sixteen introductory psychology students, fulfilling a course requirement, were assigned alternately to one of two incidental learning conditions and run in individual sessions. Following completion of the Exp. I task, each of these *S*s participated in Exp. III.

The materials were 15 easily pronounceable CVC trigrams: CUD, DAG, FAS, HIN, KEB, LOM, MEF, NUX, PIX, RIZ, TAV, WEK, WUG, and ZON. The trigrams had meaningfulness scores ranging from 22 to 95, with a mean score of 57 on Archer's (1960) 100-point a' scale. They were lettered, one trigram on each of 15 3 × 5 in. study cards. The initial consonant and the vowel were lettered as a CV bigram approximately .5 in. to the left of center; the terminal consonant, 1 in. to the right of the CV bigram. A test deck comprised 15 cards, each showing just the initial CV.

The *S*s were misinformed that the study concerned the effects of phonetic context upon articulatory voicing. In the NU condition, *S*s were instructed to pronounce the initial CV, then separately to pronounce the final C. They were to pronounce each pair in this manner three times in succession (e.g., to pronounce LO-M as "low-emm, low-emm, low-emm"). In the U condition, *S*s were instructed to blend the initial CV with the final C before pronouncing the CVC as a single unit three times in succession (e.g., to pronounce LO-M as "lom, lom, lom"). The pronunciations of each *S* were tape recorded to contribute to the credibility of the stated purpose of the experiment.

The study cards were presented in random order at a 5-sec. rate. Immediately following the single study trial, *S* was cued with each initial CV for recall of the associated terminal C. If "LO," for example, appeared on a test card, *S* was to respond with "M." Although the recall test was rationalized as an indicator of "the natural coherence of different phonetic compounds," instructions were explicit that *S* was to recall the final C associated with each CV. No *S* reported having anticipated such a recall test. Test cards were presented at a 5-sec. rate in scrambled order.

Results

The recall data supported the experimental hypothesis. When cued with the initial CVs, U *S*s recalled a mean of 7.75 terminal Cs out of 15; NU *S*s, a mean of 4.13. This difference is significant, $t\ (14) = 3.37$, $p < .01$. It may be noted that the similarity between the training stimulus and the test stimulus is greater for the NU *S*s; yet this factor was not as powerful in determining recall as were the different rehearsal procedures.

We next examined the relationship between the recallability of a CVC and preexperimental habits surrounding it. First of all, the CVCs were all selected to be high in pronounceability, so variation in their recall can not be correlated with that. Second, recall of a CV-C pair was correlated with the probability of the final C as a free associate to the initial CV, using Table F from Underwood and Schulz (1960). The rank-order correlations for Groups U and NU and the combined scores were .10 or less and insignificant. Third, recall was correlated with the meaningfulness of the CVCs (a') as scaled by Archer (1960). For the NU *S*s, recallability and meaningfulness did not correlate significantly (rank-order $\rho = .31$). Recallability and meaningfulness did correlate for the U *S*s ($\rho = .5$, $p < .05$) as well as for the combined data of the NU and U *S*s ($\rho = .49$, $p < .05$). The pattern of these correlations suggests that recall differences between the NU and U conditions may be accounted for, in part at least, by differences in the meaningfulness of the phonetic sequences for the two groups. That is, pronunciation of the unitary CVC may remind *S* of a word that it resembles or suggests, whereas the broken CV-C pronunciation may be less likely to do so. This speculative interpretation may not apply, however, to Asch's experiment since he used CVC disyllables.

Experiment II is similar to Exp. I except that it uses intentional instead of incidental learning instructions.

Experiment II

Method

Sixteen introductory psychology students, fulfilling a course requirement, were assigned randomly to one of two intentional learning conditions. Eight *S*s, 4 from each of the two conditions, completed the Exp. II task followed immediately by the paired-associate learning task constituting Exp. IV. The remaining 8 *S*s completed the Exp. IV task prior to participating in the present experiment. This counterbalancing was done to control for the possible effect of participation in one experiment on performance in the other. The two conditions were equated for sex and experimental naïveté of the *S*s.

The CVCs, study decks, and test decks used in this experiment were identical to those described in Exp. I. Instructions to *S*s in the present experiment differed from those given in Exp. I in that *S*s were informed that they were to be tested for their memory of the CVCs. This was done to generalize the findings of Exp. I beyond the incidental learning paradigm. All other procedural details were the same as for Exp. I.

Results

The intentional cued recall data were totally consistent with the results of Exp. I. When cued with the initial CVs, U *S*s recalled a mean of 9.62 terminal Cs out of 15; NU *S*s, a mean of 6.12. This difference is statistically reliable, $t\ (14) = 2.57$, $p < .025$. The effect was, furthermore, independent of the order in which *S* participated in Exp. II and IV.

Again, recallability correlated somewhat with meaningfulness for the NU *S*s ($r = .45$). The rank correlations for U *S*s and for the combined NU and U data were larger, at .59 ($p < .025$) and .64 ($p < .01$), respectively. Thus, these data are consistent with the differential meaningfulness of phonetic sequences as a possible explanation for the NU versus U recall differences.

Experiment III

Method

The 16 *S*s described in Exp. I participated in the present experiment immediately following completion of the Exp. I task. The present experiment was a one-way within-*S*s design.

Fifteen highly discriminable, abstract geometric shapes were randomly divided into three sets of 5. For example, one resembled the outline of a geometrically structured ice cream cone. Within each of the three sets, one of five color response terms was associated with each stimulus. Each shape was drawn on the left side of a 3 × 5 in. card. On the right side of these cards a response color indicator was colored in a 1-sq.-in. patch. Each set of five stimuli was assigned to either the facilitation (F), neutral (N), or interference (I) condition. Shapes of F pairs were colored solidly in the same color as the to-be-associated color patch: shapes of I pairs, in a color different from the to-be-associated color patch. Shapes of N pairs were uncolored figures drawn as black-on-white contours. Three different decks were composed, counterbalancing the assignment of particular sets across the three conditions. Each study deck was used for an equal number of *S*s. There was only one test deck. On each card of this deck was drawn an uncolored black-on-white contour figure identical to that on a study card, except for the missing color. No color patches appeared on the test cards.

Two training trials were given by the study-test method of paired-associate learning with materials presented visually at a 3-sec. rate. No feedback was given on test trials. Study and test items were presented in a different scrambled order each trial. The *S*s were instructed to associate the color patch on the right and the shape of the figure on the left, regardless of the coloring (if any) of the shape itself. A prompting card listing the five color names was available to *S* at all times, and he was encouraged to guess when uncertain.

Results

The mean correct responses per item per *S* over the two test trials were 1.61, 1.30, and 1.15 for the F, N, and I conditions, respectively. An analysis of variance yielded a significant effect of pair type, ($p < .01$). A Newman-Keuls test indicated that more F pairs were correctly recalled than either N or I pairs, but the latter two means did not differ reliably from one another, $q\ (2, 16) = 1.75$, $p > .05$. Thus when the unitary relation between a stimulus figure and its surface color was the same as the to-be-learned shape-color association, learning was facilitated relative to the neutral pairs.

Although I items were not recalled significantly worse than N items, *S*s frequently gave as their recall to I shapes the surface color of the shape rather than the appropriate color of the response patch. The frequency of these intrusion errors (IEs) in the I condition suggests that the unitary relation between a shape and its surface color may have been interfering with the acquisition of the correct shape-color association. The IEs accounted for 65% and 45% of all errors in the I condition on Trials 1 and 2, respectively. The probability of this many IEs by chance guessing is remote, $\chi^2\ (1) = 39$, $p < .01$.

Assuming that IEs beyond the 25% expected by chance would have been correct responses in the F condition, we may investigate whether the recall of F items is predictable from the recall of I items plus the excess percentage of IEs. Adding percent recall of I items to the excess percentage IEs yields predicted recall scores for the F condition of 67% and 74% for Trials 1 and 2. The comparable observed percentages of F items recalled were 70% and 91%. The prediction for Trial 1 is close, but the Trial-2 prediction is far too low. There thus appears to be no simple quantitative relation between the F and I recall scores.

Asch, Ceraso, and Heimer (1960) found that the association between two geometric shapes (e.g., a rhombus and small crosses) was learned more easily when the elements were related constitutively ("unitary") than when they were contiguous but nonunitary. If a rhombus were outlined by a series of small crosses, for example, the association between the rhombus and crosses was acquired more easily than if the rhombus were outlined by straight lines, with a row of crosses displayed to the right of the shape. Keppel (1962) argued that these results could be explained by the difference in the number of areas in space between which *S* must divide his attention. That is, while *S*s in the contiguous condition had to divide their attention between two fixation areas, *S*s in the constitutive condition had to fixate only one configuration in order to learn the association. The present experiment circumvents that criticism since all study cards had two configurations, the figure and the color patch. The superior recall of F pairs relative to the N pairs despite equated fixation areas challenges Keppel's "twoness" explanation of the earlier results.

Experiment IV

Method

Half of the 16 *S*s described in Exp. II participated first in Exp. II and then in Exp. IV. The remaining 8 *S*s participated in this Exp. IV before Exp. II. The design of the present experiment is identical to that of Exp. III, but with a minor change in materials.

The geometric figures, color responses, study decks, and test decks used in the present experiment differed in one respect from those described in Exp. III. For the N and I items, the area of the response color patch was 2 sq. in. rather than 1 sq. in. This change was made in order to equate the total exposure area of the response color patch in the N and I conditions to the sum of the two areas of exposure of the response color in the F condition. This controls for the possibility that previous differences were due to the total area occupied by the correct color on F cards. All instructions and procedural details were identical to those in Exp. III.

Results

The mean correct responses per item per *S* over the two test trials were 1.25, 1.04, and .70 for the F, N, and I pairs, respectively. Analysis of variance revealed significant differences, $F\,(2, 30) = 14.65$, $p < .01$. Newman-Keuls tests indicated that all three means differed significantly from one another. That is, recall was significantly less for I items than for either F or N items ($p < .01$). The F items, moreover, were recalled reliably more often than the N items ($p < .05$).

Thus the facilitation of recall on the F items relative to N items found in Exp. III was replicated. The Exp. III data had suggested, whereas the present data show more clearly, that correct recall is reduced when the unitary relation between a figure and its surface color conflicts with the to-be-learned shape-color association.

For these I items, *S*s again made a high proportion of intrusion errors. IEs accounted for 53.6% and 43.8% of all errors in the I condition on Trials 1 and 2, which exceeds the chance expectation of 25%, $\chi^2\,(1) = 32.2$, $p < .001$. Thus the conflicting relations between an I shape and the two colors interfered with learning the correct response.

An attempt was again made to predict percent cued recall of F items from the percent recall of I items plus the excess of IEs. The predicted percent recalls for F items on Trials 1 and 2 were 50.0% and 51.2%. The comparable observed values were 51.2% and 73.8%. Again, while the Trial 1 prediction is close, the Trial 2 prediction is too low.

From these experiments, it may be concluded that the associative effect of perceptual unity is quite robust despite variation in experimental details. Unitary pronunciation facilitates recall relative to nonunitary pronunciation under intentional as well as incidental learning conditions, although the effect may be due to differential meaningfulness of the unified versus separated phonetic compounds. A constitutive relation between a shape and its surface color fosters their natural coherence in memory in comparison to having the color patch simply contiguous to the outlined shape. This natural coherence can be arranged to facilitate or conflict with the to-be-recalled shape-color association.

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ERRATUM

In the article "Modes of Representation and Problem Solving" by Steven H. Schwartz in the November 1971 issue, the question numbered 9 in the second sample problem, column 2, page 347, should be corrected as follows:

The Japanese doesn't live in the blue house and the Indian doesn't drink coffee.