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UMEÅ PSYCHOLOGICAL REPORTS

No. 124 1977

Department of Psychology
University of Umeå

EFFECTS OF INTERFERENCE ON INTRA-MODAL AND CROSS-MODAL MATCHING OF FORM

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Garvill, J., and Molander, B. Effects of interference on intra-modal and cross-modal matching of form. Umeå Psychological Reports No. 124, 1977. - This experiment was designed to test two hypotheses concerning differential memory for visually and tactually acquired information in intra-modal and cross-modal matching of form. The intra-modal conditions were VV (visual standard, visual comparison) and TT (tactual standard, tactual comparison). The cross-modal conditions were VT (visual standard tactual comparison) and TV (tactual standard, visual comparison). Between the standard stimulus and comparison stimulus either an unfilled interval or a visual matching task or a tactual matching task was interpolated. The first hypothesis suggests that the memory traces for tactually acquired information are less stable than those for visually acquired information and thus more sensitive to interference. According to the second hypothesis there are modality specific memory storages and the information acquired are coded and stored in the memory for the comparison modality. This hypothesis predicts interference only when the interfering task is presented in the same modality as the comparison stimulus. The results gave clear evidence of interference. However, the interference effects were the same regardless of standard modality, comparison modality or kind of interference. Thus, the results suggest a common form of storage for visual and tactual information.

Goodnow (1971) has suggested that memory for visually acquired information is more stable than memory for tactually acquired information. She based this hypothesis on an earlier study by Posner (1967) who compared retention of visual and kinesthetic information, as well as on a review of earlier studies on cross-modal and intra-modal matching of form. In her own experiment, she obtained support for

her hypothesis in that she found that the relative superiority of matching performance with a visual standard increased as a function of the number of objects interpolated between standard and comparison objects. These results suggest that tactually acquired information is more sensitive to interference effects than visually acquired information, a result consistent with the hypothesis that memory for the former kind of information is less stable than that for the latter kind of information.

However, in Goodnow's study, the effect of the number of interpolated objects was confounded with that of the length of the time interval between standard and comparison stimuli, thus suggesting an alternative explanation for her results. In a later study, therefore, Garvill and Molander (1973) examined the effect of the length of the interstimulus interval to test this alternative explanation. They found no effect of this variable, however, thus supporting the original interpretation that the effects in Goodnow's experiment were due to interference.

The present study was designed to investigate the interference effects in more detail to provide a stronger test of the hypothesis concerning the relative stability of the memory traces for information acquired in different modalities. Specifically, we required our subjects to carry out an extra matching task between the presentation of the standard stimulus and the comparison stimulus in a matching task which required intra-modal and cross-modal matching of form. The interference task was an intra-modal matching task which required either tactual or visual matching. An unfilled interstimulus interval was used as a control condition.

The hypothesis that memory for tactually acquired information is less stable than that for visually acquired information predicts that the interference effects will be greater when the standard stimulus is presented in the tactual mode than when it is presented in the visual mode, regardless of the mode in which the comparison stimulus is presented, and regardless of the nature of the interfering task.

There is, however, also an alternative hypothesis, suggested by Connolly and Jones (1970). According to this hypothesis, there are modality specific memory storages and in the cross-modal conditions the information obtained in the standard modality is translated and stored in the memory for the comparison modality. This hypothesis predicts that there will be interference only when the interfering task is presented in the same modality as the comparison stimulus.

Our present experiment was designed to test these hypotheses.

Method

Subjects. Forty undergraduate psychology students from the University of Umeå served as subjects to fulfill a course requirement. The subjects were randomly assigned to four groups of ten subjects each.

Design. The independent variables studied in this experiment were standard modality (visual or tactual presentation of the standard object), comparison modality (visual or tactual presentation of the comparison object), and interpolated activity (unfilled interval, visual matching task or tactual matching task). The dependent variables were number of FN-errors (false negatives, i.e., the subject responds "different" when the objects are in fact identical) and number of FP-errors (false positives, i.e., the subject responds "same" when the objects are in fact different). Thus, the design was a 2 by 2 by 3 factorial design with repeated measures on the third variable.

Stimuli. The stimuli were five three-dimensional "nonsense" objects of the same kind as those used by Gibson (1962). They were all painted white, and had the same weight. Thus, they differed only in form. A drawing of one of the stimuli as well as of the experimental setting is provided in Garvill and Molander (1971). A second set, clearly discriminable from the first set, of five three-dimensional "nonsens" objects were used in the interpolated matching task.

Apparatus. During the experiment the subject was seated in front of a screen. When an object was presented in the tactual modality the subject put his hands under the screen and could then explore the object without seeing it. During the visual presentations the objects were placed in the middle of a rotating disc behind the screen and at the same level as the upper edge of the screen (eye-level).

Procedure. There were four conditions in the experiment, each involving one modality condition VV, VT, TV and TT. In each condition, the subjects made 120 comparisons. Each object appeared 24 times as standard object in a randomized order. On 12 occasions it was paired with itself as comparison object and on the other 12 occasions it was paired with one of the remaining objects, three times with each of them. Thus the subjects made 60 comparisons of identical objects and 60 comparisons of different objects in a randomized order. On 40 occasions there was an unfilled interval between the removal of the standard object and the presentation of the comparison object, on 40 occasions there was an interpolated visual matching task and on the remaining 40 occasions there was an interpolated tactual matching task. The conditions appeared in a randomized order. For both kinds of interpolated matching there were 20 comparisons of identical objects and 20 comparisons of different objects in a randomized order.

The visual standard was presented for 7 sec. and the tactual standard for 15 sec. The visual and tactual comparison were presented for 5 sec. These presentation times were found suitable in an earlier experiment (Garvill & Molander, 1975). The retention interval was 10 sec. In the interpolated matching task the standard stimulus was presented for 5 sec. and the comparison for 5 sec. The subjects were required to respond "same" or "different" for each comparison. They were not told whether their answer was correct or not. The procedure for a trial in the VT-condition with tactual interference would thus be as follows: Presentation of visual standard for 7 sec. then presentation of tactual standard for 5 sec., presentation of tactual comparison for 5 sec., and the subject is required to respond "same" or "different" to the interpolated matching task, then the comparison object in the main task is presented tactually for 5 sec., and the subject has to respons "same" or "different" for the main task. The intertrial interval was 5 sec.

Results

Tables 1 and 2 give the results of the experiment. As can be seen from Table 1, a visually presented standard stimulus leads to less FN-errors

Table 1. Mean number of transformed FN-errors for modality conditions and kind of interference.

Modality condition	Unfilled interval	Visual interference	Tactual interference
VV	.13	.20	.22
VT	.29	.26	.35
TV	.34	.40	.41
TT	.61	.45	.51

than a tactually presented standard stimulus, but no other factor seems to have any effect on these errors. The results of an analysis of variance confirmed these interpretations, in that it yielded a significant main effect of standard stimulus modality ($F\ 1/36 = 9.03$, $p < .01$), but no other significant effects. Because the distribution of errors was skewed, the data were transformed according to the formula $x' = \log$ (number of errors + 1) before the analysis (see Winer, 1962).

Table 2. Mean number of transformed FP-errors for modality conditions and kind of interference.

Modality condition	Unfilled interval	Visual interference	Tactual interference
VV	.06	.23	.32
VT	.29	.26	.45
TV	.15	.31	.37
TT	.06	.22	.23

For the FP-errors, see Table 2, we find that the intra-modal conditions lead to less errors than in the cross-modal conditions. The standard stimulus modality by comparison stimulus modality interaction is significant ($F\ 1/36 = 4.53$, $p < .05$) in the analysis of variance for the FP-errors which were transformed in the same way as the FN-errors before the analysis. The pattern of FP-errors, as well as that of FN-errors in this experiment replicates earlier results (Garvill & Molander, 1973; Garvill & Molander, 1975).

In addition to the interaction, the analysis yielded a main effect of interference ($F\ 2/72 = 11.59$, $p < .01$). Newman-Keuls tests showed that the unfilled interval led to less errors than the intervals with interpolated activity, but there was no difference between the two kinds of activity. Thus, the present results show that the interpolated activity led to interference, but the interference did not vary with the modality in which the standard or comparison stimuli were presented.

Discussion

Although the present experiment yielded clear evidence of interference from the interpolated activity, thus replicating the earlier results of Goodnow (1971), the interference effects did not agree with the prediction from the hypothesis of Goodnow, nor with that from the hypothesis of Connolly and Jones (1970). Thus, we found no difference in amount of interference for visually and tactually presented standard stimuli, as would be expected if the memory traces for information acquired tactually were less stable than the memory traces for information acquired visually, nor did we find any interaction between the nature of the interfering activity and the mode of stimulus presentation, as would be expected if there were modality specific storages.

Instead, the result that interpolated activity has the same effects, regardless of whether the information has been acquired visually or tactually, suggests that the information is stored in the same way regardless of how it has been acquired. One possibility here is, of course, that the information is recoded in verbal form, as we have suggested elsewhere (Garvill & Molander, 1968).

The hypothesis of a common form of storage, whatever that form may be, is, however, not sufficient to explain why interference effects are obtained only for FP-errors. This differential effect of interference remains to be explained.

This study was made possible by a grant from the Swedish Council for Social Science Research.

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