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DETECTION OF CUE INTERCORRELATION AND CUE VALIDITIES IN A
MULTIPLE-CUE JUDGMENT TASK WITH A SUPPRESSOR CUE

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DETECTION OF CUE INTERCORRELATION AND CUE VALIDITIES IN
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Armeliu, B., & Armeliu, K. Detection of cue intercorrelation and cue validities in a multiple-cue judgment task with a suppressor cue. Umeå Psychological Reports No. 74, 1973. - The subjects detection of cue intercorrelation, r_{ij} , and cue validities, r_{ei} , was tested after completion of a learning task with three levels of r_{ij} (.00, .40 and .80). The detection was tested by means of reproduction of r_{ij} in one test condition and r_{ei} in another. The reproduced r_{ij} values in the two redundant conditions closely matched the r_{ij} values of the learning tasks. There were, however, no differences among reproduced r_{ij} values which was explained as a positive set in the $r_{ij} = .00$ condition. The reproduced r_{ei} values were generally close to the r_{ei} values of the task with the exception of the non-valid cue for the $r_{ij} = .00$ condition, which was greatly overestimated. The conclusion was that the poor performance in suppressor variable tasks is due to the subjects inability to adjust the weights given to the cues, rather than to poor learning of r_{ij} and r_{ei} .

To perform optimally in multiple-cue probability learning (MCPL) tasks with intercorrelated cues, the subjects must (1) learn the validities for the cues, r_{ei} , (2) learn the intercorrelation between the cues, r_{ij} , and (3) understand how to use the intercorrelation to adjust the weight given to a cue.

Evidence from experiments on single-cue probability learning which study the learning of cue validities in its purest form, indicate that the subjects are able to learn the validities of probabilistic cues. In fact, the validity of the cue is the only factor which affects the subjects utilization of the cue (Brehmer, 1974a). When the subjects have to learn

the validities of a set of cues concurrently, as in a MCPL-task, the cues interfere with each other (Brehmer, 1973a), but there is still a reasonably good correspondence between the validities of the cues and the utilization of the cues, r_{si} . There is, however, a tendency to give too much weight to low validity cues and too little weight to high validity cues (Dudycha & Naylor, 1966; Peterson, Hammond, & Summers, 1965; Uhl, 1966). In general, however, the results from nonredundant MCPL-tasks indicate that the subjects are able to meet the first condition given above. In MCPL-tasks, with intercorrelated cues, no performance measure will show directly whether or not the subjects know the cue validities, since cue-judgment correlations, r_{si} , will be directly influenced by r_{ij} (Schenck & Naylor, 1968) and cue-judgment beta-weights, β_{si} , are determined from both r_{ei} and r_{ij} . It is therefore necessary to obtain independent measures of the subjects' knowledge of cue validities in redundant MCPL-tasks.

Detection of cue intercorrelations has been studied by Knowles, Hammond, Stewart and Summers (1972), by having subjects judge how likely/unlikely they thought a set of orthogonal cue combinations were on the basis of their experience with a learning task with different cue intercorrelations. Their results indicate that the subjects are able to discriminate between positive and negative intercorrelations, but that they have little ability to detect the actual level of intercorrelation. This would suggest that the subjects may not be able to fulfill the second condition given above.

Subjects ability to meet the third condition has been investigated in a few experiments. The results from studies employing suppressor variable tasks, i.e., tasks where one cue is given zero or low correlation with the criterion and receives a negative weight in the regression equation due to r_{ij} (Darlington, 1968), indicate that subjects do not understand the implications of r_{ij} . This is shown by the fact that the subjects utilization of the cues varies with the correlation between the cue and the criterion, r_{ei} , rather than with the cue-criterion beta-weights, β_{ei} (see Armelius & Armelius, 1974; Miller & Sarafino, 1970). When there is no suppressor variable in the task, the opposite results have, however, also been obtained (see Brehmer, 1971, 1973b).

It is not possible to tell whether the subjects' poor performance in the suppressor variable tasks was due to the subjects not having learned r_{ij} and r_{ei} or whether it was due to the subjects inability to adjust the weights given to the cues, since detection of r_{ij} and r_{ei} was never tested.

The purposes of the present study are (a) to test the subjects learning of cue intercorrelations in suppressor variable tasks, and (b) to test the subjects knowledge of cue validities in redundant MCPL-tasks.

Suppressor variable tasks are well suited to investigate whether or not the subjects adjust the weights given to the cues, since the difference between r_{ei} and β_{ei} will be very large in those tasks. Therefore, the subjects must be very accurate in adjusting their weights if the performance should increase above the level expected if the subjects only utilize r_{ei} .

Method

Subjects. Forty-two undergraduate students from the University of Umeå participated in the experiment to fulfill a course requirement. An equal number of subjects were randomly assigned to experimental treatments.

Procedure

Learning phase. Three learning tasks were constructed with different correlations between the two cues, $r_{ij} = .00, .40$ and $.80$. Table 1 gives the task characteristics in detail for all three learning tasks. The actual values differed from the desired theoretical only by sampling error.

On each of the 100 learning trials the subjects observed the two cue values together, gave his prediction of the criterion value, and observed the correct criterion value. The subjects were not informed of the relations in the task. The task and procedure of the learning phase are described in more detail in Armelius and Armelius (1974).

Table 1. Theoretical characteristics of the three learning tasks.

r_{ij}	r_{e1}	r_{e2}	β_{e1}	β_{e2}	R_e	s_1	s_2	s_e	$\bar{x}_1$	$\bar{x}_2$	$\bar{x}_e$
.00	.99	.00	.99	.00	.99	2.5	2.5	2.5	5.0	5.0	5.0
.40	.91	.00	1.08	-.43	.99	2.5	2.5	2.5	5.0	5.0	5.0
.80	.60	.00	1.67	-1.33	1.00	2.5	2.5	2.5	5.0	5.0	5.0

Test phase. After completion of the learning task subjects in each r_{ij} condition group were assigned to one of two test groups. The only difference between the learning and test materials was that no criterion values existed during the test phase since subjects were not given any feedback.

Reproduction of cue intercorrelation. The subjects in this test group (group r_{ij}) were given 50 test trials with presentation of only one of the two cues, every second trial with each cue. When presented the cue value subjects were asked to predict both the value of the cue not presented on that trial and the criterion value. If the subjects had learned the cue intercorrelations during the learning phase, they ought to be able to reproduce them under this test condition. The subjects were told to base their predictions on their experiences during the learning task.

Reproduction of single-cue validities. The subjects in this test-group (group r_{e1}) were given 50 trials with each of the two cues. Each cue was presented on every second trial. When presented the cue value they were asked to predict the criterion value according to what they had learned during the training phase. This was done to see if subjects had learned the single cue validities during the learning phase.

Results

Learning phase. The learning results are described in detail in Armelius and Armelius (1974). The main result was that all performance measures: achievement, r_a , subject consistency, R_s^2 , and the matching index, r_m , decreased with increasing r_{ij} and decreasing r_{ei} . These results are a consequence of the fact that the cue-judgment beta-weights match r_{ei} rather than β_{ei} , i.e. the subjects are not able to utilize the cue intercorrelation to improve their performance. The performance measures for the last learning block (trial 75-100) are shown in Table 2.

Table 2. Achievement, r_a , subject consistency, R_s^2 , matching, r_m , and the cue-judgment beta-weights, β_{s1} , for the last learning block in the different r_{ij} condition groups.

r_{ij}	r_a	R_s^2	r_m	β_{s1}	β_{s2}
.00	.99	1.00	.99	1.00	.01
.40	.85	.71	.92	.82	-.12
.80	.38	.43	.49	.46	-.03

Test phase

Reproduced cue intercorrelation. For each subject in test group r_{ij} , the subjective intercorrelation, r_{ij}' , was computed for each of two blocks of 25 trials and transformed to Fishers' Z for purpose of analysis: A 3 (r_{ij} condition) x 2 (block) ANOVA yielded no significant effects. This means that there were no significant differences among the reproduced cue intercorrelations for the different r_{ij} conditions. The results are shown in Figure 1. As can be seen from the figure the subjects in the $r_{ij} = .40$ and $.80$ conditions closely match the given intercorrelations, but the subjects in the $r_{ij} = .00$ condition clearly overestimate the intercorrelation between cues.

Fig. 1. Reproduced cue intercorrelations, r_{ij} , as a function of cue intercorrelation in the learning task, r_{ij} , and blocks.

Reproduced single cue validities. To see if the subjects had learned the cue validities in the learning task, the cue-judgment correlations, r_{si} , for cue 1 and 2 were computed for each subject and block in test group r_{ei} . These correlations are shown in Figure 2a and 2b respectively. As can be seen in Figure 2a subjects in the .00 condition show a perfect matching of the validity of cue 1, while subjects in both the .40 and .80 conditions underestimate the cue validity. As can be seen in Figure 2b the subjects in the .00 condition greatly overestimate the validity of the suppressor cue. The subjects in the .40 condition show a slight overestimation and the subjects in the .80 condition show a perfect matching of the cue validity.

Fig. 2. Reproduced cue-judgment correlations for cue 1, r_{s1} , (a), and for cue 2, r_{s2} , (b), as a function of cue intercorrelation in the task, r_{ij} , and blocks.

Discussion

One question asked in this experiment is whether the subjects are able to reproduce cue intercorrelations. The results from this experiment do not indicate that the subjects detect the cue intercorrelations in the learning task, since there were no differences among the intercorrelations reproduced by the three r_{ij} condition groups.

There are two possible explanations for these results. One is that none of the groups learned anything of the cue intercorrelation in their learning tasks. As can be seen in Figure 1, all reproduced r_{ij} values fall between .40 and .75. If the subjects in the three r_{ij} condition groups never learned anything about the cue intercorrelation it is reasonable to expect positive subjective intercorrelations since Brehmer (1974b) has shown that subjects have a hierarchy of hypothesis about relations between two scaled variables. The first hypothesis in that hierarchy is that there is a positive linear relation between any two variables. The high positive subjective r_{ij} for the three r_{ij} condition groups might thus be explained as a positive set that was never corrected or unlearned.

The other explanation is that the groups given $r_{ij} = .40$ and $.80$ detected the cue intercorrelation in the learning tasks since the subjects in these groups very closely matched their reproduced r_{ij} values with those given. The conclusion would then be that the only group that did not detect the cue intercorrelation in their learning task was the $r_{ij} = .00$ condition. The subjects in this condition greatly overestimated the r_{ij} value given in the learning task. This overestimation might then be explained as a positive set that never was corrected or unlearned, since the task for the subjects in the $r_{ij} = .00$ condition was so easy that all they had to do was to learn which cue was valid and then use the value of that cue to predict the criterion value since that cue correlated .99 with the criterion. This explanation implies that if a more difficult learning task is used the subjects given $r_{ij} = .00$ will detect the cue intercorrelation. This hypothesis has been supported in a recent study (Armeliu & Armeliu, 1973).

The other question asked was whether subjects are able to reproduce the cue validities given in the task. The answer to that question is that they generally are. For the valid cue, the subjects in the $r_{ij} = .40$ and $.80$ conditions slightly underestimate the cue validity, while the subjects in the $.00$ condition show a perfect learning of the cue validity. For the suppressor cue, the subjects in the $.00$ condition clearly overestimate the validity, the subjects in the $.40$ condition slightly overestimate the validity and the subjects in the $.80$ condition show a perfect matching of the cue validity.

If we accept the second explanation concerning the learning of r_{ij} and look at the results of the two redundant groups we find that they a) correctly reproduced the cue intercorrelation, b) closely matched the cue validities. Clearly, the subjects in these groups learned all the necessary relations of the task in order to reach a perfect achievement. Therefore it seems as if the prime reason for the subjects poor performance in tasks with a suppressor variable is that the subjects do not understand the implications of r_{ij} , i.e., they are not able to meet the third condition.

Even if subjects have detected all the necessary information of a redundant MCPL-task it is difficult to utilize it to achieve optimal performance. The third condition requires subjects to adjust the weight given to a cue depending on the number and validity of other cues present and on the relations that exist between the various cues. This is obviously a very difficult task even for someone who knows exactly how the corrections should be made.

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