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INTERACTION OF CUE SALIENCY, STIMULUS UNITIZATION AND FAMILIARIZATION IN CONCEPT IDENTIFICATION: ATTENTION OR MEMORY PHENOMENON?

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The effects of cue saliency, stimulus unitization and familiarization on the number of errors to criterion in some concept identification tasks were studied. Cue saliency, familiarization, and their interaction had significant effects. Further analysis showed that cue saliency was only effective in the first concept problem (no pretaining was given) with nonunitized stimulus material. The overall effect of cue saliency appeared when the salient dimension was irrelevant as well as when it was relevant, and prediction of second task performance on the basis of the first task performance according to an additivity of cues model failed. These results were interpreted as evidence against the additivity of cues hypothesis and the selective attention view of concept learning. The findings are shown to confirm the hypothesis that information processing during concept learning is principally guided by memory operations.

Most recent theories of concept identification hypothesize that the subject (*S*) solving a concept problem constructs a sample focus containing hypotheses about the correct solution (Neimark & Santa, 1975). Within this framework, one of the main research topics concerns the processes that come into play in the composition of this sample focus. The current models assume either that hypotheses are selected randomly with equal weights (e.g., Simon & Newell, 1974) or that hypotheses are selected according to some system of weights (e.g., Falmagne, 1970; Trabasso & Bower, 1968). Commonly, this system of weights is interpreted as a formalization of an attentional process. This leads to the prediction that *saliency* (perceptual discriminability) of the stimulus dimensions or cues in concept identification tasks should affect performance level.

However, the evidence relative to this prediction is rather confused. For this reason, it seems opportune to list the known facts:

a. problem difficulty (in terms of the number of errors or the number of trials to criterion) increases with the number of irrelevant dimensions

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(Bourne & Dominowski, 1972; Trabasso & Bower, 1968) and decreases with the number of relevant redundant dimensions (Dominowski, 1970; Trabasso & Bower, 1968) as well as with the discriminability (saliency) of the relevant dimension (Bourne & Dominowski, 1972; Kendler, Basden & Bruckner, 1970; Trabasso & Bower, 1968, ch. 6);
b. problem difficulty of a task with dimensions *i* and *j* relevant and redundant is an additive function of the difficulty of a problem with dimension *i* and a problem with dimension *j* relevant (this is the so-called *additivity of cues*: Restle, 1962; Trabasso & Bower, 1966);
c. difficulty of a problem with dimension *i* relevant and dimension *j* irrelevant is an additive function of the difficulty of a problem with dimension *j* relevant and *i* constant and a problem with dimension *j* relevant and *i* irrelevant; however, also interactions of cues have been observed, which suggests restricted validity of this additive relationship (Wickens & Zax, 1973);
d. in the selection paradigm, subjects select dimensions in a systematic order (Millward & Spoehr, 1973);
e. the degree to which a subject experiences the relevant dimension as salient is not related to problem difficulty (Bourne & Dominowski, 1972; Vandierendonck, 1977);
f. there appears to be no relation between problem difficulty and the absolute or relative strength (as in Falmagne's 1970 model) of the relevant dimension as measured by confidence ratings (Vandierendonck, 1977).

A straightforward interpretation of the sample focus is in terms of a list of value-class assignments, e.g., "red is A", held in working memory during the concept task. However, in this kind of conceptualization, processes of hypothesis generation and stimulus encoding are usually left unspecified. To the advantage of the additivity of cues hypothesis it must be pointed out that it attempted to explain the construction of the sample focus as a process of selective attention: The probability of selecting a dimension is assumed to be directly proportional to the (perceptual) discriminability of the values of that dimension occurring in the stimulus material of the concept task. In the Trabasso-Bower model, this prediction has been confirmed at the expense of inconsistent parameter estimates (Trabasso & Bower, 1968, ch. 6). In view of the evidence cited above, this finding casts doubt on the validity of such cue sampling models.

In a series of intriguing investigations, Modigliani (1971; Modigliani & Rizza, 1971) studied the effects of stimulus "boundedness" (whether the components of the stimulus are connected or not) and stimulus transformation (whether all or only part of the components are present in the drawing) on the generality of affirmative conceptual rules. He found that generalization of learned affirmative rules was hampered by both factors and their interaction. Modigliani attributed these effects to a coding process. This is an interesting suggestion, because, if it is true that bounded or unitized stimuli are coded differently from unbounded stimuli, certain consequences for the hypothesis selection process and thus for the composition of the sample focus can be expected. For the present purposes, *unitized stimuli* are considered to have their features grouped "into a single unit so that the simultaneous presence of all (or almost all) the features causes the perception of the higher order unit." (Shiffrin, 1976, p. 196).

Obviously, unitized stimuli have been frequently encountered by the subject, so that he will have rather clear expectations about the probability that a certain feature is critical. If this is true, it may be expected that the discriminability of a particular dimension has little or no effect on the order in which the subject generates and tests hypotheses. Thus, with unitized stimuli, no effects of cue saliency manipulations would be expected.

On the other hand, if stimuli are not unitized, it is assumed that the subject has little or no relevant experience to develop expectations about critical features. In this case, it is expected that discriminability of a particular dimension has clear effects on the order in which the subject generates hypotheses and thus on the performance level in a concept task.

Furthermore, if the above interpretation of unitization coding is correct, it may be expected that the observed cue saliency effect would lessen or even disappear with an increase in experience with the non-unitized stimuli. The same effect is not expected with unitized stimuli, because a further increase of experience cannot bring any gain for the subject.

The present investigation was designed to test these predictions. Therefore, the factors of stimulus unitization, cue saliency and experience with the stimulus material and the task were studied in a factorial design. Some other factors were included to increase experimental control, viz., experimenter and rank order of problems.

METHOD

SUBJECTS

Sixty-four introductory psychology students of the University of Ghent (Belgium) participated in the experiment for course requirements. They were assigned randomly to the cells of the design, and they had never participated in similar experiments before. Fifteen *S*s who did not enter the criterion run by Trial 32 and four *S*s who solved the task with a more complex rule were discarded from the analysis. They were randomly replaced with *S*s from the same population[2].

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[2] According to a chi-square test the discarded subjects were not selectively distributed among the conditions of the experimental design. Analyses of their scores (number of errors to criterion or trial 32) revealed roughly the same pattern of results as those reported for the subjects who were not rejected.

MATERIALS

There were two sets of stimulus cards, one with unitized and one with nonunitized stimuli. Each set consisted of 16 instances which were generated by combining independently four binary dimensions.

In the stimulus unitization condition, the stimuli of the concept tasks consisted of line drawings of houses varying in the following dimensions: size of the window (small or large), smoothness of the ground (smooth or rough), slope of the roof (25° or 45° deviation from the horizontal), and form of the walls (bowed or straight). The top of Fig. 1 shows two complementary instances of this kind of stimulus. In the salient condition the distance of the values on one of these four dimensions was made greater than in the nonsalient condition. For instance, in the salient condition the sizes of the window would be 1 and 6 cm^2, whereas in the nonsalient condition the sizes would be 1 and 3 cm^2.

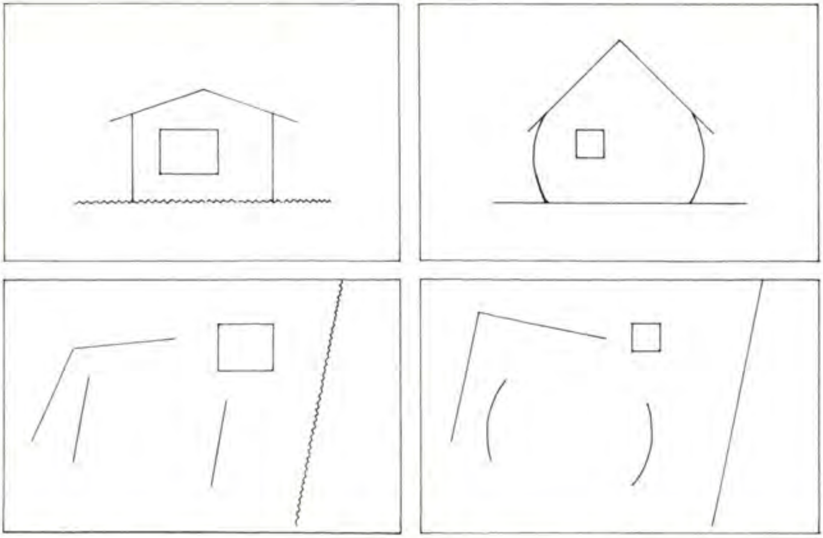

FIG. 1. TWO COMPLEMENTARY INSTANCES OF THE UNITIZED AND NONUNITIZED STIMULUS SETS

In the nonunitized condition, the stimuli consisted of the same line drawings with the components of the unit scrambled to form a meaningless figure, so that, in fact, the stimuli were at the same time unbounded. In all instances, the components were displayed in the same position and orientation. The bottom half of Fig. 1 shows two complementary instances of this nonunitized set. Dimensional saliency was introduced in this set in exactly the same way as in the unitized set.

All stimuli were drawn in blue ink in the center of 9 × 14 cm white index cards, by means of stencils cut from cardboard. The ground was always 9 cm long, the width of the house was 5 cm and the height of the walls was 3 cm. If the roof was rather flat, the height from base to ridge was 4 cm, otherwise it was 5.5 cm. The same stencils were used to draw the stimulus components in the unbounded stimulus set. For convenience of communication, the four stimulus dimensions will be referred to as W (window), G (ground), R (roof) and wa (walls), regardless of the stimulus set (unitized or not) under consideration.

PROCEDURE

Standard instructions (cf. Trabasso & Bower 1968) were read to *S*s in all conditions: they were told that the purpose of the experiment was to investigate how university students learn to make classifications, and that the classification rule they had to learn was a unidimensional one. All four stimulus dimensions were shown and explained to the *S*s. After a brief recapitulation, the experimenter shuffled the cards and presented them one at a time (standard reception procedure). A few seconds after the delivery of feedback information, the card was taken away and another one was presented. When all 16 cards of the set had been shown, the deck of cards was shuffled again and the experiment continued. The task was terminated whenever either the criterion of six consecutive correct trials was met and a correct formulation of the rule was given or the criterion run had not yet started on the 32th trial.

After the first task was finished, immediately a second task with another relevant dimension was started. The same procedure was used, but the instructions were not repeated. After this second concept task, the experiment was finished, *S*s were thanked for their participation and asked to fill in a questionnaire, with questions on the conditions of the experiment, subjective experiences and demand characteristics.

DESIGN

The design was rather complex, which was inevitable since there were three main factors to be studied (saliency, unitization and familiarization). Because *S*s were seen individually, it is quite possible that the correct solution of a concept problem is communicated to fellow students even when instructed not to do so. To avoid this source of bias several problems were included in the research plan. Therefore, the saliency manipulation was replicated on a second dimension, and the salient dimension could be relevant or irrelevant. The simplest possible realization of a plan with all these features appeared to be a Greco-Latin square design.

In Keppel's (1973) notation the basic scheme of the design was $A' \times B' \times (H \times S)$, where the $A' \times B'$ part was a 4 × 4 Greco-Latin Square design consisting of two pseudo factors A' and B'. The H × S part of the design was a repeated measures design. Pseudo factor A' contained four conditions originating from a 2 × 2 combination of the *saliency* (nonsalient vs. salient) and *stimulus unitization* (nonunitized vs. unitized stimulus set) manipulations. Analoguously, pseudo factor B' contained four conditions from a 2 × 2 combination of a salient dimension and a relevant dimension factor. The *salient dimension* factor introduced a replication of the saliency manipulation within the research plan. To obtain this variable, two of the four stimulus dimensions were randomly selected, so that in the salient conditions either dimension W or dimension G was made more discriminable. The simplest case would have been to give any *S* in the W-condition a concept-problem with W as the relevant dimension. In the same way, *S*s in the G-condition would solve a problem with G relevant. However, we intended to check for effects of relevance vs. irrelevance also. This was achieved with the *relevant dimension* factor : half of the *S*s in the W-condition had to solve a problem with W relevant and the other half had a problem with G relevant. Similarly, half of the ss in the G-condition solved a problem with G, the other half a problem with W relevant.

	CD$_{11}$	CD$_{12}$	CD$_{21}$	CD$_{22}$
AB$_{11}$	E1 W – Wa	E2 Wa – G	E3 R – G	E4 W – R
AB$_{12}$	E4 R – W	E3 G – R	E2 G – Wa	E1 Wa – W
AB$_{21}$	E2 W – R	E1 R – G	E4 Wa – G	E3 W – Wa
AB$_{22}$	E3 Wa – W	E4 G – Wa	E1 G – R	E2 R – W

TAB. 1. SCHEMATIC REPRESENTATION OF THE EXPERIMENTAL DESIGN. The symbols A, B, C, D, and E stand for saliency, unitization, salient dimension, relevant dimension and experimenter, respectively. E1, E2, ... indicate the four experimenters. The sequences of concept tasks are listed in the cells of the matrix. The symbols refer to the four possible relevant dimensions : W (window), G (ground), R (roof), and Wa (walls).

Within this A' × B' or A (saliency) × B (unitization) × C (salient dimension) × D (relevant dimension) part of the design, two additional main factors were introduced according to a Greco-Latin Square scheme, viz., the experimenter and the sequences factor. The *experimenter* variable refers to the possible effect of the four experimenters who participated in this investigation. They were not aware of the author's hypotheses. The *sequences* factor refers to four possible sequences of two concept problems which were used. Let d_r stand for the dimension which is relevant in the salient dimension condition, and d_3 and d_4 for the remaining two dimensions (R or Wa), then these sequences are : d_r–d_3, d_3–d_r, d_r–d_4, and d_4–d_r. The Greco-Latin Square was constructed and randomized according to the prescriptions given by Winer (1962).

The H factor in the design is a within *S*s factor which estimates a kind of learning or *familiarization* effect. It expresses the differences between first and second task performance. This difference is free from effects of the between *S*s variables, because their effects are equally distributed among the first and the second problem.

The between *S*s part of the design contains 16 cells, each with four *S*s, who participated in the experiment with the same experimenter and the same sequence of two tasks. Tab. 1 shows a schematic representation of the design.

RESULTS

Analyses of variance on the number of errors to criterion and the trial of the last error yielded the same results. The product-moment correlation coefficient of both variables was 0.93 in the first and 0.83 in the second task. Because of this similarity, only analyses of the number of errors to criterion will be reported here.

GLOBAL ANALYSIS OF VARIANCE

The assumption of homoscedacity of error variance appeared to be strongly violated : $F_{\max}$ (32,3) = 315.79, $p < 0.01$ and C_{Cochran} (32,3) = 0.2461, $p < 0.05$. Moreover, within cell variance displayed the same pattern of relations as the means. Therefore, a logarithmic transformation of the form ln $(T+1)$ was attempted (T refers to the number of errors to criterion). Both tests of homogeneity of error variance proved nonsignificant : $F_{\max}$ (32,3) = 24.40, $p > 0.05$ and C_{Cochran} (32,3) = 0.0849, $p > 0.05$. As this logarithmic transformation appeared satisfactory, all analyses presented in this report are based on it, unless otherwise stated.

The mean number of errors to criterion for all cells of the design are shown in Tab. 2. The analysis of variance showed that problems with a salient dimension were in general easier than those with no salient dimension, F (1,48) = 6.14, $p < 0.05$, $MS_e = 0.4069$. The second problem was on average easier than the first, F (1,48) = 7.56, $p < 0.01$, $MS_e = 0.3303$, and the interaction of these both factors (saliency and familiarization) was also significant, F (1,48) = 7.15, $p < 0.05$, $MS_e = 0.3303$.

The effects of stimulus unitization and its interaction with saliency, on the contrary, were not significant, F (1,48) = 1.20, $p > 0.25$, $MS_e = 0.4069$, and F (1,48) = 1.86, $p > 0.25$, $MS_e = 0.4069$, respectively.

The use of a Greco-Latin Square design seemed acceptable as the residual interaction of A'×'B' was nonsignificant, F (3,48) < 1, $MS_e = 0.4069$. However, experimenter effects fell short from significance, $F(3, 48) = 2.43$, $p < 0.10$, $MS_e = 0.4069$. Since no interactions of the experimenter variable with other variables were detected (residual A'×B' not significant; experimenter × familiarization: $F(3,48) = 1.09$, $p > 0.25$, $MS_e = 0.3303$; and experimenter × saliency × familiarization: $F(3,48) = 1.79$, $p > 0.25$; $MS_e = 0.3303$), this difference between experimenters does not restrict the validity of the main findings.

PREDICTED INTERACTIONS

The predicted interaction of saliency and unitization was not significant (cf. supra). However, the predictions concerned a specific component of the global interaction. An analysis of the simple main effects in the A×B component of the design confirmed the prediction: In the unbounded stimulus set, the effect of saliency was pronounced, $F(1,48) = 7.38$, $p < 0.01$, $MS_e = 0.4069$. In the bounded stimulus set, on the contrary, there was no effect of saliency, $F(1,48) < 1$. The corresponding means are shown in Tab. 3.

	W salient		G salient	
	relevant	irrelevant	relevant	irrelevant
nonsalient				
nonunitized				
1st task	6.75	4.50	7.00	8.50
2nd task	2.50	1.75	2.75	3.25
unitized				
1st task	4.75	8.00	1.75	1.25
2nd task	3.25	1.25	2.25	1.00
salient				
nonunitized				
1st task	1.50	2.00	4.00	1.50
2nd task	2.25	3.00	2.00	1.75
unitized				
1st task	4.00	3.00	1.75	2.25
2nd task	2.25	1.75	3.00	0.75

TAB. 2. MEAN NUMBER OF ERRORS TO CRITERION IN ALL CELLS OF THE DESIGN

In the same way, the interaction of saliency and familiarization was in first order due to the effects of saliency on the performance on the first problem (see also Tab. 3), $F(1, 48) = 11.95$, $p < 0.01$, $MS_e = 0.3303$. Performance on the second problem was not affected by saliency, $F(1, 48) < 1$.

To get a clearer picture, the triple interaction of saliency, unitization and familiarization was analyzed in the same way. There was a nonsignificant tendency for the saliency × unitization interaction to appear on the first problem, $F(1, 48) = 3.19$, $p < 0.10$, $MS_e = 0.3303$, but not on the second problem, $F(1,48) < 1$. In general, however, saliency operated almost exclusively on the first task of the nonunitized stimulus condition, $F\ (1,\ 48) = 13.64$, $p < 0.001$, $MS_e = 0.3303$. In the other conditions, saliency had no effects (first problem of the unitized stimulus set, $F\ (1,\ 48) = 1.43$, $p < 0.25$; second problem of nonunitized set, $F\ (1,\ 48) < 1$; and second problem of unitized stimulus set, $F\ (1,\ 48) < 1$).

	nonsalient	salient	total
first task			
nonunitized	6.69	2.25	4.47
unitized	3.94	2.75	3.34
total	5.31	2.50	3.91
second task			
nonunitized	2.56	2.25	2.41
unitized	1.94	1.94	1.94
total	2.25	2.09	2.17
both tasks			
nonunitized	4.63	2.25	3.44
unitized	2.94	2.34	2.64
total	3.78	2.30	3.04

TAB. 3. MEAN ERRORS TO CRITERION AS A FUNCTION OF SALIENCY, UNITIZATION AND FAMILIARIZATION

PREDICTABILITY OF SECOND PROBLEM PERFORMANCE

Considering only the nonsalient condition, the four different problems (W, G, R or wa relevant) of the present study were attempted each by eight *S*s. On the basis of these rather restricted data, we tried to estimate attentional values (a_i) for each of the four dimensions. These attentional weights are defined by Trabasso and Bower (1968) as

$$a_i = w_i/(\Sigma_j\ w_j),$$

where w_i is the weight of dimension i. These a_i values may be interpreted as the probability that attention is paid to the dimension. Trabasso and Bower (1968) have shown that the basic axioms of their model imply that the expected number of errors to criterion in a concept identification problem is inversely related to the attentional weight of the relevant dimension :

$$\mathrm{E}(T) = 1/a_i, \text{ if i is relevant.}$$

Hence, given the average number of errors to criterion ($\bar{T}$), it is possible to estimate the attentional weight of dimension i, if it is relevant, by means of the equation : $\hat{a}_i = 1/\bar{T}$. Application of this estimation procedure produced the following a_i values for dimensions W, G, R, and wa, respectively : 0.13, 0.21, 0.17 and 0.35. An error fraction of 0.14 remained.

Some additional assumptions were introduced to predict the performance on the second problem : a. *S* eliminates the dimension which was relevant in the first problem from the hypothesis pool, so that it cannot be sampled, and b. *S* has learned to concentrate attention on the remaining three dimensions (familiarization effect), so that the error fraction obtained in the estimation has disappeared. The predictions were made for each of the eight different sequences (four with $d_r = \text{W}$ and four with $d_r = \text{G}$). A Wilcoxon matched pairs signed ranks test (cf., Siegel 1956) on the eight predictions (one for every sequence) yielded $T_{\text{Wilcoxon}} = 1$, $p < 0.01$. The Spearman rank correlation coefficient between predicted and observed values was 0.20, $t\,(6) = 0.548$, $p > 0.25$.

Neither the predicted magnitude, nor the predicted order of problem difficulty of the second problem is very close to the observed data. Two interpretations come immediately to mind : either the number of observations is too small, or the Trabasso-Bower model is not acceptable as a conceptualization of the processes underlying concept identification. Although the number of observations per sequence is rather small, the deviation of predicted and observed values is obvious. Moreover, inspection of other parts of the data reveals that the saliency manipulation has rather generalized effects, which is also at variance with the Trabasso-Bower model : Increase of the saliency of dimension *i* should, according to the model, lead to a decrease in performance on a problem with another dimension relevant. The data displayed in Tab. 2 do not confirm this prediction : As the saliency of dimension W is increased, there appears a rise in performance when W is relevant, but also when W is irrelevant. The same pattern of results holds for the saliency manipulation on G.

The failure of the assumption of additivity of cues is further stressed by the finding that an increase of the saliency of a dimension facilitates concept attainment irrespective of the relevance of this dimension. According to the assumption, an increase of the saliency of dimension *i*, is expressed as an increase of the attentional weight, a_i, of that dimension. This leads to a decrease of the other a values. Consequently, according to the model, the saliency manipulation on dimension *i* should facilitate concept attainment if and only if dimension *i* is relevant, and should hamper learning if any other dimension is relevant. In the present study, 64 of the solved problems were in the nonsalient conditions, 16 were in conditions with the *salient dimension relevant*, and 48 in conditions with the *salient dimension irrelevant*. So, either the difference between salient and nonsalient conditions should have not attained significance, or the effect should have been in the opposite direction, with nonsalient problems solved faster than salient problems. The rather strong saliency effect obtained clearly contradicts the additivity of cues hypothesis.

DISCUSSION

By way of summary, we observed strong effects of saliency and familiarization, but not of stimulus unitization. However, the saliency manipulation was only effective with nonunitized stimuli on the first concept problem. These results confirm our predictions on the effects of these variables. It could be argued, however, that the nearly significant experimenter effect casts doubt on the validity of the findings. Surely, it is not surprising to observe an experimenter effect, because even in strictly standardized situations, there is some room for unintended influences (cf. Rosenthal, 1964). Still, even if the experimenter effect in the present study were beyond doubt, it would do no harm to the validity of the findings, because the variables of interest do *not interact* with the experimenter variable. In other words, the subject's performance level in a concept task is affected by the particular experimenter, but the effects of the experimental variables seem to be similar for the different experimenters.

The results of the present study, then, seem to be concordant with our hypothesis that saliency is only effective if the subject lacks experience with the stimulus material. No saliency effect was obtained with bounded stimuli, which, in the present experiment, were drawings of familiar objects, viz., houses. Likewise, saliency had no effect when subjects had already solved a problem with the stimulus material, even when the stimuli were unbounded.

These findings posit a problem for the attentional interpretation of concept learning and discrimination learning. If it is true that the saliency manipulation results in a change of the attentional weight of a cue, why, then, is this manipulation only effective with unbounded stimuli in a first concept task? Do these weights change as a result of learning a particular concept? If they do, what kind of learning process is involved? Furthermore, is there any reason to assume that these weights exist or are created in the presence of unbounded but not in the presence of bounded stimuli? For sure, one can argue that what the subject considers to be a dimension is a subjective matter, and depends on a kind of encoding process. The weights can then be assigned to the results of this encoding process. It is easily imagined that unbounded stimuli are initially coded as they appear, whereas coding of bounded stimuli depends on experience with similar stimuli. However, in concept learning tasks, the experimental situation is such that the dimensions of variation are given by the experimenter (instructions), so that it is not clear how such a difference in interpretation of the stimuli on the side of the subject may arise, unless the familiarity of the stimuli is important.

These considerations, together with the finding that the additivity of cues hypothesis does not agree with the data, lead to serious doubts about the classical attentional interpretation of concept learning. Of course, this does not mean that attentional processes are absent in concept learning. On the contrary, we still believe that attention is an important determinant of conceptual learning. Data from the post experimental questionnaire suggest this. Subjects were asked whether they had needed great efforts to solve the problems. In general, it appeared that the effort was rather large, and it did not differ among experimental conditions (F (15,48) $<$ 1). It is evident that the kind of attentional process which is here referred to, relates to what is often called "*intensive attention*" (e.g., Berlyne, 1970).

Whether selective attentional responses are really important processes in concept learning is a matter of debate. For one thing, it depends on what is meant by "selective attentional response". As suggested above, it may be a kind of selection process among the results of stimulus encoding. That this selection is of an attentional nature is then supposed to mean that certain perceptual characteristics of the stimulus possess distinguishing features to form the basis of this selection. However, as already mentioned, a problem for such a conceptualization is that an increase in the discriminability of a particular dimension is only effective for certain kinds of stimuli, c.q., unbounded stimuli. Therefore, it appears more plausible to assume that the selection process is based on information available from memory. It is then assumed a. that encoding of the stimulus takes place on the basis of data in the long-term memory system; and b. that on the basis of certain retrieval processes, such as the activation of similar material, expectations are developed which are used to *guide* the selective responses. Clearly, selective responses so defined are no longer perceptual-attentional in nature, but based on *memory processes*. Still, saliency is supposed to affect attentional processes when the information available from memory is *insufficient* to guide the selection process. This would for example be the case with nonunitized stimuli.

Another advantage of the conceptualization in terms of memory-guided selective responses, is that the discriminability manipulation results in a facilitation of coding processes, so that, even if the more discriminable dimension is irrelevant, the information processing necessary during problem solving is facilitated, but less than when the salient dimension is relevant. This seems to agree with our findings, although the present data do not permit such conclusions to be drawn unequivocally. Future research may settle this issue.

An implication of these assumptions is that the saliency manipulations should have an effect on memory for stimulus instances. If it is true that the salient feature is more easily encoded, more time would be left for the encoding of the other features and the chances for the instance of being remembered would increase.

Although the present findings show that saliency effects are restricted to certain conditions, viz., a first problem with unbounded stimuli, the question arises as to which conditions are limiting the effectiveness of saliency. In the light of the previous discussion, it is probable that the limiting conditions depend on whether a particular set of stimuli activate memory so that information is obtained to guide hypothesis selection. Surely, more research will be needed to clarify which conditions are operative. In any case, it may be expected that even with bounded stimuli which are unfamiliar, the saliency manipulation would have effect. Likewise, with unbounded familiar stimuli, increase of discriminability of a dimension would hardly have any effect, unless the attentional interpretation of selective responses still holds.

All these implications of the currently developed thesis that hypothesis selection in concept learning depends on memory processes need empirical support. For sure, current research and theories of memory support these ideas indirectly, but more direct evidence is badly needed. Furthermore, our theory of memory-guided hypothesis selection in concept attainment accounts for all the findings obtained in the present experiment and for the data available on saliency. This is clearly not the case for the attentional theory.

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