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Number of Memory Representations in Perceptual Concepts

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Three reaction time (RT) experiments using a modified Sternberg procedure were conducted to determine the number of memory representations maintained for perceptual (dot-pattern) concepts. The difference in RT to test stimuli from memory sets of different sizes was used to infer whether one, or more than one, memory representation was utilized for the perceptual concepts. It was concluded that multiple specific representations are utilized in early stages of experience with stimuli but that a single generic representation serves to represent the concept information after moderate amounts of experience.

One of the current issues in research on visual pattern recognition and perceptual concept learning concerns the number and type of memory representations that are established and maintained to represent perceptual concepts (e.g., Charness & Bregman, 1973; Peterson, Meagher, Chait, & Gillie, 1973; Posner & Keele, 1968; 1970; Reitman & Bower, 1973; Strange, Keeney, Kessel, & Jenkins, 1970). The three panels of Figure 1 illustrate three major possibilities that have been proposed for the form of the memory representations within a single concept. Alternative a indicates that only representations of the specific experienced exemplars might be stored in memory. Alternative b reflects the possibility that after experiencing several exemplars from a particular concept a single generic memory representation is developed or constructed that serves to represent the entire concept.

It should be emphasized that the distinction between Alternatives a and b in Figure 1 is based primarily on the issue of whether concepts have only one, or have more than one, representation in memory. The single representation, referred to here as the generic representation, may be either the prototype of the concept, an attribute frequency compilation, a single "best" exemplar, or something else. The important characteristic is that in this alternative the concept has only a single representation in memory. The multiple representations of Alternative a are presumably individual memory representations of each exemplar from the concept that have been presented to the subject.

The third panel of Figure 1, Alternative c, illustrates the possibility that both of the alternatives discussed above are correct. That is, upon experiencing several exemplars from a concept the subject might have stored both representations of specific exemplars as illustrated in Alternative a and a generic representation characteristic of the concepts as a whole, as illustrated in Alternative b.

The three experiments in the current article were designed to distinguish between Alternatives a and b of Figure 1. The technique used to assess the number of concept representations maintained in memory was based on the well-documented empirical result that for conceptually distinct stimuli such as letters and digits the reaction time (RT) to decide whether a test stimulus is one that had been presented before is positively related to the number of stimuli in the earlier presented memory set. Although this result has been the source of a great deal of theoretical speculation and its precise interpretation is still a source of great contro-

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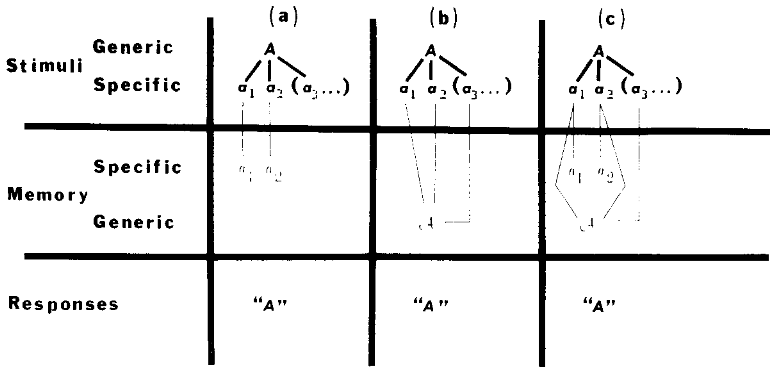

Figure 1. Three possibilities for the form of the memory representations for perceptual concepts.

versy (e.g., Sternberg, 1974), the general finding of increased RT with increased set size is sufficiently robust to allow its use as a tool for investigating the number of representations maintained in memory. Specifically, the procedure of these experiments involved contrasting the difference in RT between memory sets of two sizes for letter stimuli, which are conceptually distinct, to the difference in RT between memory sets of two sizes for dot-pattern stimuli, in which all of the items in a particular memory set were from the same concept.

The logic of the comparison is that if there is a difference in RT between the large and the small memory sets with the letter stimuli but no difference with the dot-pattern stimuli, then one could infer that the memory representations for the dot-pattern concepts are independent of the number of exemplars and therefore are probably unitary. On the other hand, if there is no interaction of stimuli with set size, and both the letter and the dot-pattern stimuli result in greater RTs with increased set size, then one could infer that there are multiple specific representations for each dot-pattern concept.

Experiment 1

Method

Subjects. Five college students of both sexes participated in four sessions of approximately 90 min. each. All subjects were tested individually.

Stimuli and apparatus. The dot-pattern stimuli were very similar to those described in earlier studies (e.g., Peterson et al., 1973; Posner, Goldsmith, & Welton, 1967) and consisted of nine 3.7-bit distortions of four prototype patterns of nine dots each. Photographic slides were made of each pattern, with black lines around the outer borders to indicate the effective boundaries of the pattern. Photographic slides were also made of the 20 consonants of the alphabet in their uppercase forms.

The slide stimuli used for the memory set stimuli were arranged in blocks of two or six in a Kodak Carousel slide projector under the control of the subject. The slide stimuli used as the test probe stimuli were arranged in a tray in front of the experimenter for easy placement into another slide projector that was connected to an arrangement of timers and clocks. This second slide projector was controlled by a timer that initiated an RT clock, accurate to the nearest millisecond. The RT clock was stopped by a response of the subject on one of the two response keys located in a panel in front of him. The left key was to be pressed if the test slide was not one of those seen in the memory set, and it was consequently labeled *different,* whereas the right key was to be pressed if the test slide was one of those seen in the memory set, and thus it was labeled *same.*

The test probe stimuli were arranged such that one half of the trials, selected randomly, should result in a positive (same) response and one half in a negative (different) response. As nearly as possible in the number of trials available, all stimuli within each memory set were presented equally often.

The procedure with the dot-pattern stimuli was different from that with the letter stimuli in three respects. First, all of the dot-pattern stimuli within the same memory set were related, since they were all exemplars from the same concept. The letter stimuli within the memory sets had no internal relationship. Second, the rule governing a positive (same) response for the dot-pattern stimuli was altered to include any stimulus (exemplar) from the same concept as that presented in the memory set and not just the particular exemplars actually presented. And third, one half

Table 1
Error Rates Across Set Sizes and Stimuli

Experiment and set size	Letters (%)	Dot patterns (%)
1		
2	1.4	4.9
6	2.7	3.3
2		
1	3.4	4.9
4	7.6	11.7
3		
2	6.8	12.0
4	5.5	13.0

of the trials requiring a positive response involved new exemplars from the same concepts presented in the memory set, and one half of the positive trials involved old exemplars that had been presented in the memory set.

Procedure. Within each session the subject received either the dot-pattern stimuli or the letter stimuli for two blocks of 72 RT trials. A trial consisted of the following events: (a) The experimenter instructed the subject to advance the slide projector the proper number of slides; (b) the subject inspected each memory set slide for as long as desired; (c) the subject informed the experimenter that he was ready for the test slide; (d) the experimenter presented the test slide for 1 sec; (e) the subject responded; and (f) the experimenter gave the subject time and accuracy feedback. The subject received one set of stimuli with Set Size 2 (or 6) on the first trial, a second set of memory stimuli with Set Size 6 (or 2) on the second trial, a third set of memory stimuli with Set Size 2 (or 6) on the third trial, and a fourth set of memory stimuli with Set Size 6 (or 2) on the fourth trial. After the fourth trial the sequence of memory stimuli was repeated in the reverse order, and this alternation process continued for nine cycles to reach 72 trials.

No two subjects were treated in exactly the same fashion in this experiment. Three subjects received the letter stimuli on the first and fourth sessions and the dot-pattern stimuli on the second and third sessions, and the other two subjects received the stimuli in the reverse order. Three subjects started the sequence of trials with a two-item memory set trial and two started it with a six-item memory set trial. And finally, three subjects received a particular dot-pattern concept or group of letters as a two-item memory set, whereas the other two subjects received that dot-pattern concept or that group of letters along with other additional letters as a six-item memory set. Whichever set size was assigned to a particular dot-pattern concept or group of letters for a subject remained unchanged throughout all experimental trials for that subject.

Results

Both latency and accuracy information were obtained on every trial. The error data, which are summarized in Table 1, mirrored the RT data in nearly all respects (i.e., errors increased as RT increased and vice versa) and will not be discussed further.

The RT data (from all trials and not just from correct trials) were subjected to several analyses. The first was based on the mean RTs for clusters of 18 trials each. These data were entered into an analysis of variance with subjects (five levels), stimuli (dot patterns or letters), set size (two or six), and practice (eight levels) as factors. The error term in this analysis was the mean squares of the four-way interaction of Subjects × Stimuli × Set Size × Practice ($MS_e = 3{,}823.02$). The following effects were found to be statistically significant: subjects, $F(4, 28) = 187.66$, $p < .0001$; stimuli, $F(1, 28) = 452.50$, $p < .0001$; set size, $F(1, 28) = 43.82$, $p < .0001$; practice, $F(7, 28) = 17.77$, $p < .0001$. The patterns of the main effects as well as the interactions can be seen illustrated in Figure 2. Note that letter stimuli were responded to more rapidly than dot-pattern stimuli, that two-item memory set stimuli were responded to more rapidly than six-item memory set stimuli, and that there was a reduction in RT with increased practice. Perhaps the most interesting result, however, is the interaction of stimuli with set size, indicating that the dot-pattern stimuli do not exhibit the trend evident in the letter stimuli for RT to be slower with increased memory set size. Also of interest is the interaction of stimuli with practice, which indicates that the dot-pattern stimuli exhibit greater reductions in RT with increased practice than the letter stimuli. It is worth noting, however, that even in the last data point the RT to the dot-pattern stimuli is not at the level of the RT to the letter stimuli.

Another interesting feature of the data illustrated in Figure 2 is that the RTs to the letter stimuli replicate almost exactly the findings of Sternberg and others using the paradigm he developed (e.g., Sternberg, 1974). For example, the average difference

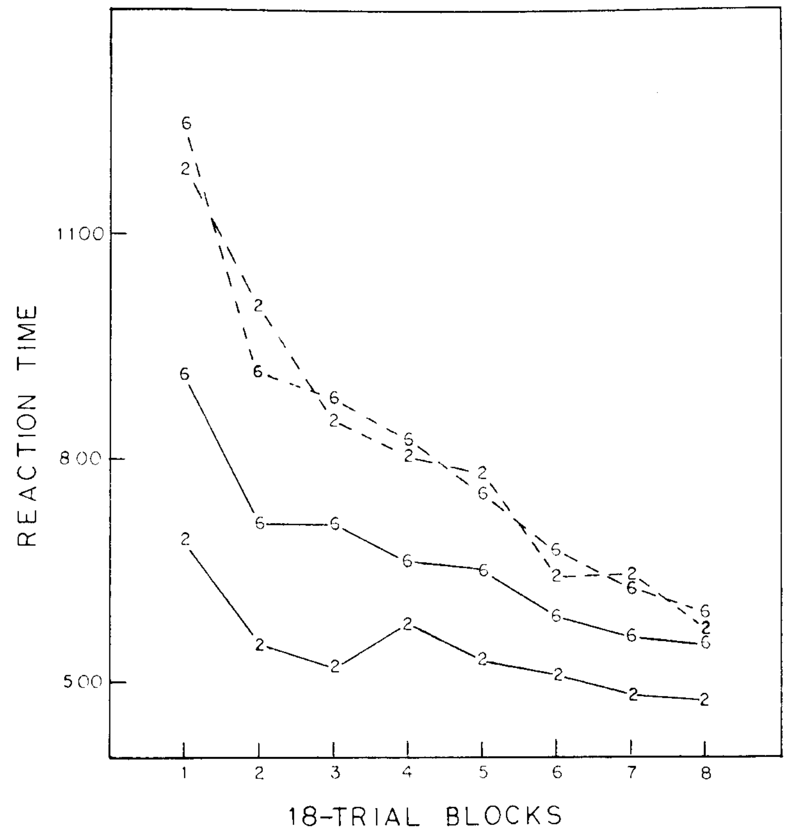

Figure 2. Reaction time as a function of memory set size and practice for dot-pattern stimuli (dotted lines) and letter stimuli (solid lines), Experiment 1.

between the six-item RT and the two-item RT is 127 msec, a value that leads to an estimate of 32 msec per item in the memory comparison phase of Sternberg's model. Other estimates of this parameter have typically ranged from 30 msec per item to 45 msec per item (e.g., Sternberg, 1974). Also consistent with many previous results is the finding that the difference between the two set sizes was nearly identical for positive (658 vs. 534 msec) and negative (683 vs. 567 msec) responses.

Although the Stimuli × Set Size × Practice interaction was not statistically significant, $F(7, 28) = 1.51$, $p > .05$, the first data point in Figure 2 suggests that the Stimuli × Set Size interaction might not be evident at the very early stages of practice. To test this possibility, the data from the first 18-trial cluster were segmented into nine two-trial groups, and an analysis of variance similar to that described above was conducted on these data. Note that since there were two sets of stimuli with each set size, this segmentation of the data results in each two-trial group representing RT performance on each successive experience with the concepts. In other words, tht RTs are averaged only across the two different sets of stimuli with the same set size and not across successive experiences with the same stimulus sets.

The results of this second analysis of variance with the four-way interaction as the error term ($MS_e = 126{,}710.49$) were as follows: statistically significant effects of subjects, $F(4, 32) = 24.05$, $p < .0001$; stimuli, $F(1, 32) = 99.74$, $p < .0001$; and practice, $F(8, 32) = 3.45$, $p < .01$; but no effect of set size or of any interactions among stimuli, set size, or practice. The lack of a main effect of set size or of an interaction of set size with stimuli, even though these factors were statistically significant in the analysis of the complete set of data, suggests either that the determinants of these effects are not effective early in practice or that the variability was so great as to preclude their detection.

A third analysis was based only on the data from the positive trials with the dot-pattern stimuli to determine whether there were any differences in RT to old exemplars and new exemplars from the learned concepts. Mean RTs were computed for the old exemplars and the new exemplars for each block of 18 trials, and these values entered into an analysis of variance with subjects (five levels), exemplar type (old or new), set size (two or six), and practice (eight levels) as factors. As in the earlier analyses, the four-way interaction term was used as the error term for all comparisons ($MS_e =$ 13,050.22). The following effects proved to be statistically significant: subjects, $F(4, 28) = 152.93$, $p < .0001$; exemplar type, $F(1, 28) = 11.56$, $p < .005$; and practice, $F(7, 28) = 56.56$, $p < .0001$. Neither the main effect of set size nor any of the interactions among exemplar type, set size, and practice were significant. The direction of the exemplar effect was for new exemplars to have longer RTs than old exemplars (i.e., 812 vs. 751 msec).

Discussion

The major result from this experiment is the interaction between stimulus type and set size. Increasing the memory set size from two to six results in a large increase in RT for the letter stimuli (i.e., 541 to 668 msec) but almost no increase for the dot-pattern stimuli (i.e., 811 to 814 msec). According to the argument proposed earlier, this result may be taken as evidence that the number of memory representations maintained for a dot-pattern concept is not related to the number of exemplars presented from that concept. It is therefore reasonable to infer that a single generic representation serves as the memory representation for perceptual concepts.

Whether the form of the memory representations evolves from multiple specific representations to a single generic representation with increased experience is difficult to assess from these data. The greater RT with the six-item set size than with the two-item set size in the first data point with the dot-pattern stimuli is consistent with such an evolution. However, the statistical results lead to somewhat contradictory conclusions. On the one hand, in the analysis of all of the data the Stimuli × Set Size interaction was statistically significant and the Stimuli × Set Size × Practice interaction was not, thus suggesting that the same Stimuli × Set Size interaction pattern existed through all stages of practice. On the other hand, the Stimuli × Set Size interaction was not significant in the analysis of the data from only the first 18 trials, thereby indicating that the Stimuli × Set Size interaction was not evident in the earliest stages of practice. Unfortunately, interpretations of these findings are hampered by a relatively large degree of variability at the earliest stages of practice. In an attempt to obtain more precise estimates of the effects early in practice, another experiment was designed with a larger number of subjects.

Experiment 2

The purpose of this experiment was the same as that of Experiment 1, that is, to determine the number of memory representations maintained for perceptual concepts, but with a concentration on the subject's initial 12 experiences with the stimuli. To simplify the task and reduce the time necessary to complete it, the set sizes were reduced from six and two to four and one.

Method

Subjects. Sixteen college students of both sexes participated in a single session of approximately 45 min. All subjects were tested individually; none had participated in the earlier experiment.

Stimuli and apparatus. The stimuli and apparatus were identical to that used in Experiment 1.

Procedure. All of the procedural details were identical to those described in Experiment 1, with the following exceptions: (a) The rule for positive responses was the same for both letter and dot-pattern stimuli (i.e., respond with the key labeled *same* if the test slide was the same as one of those presented in the memory set); (b) no new exemplars were presented with the dot-pattern stimuli (i.e., all positive trial stimuli were old exemplars); (c) the set sizes were four items and one item; and (d) the trials were arranged in a single block of 48 trials.

One half of the subjects received the letter stimuli as the first stimuli in the session and one half received them as the second. Furthermore, one half of the subjects received a particular dot-pattern concept as a one-item memory set and one half received it as a four-item memory set. All subjects received the same groups of letters as one-item and four-item memory sets.

Results

As in the previous experiment, both accuracy and latency information were recorded, but only the latency data will be discussed because the pattern of errors, summarized in Table 1, was very similar to the pattern of RTs.

The mean RTs were determined for each two-trial group, representing each successive experience with a particular stimulus set, and these means were analyzed in an analysis of variance with subjects (16 levels), stimuli (dot patterns or letters), set size (one or four), and practice (12 levels) as factors. The error term for this analysis was the pooled residual error after the extraction of all main effects and all interactions not involving subjects ($MS_e =$ 76,812.18). The results of the analysis were that all four main effects were statistically significant: subjects, $F(15, 706) = 25.7$, $p < .0001$; stimuli, $F(1, 705) = 629.88$, $p < .0001$; set size, $F(1, 705) = 80.11$, $p < .0001$; and practice, $F(11, 705) = 16.85$, $p < .0001$. The Stimuli × Practice interaction was also significant, $F(11, 705) = 4.77$, $p < .0001$, but no other interactions among stimuli, set size, or practice were significant. The general patterns of results can be seen illustrated in Figure 3.

Separate analyses of variance on the letter and dot-pattern stimuli with set size (one and four) and response type (positive and negative) as factors yielded nearly identical results. The effect of set size was significant for letters, $F(1, 45) = 95.97$, $p < .0001$ ($MS_e = 4{,}375.53$), and for dot patterns, $F(1, 45) = 20.93$, $p < .0001$ ($MS_e =$ 29,415.48), but neither the factor of response type nor the interaction of response type with set size was significant for either set of stimuli.

Discussion

The results of this experiment provide no evidence that only a single generic representation was utilized as the memory representation for perceptual concepts at very early stages of experience with the stimuli. The RT to the four-item memory set was substantially greater than the RT to the one-item memory set for both the letter stimuli (i.e., 752 vs. 590 msec) and the dot-pattern stimuli (i.e., 1,272 vs. 1,076 msec). Moreover, this set size effect was statistically significant with both sets of stimuli and evidently held for positive and negative responses, since the Set Size × Response Type interaction was not significant. The inference from the arguments presented earlier is that, at this early stage in practice, separate memory representations are maintained and established for each exemplar from the dot-pattern concepts.

Before completely accepting this conclusion, however, it might be prudent to consider whether the use of a single-item memory set could have led to some misleading results. With only a single memory set item, there is no need to integrate, assemble, or compile a generic representation, and thus the decisions in the one-item memory set trials might have been based on a memorial representation that differed qualitatively, rather than quantitatively, from the memorial representations utilized in the four-item memory set trials. As a test of this possibility, another experiment was designed with different set sizes.

Experiment 3

This experiment was identical to Experiment 2 except that the memory set sizes were two items and four items rather than one item and four items.

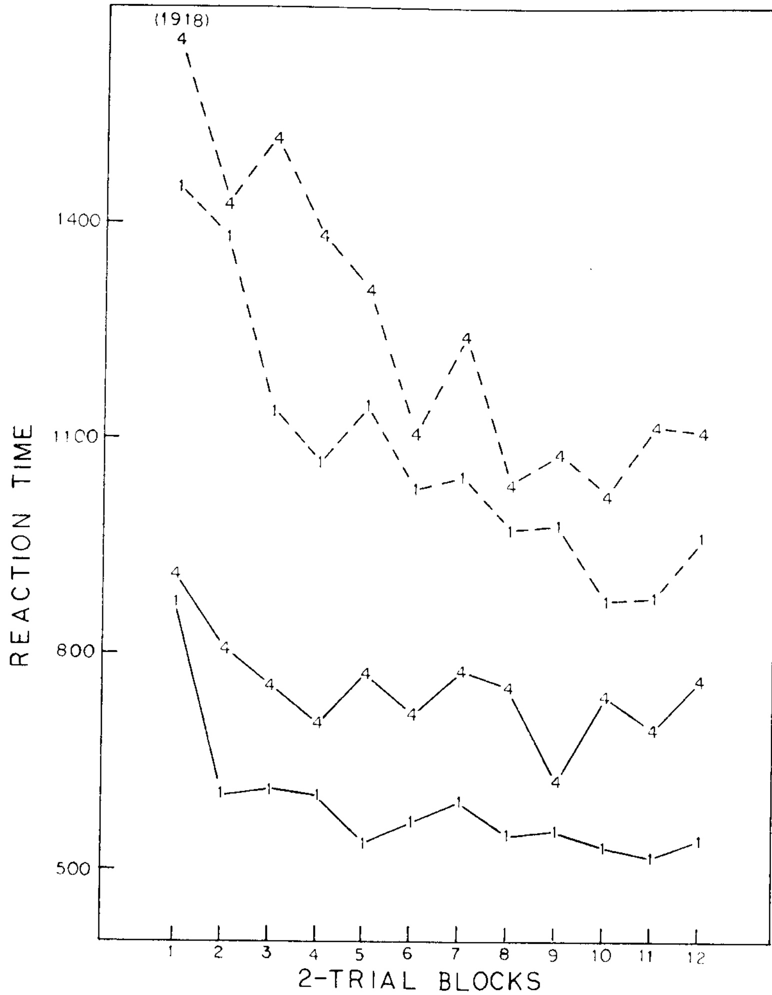

Figure 3. Reaction time as a function of memory set size and practice for dot-pattern stimuli (dotted lines) and letter stimuli (solid lines), Experiment 2.

Method

Subjects. Sixteen college students of both sexes participated in a single session of approximately 45 min. All subjects were tested individually; none had participated in any earlier experiments of this series.

Stimuli and apparatus. The stimuli and apparatus were identical to that used in Experiments 1 and 2.

Procedure. The procedure was identical to that of Experiment 2 with the exception that the two memory set sizes were four and two.

Results

As in the earlier experiments, both errors and RT were recorded, but only the RT data will be discussed because the trends in the error data were generally similar to those evident in the RT data. The mean error rates are displayed in Table 1.

The mean RTs for each two-trial group were analyzed in a four-factor (i.e., subjects, stimuli, set size, and practice) analysis of variance with all interactions with subjects pooled as the error term ($MS_e = 49{,}775.56$). The results of this analysis were identical to those obtained in the previous experiment: statistically significant effects of subjects, $F(15, 705) = 22.18$, $p < .0001$; stimuli, $F(1, 705) = 512.33$, $p < .0001$; set size, $F(1, 705) = 21.37$, $p < .0001$; practice, $F(11, 705) = 10.07$, $p < .0001$; and the Stimuli × Practice interaction, $F(11, 705) = 5.36$, $p < .0001$. Again, the interaction of stimuli with set size was not significant nor were any other interactions. However, the set size factor was a significant source of variance in separate analyses on the letter stimuli, $F(1, 45) = 41.59$, $p < .0001$ ($MS_e = 3{,}173.03$), and the dot-pattern stimuli, $F(1, 45) = 6.43$, $p < .02$ ($MS_e = 11{,}376.32$). As before, neither the factor of response type (positive or negative) nor the Response Type × Set Size interaction was significant with either set of stimuli. The general pattern of results can be seen illustrated in Figure 4.

Discussion

The results of this experiment rule out the possibility that the use of a one-item memory set in Experiment 2 contributed to an artifactual pattern of results. The greater RT to trials with larger memory set sizes was found for both letter stimuli (i.e., 707 vs. 616 msec) and dot-pattern stimuli (i.e.,

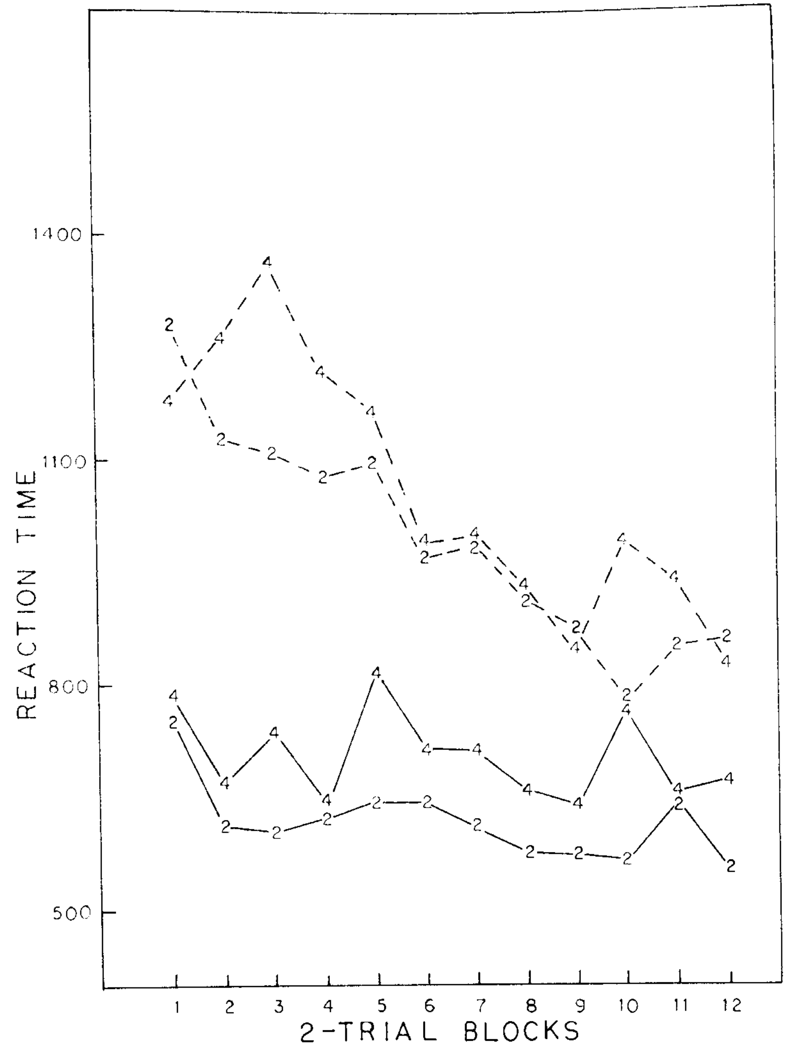

Figure 4. Reaction time as a function of memory set size and practice for dot-pattern stimuli (dotted lines) and letter stimuli (solid lines), Experiment 3.

1,058 vs. 993 msec) in the current experiment with set sizes of four and two, just as was found in the previous experiment with set sizes of four and one. Evidently, separate memory representations are established for each exemplar from the concept in the earliest stages of experience with the dot-pattern stimuli.

General Discussion

The overall conclusion from Experiments 1, 2, and 3 is that the nature of the memorial representations for perceptual concepts changes with increased experience. In the initial stages of practice, the dot-pattern concepts are apparently represented in memory by multiple specific exemplars, as illustrated in Figure 1a, but later, after a moderate amount of experience with the stimuli, a single generic representation serves as the concept memory representation, as illustrated in Figure 1b.

The conclusion that a single generic representation is utilized after some experience with the stimuli is based on the Experiment 1 result of an absence of any difference in RT between set sizes of six and two for the dot-pattern stimuli, whereas quite large differences were evident for the letter stimuli. The inference that multiple specific representations exist at early stages of experience with the stimuli is based on the similar pattern of larger set sizes leading to longer RTs for both dot patterns and letters in the first 18 to 24 trials of each experiment.

It is reassuring to note that the similar pattern of results at early stages of experience among the three experiments suggests that the procedural differences among experiments were relatively unimportant. For example, the particular set sizes used in the experiments are apparently not critical, nor is the rule by which positive responses for the dot patterns are defined. Additional support for the latter inference is the congruent set of results (as evidenced by the absence of statistical interactions among exemplar type, set size, and practice) for new and old exemplars in Experiment 1.

It is conceivable that the mechanism by which RT was increased with an increase in set size was different for letter stimuli and dot-pattern stimuli. For example, while increasing the number of items in the memory set might increase the number of memory representations for conceptually unrelated stimuli such as letters, it might merely increase the complexity of a single representation or change the nature of the decision process for conceptually related stimuli as dot patterns. From the perspective of changes with experience, however, these alternative explanations appear to be equivalent to the interpretation favored here. In all cases it is possible to make a distinction between the quantity or the quality of the memory representations or the decision process based upon them early in practice, but it becomes impossible to make such a distinction later in practice. Therefore, although it might be possible to challenge the specific inference that the number of memory representations for a concept is reduced with increased experience, the general conclusion that something associated with the concept *memory representation* changes with increased experience appears indisputable.

Little has been mentioned thus far of the third alternative in Figure 1—reflecting the possibility that both a single generic representation and multiple specific representations might be maintained in memory concurrently. The result that new exemplars are responded to less rapidly than old exemplars in Experiment 1 might be considered to be support for this alternative, since similar results have been interpreted by other authors as indicating that some specific information is stored from each exemplar (e.g., Homa, Cross, Cornell, Goldman, & Shwartz, 1973; Peterson et al., 1973; Posner & Keele, 1968, 1970; Strange et al., 1970). This interpretation, however, seems dependent upon an implicit acceptance of the concept prototype, that is, the pattern from which all concept exemplars were derived, as the generic representation. This is not the only possibility for the generic representation, since, as was stated earlier, the generic representation could be just about anything, including a most typical exemplar, a feature list, a composite representation, or a prototype. The critical attributes of the generic representation seem to be that it be unitary rather than multiple and that it represent the characteristics of the concept effectively enough to allow for equivalence across old (i.e., experienced) exemplars and generalization to new exemplars.

Actually, the possibility that the concept prototype is the generic representation seems unlikely on several grounds. First, as Homa et al. (1973) have pointed out, it is highly improbable that subjects presented with a limited number of exemplars would abstract a central tendency that would be identical to the original prototype. The statistical permutations used to generate the distorted exemplars seldom exactly balance one another out in a manner such that the average values would be equivalent to the prototype, and even if they did, it is unreasonable to expect the subjects to abstract the precise central tendency without any error.

The second reason for having reservations that the concept prototype is the generic representation is that the evidence previously considered to be the strongest in support of the prototype alternative is actually quite equivocal. Several investigators (e.g., Homa et al., 1973; Posner & Keele, 1970; Strange et al., 1970) have reported that the accuracy of classifying prototype stimuli declines less over a period of time than does the accuracy of classifying old exemplar stimuli. Although these authors have emphasized the distinction between the prototype and the old exemplars, it is important to realize that the prototype stimuli are not unique in maintaining classification accuracy over a time delay, because all new exemplar stimuli exhibit this trend. In other words, the prototype is special when compared to old exemplars but is not in any way unique when compared to new exemplars. By conceptualizing the prototype stimulus as merely another new exemplar stimulus, albeit one of low or no distortion, the meaning of the time delay results is vastly changed, and they can no longer be interpreted as providing direct evidence of the existence of the prototype in memory.

Without the burden of having to assume that the concept prototype is the generic representation, one can take the position that, since the generic representation is based upon the information from the old exemplars, it must necessarily resemble the old exemplars to a greater degree than the never-before-presented new exemplars. This will be the case despite the fact that the old and new exemplars were generated in the same manner from the same original pattern, since all of the exemplars contain slightly different information.[1] The accuracy and latency advantages of old exemplars over new exemplars are therefore explainable as a result of the greater resemblance of the generic representation to old exemplars.

An interesting implication of the argument presented above is that, since the generic representation is constructed from, and indeed based upon, the old exemplar information, it may be impossible to determine whether the generic representation exists alone or together with representations of specific exemplars. This suggests that the alternatives portrayed in Figure 1b and Figure 1c are indistinguishable, at least from the perspective of the interpretation favored here.

The important issues concerning the memory representations for perceptual concepts appear to center around two basic questions. The first concerns the number of memory representations that are maintained for perceptual concepts and whether that number changes as a function of experience.

[1] A prediction from this interpretation of the generic representation is that the performance difference between old and new exemplars should be directly related to the variability level of the exemplars. The reasoning is that, since the similarity among exemplars decreases as the variability among exemplars increases, the old exemplars (and the generic representation based upon them) will decrease in resemblance to the new exemplars with increasing variability. Empirical evidence in support of this prediction is available in a study by Peterson, Meagher, Chait, and Gillie (1973). In Experiments 1, 2, and 3 of the Peterson et al. study the performance difference between new and old exemplars of the same level of variability increased as the variability level increased from 1 to 5 to 7.7 bits per dot.

The second deals with the nature of the information embodied in the generic representation. The experiments of the current study provide an initial answer to the first question; the second awaits further investigation.

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