Repetition effects in choice reaction time to multidimensional stimuli*

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Ss classified as quickly as possible stimuli back-projected one at a time on a small screen by pressing one of two levers in response to each stimulus, according to the levels of a single specified binary stimulus dimension. Stimuli were rectangles varying in height alone, in width alone, or in both dimensions, in either a correlated or an orthogonal fashion. Stimuli followed responses by a fixed interval of 82, 580, or 1,080 msec. Response time was longer when both dimensions varied orthogonally than when only one dimension varied, indicating that Ss were unable to avoid perceiving the rectangle figures as wholes. Repeated stimuli were responded to more quickly than stimuli which were different from the immediately preceding stimulus in all conditions. With orthogonally combined dimensions, response time to stimulus repetitions was lowest, increased when the stimulus changed while the response was repeated, and increased still further when both the stimulus and the response changed. Increasing the time interval between stimuli decreased response time for nonrepetitions, while response time for repetitions was relatively unaffected. The results were discussed in terms of two models of serial choice reaction time.

Garner and his coworkers (Garner, 1969; Garner & Felfoldy, 1970; Gottwald & Garner, 1972) have used a speeded classification technique (card sorting) to study the perceived relations among stimulus dimensions. Garner and Felfoldy (1970), for example, used the card-sorting task in a series of experiments on different pairs of dichotomous dimensions. Dimensions were varied singly, orthogonally, or in a perfectly correlated fashion for each pair of dimensions. S's task was always to sort a deck of equiprobable stimuli into two piles according to the two levels on a single specified dimension. Using the single-dimension decks to provide a measure of base sorting speed for each dimension, the experiments were designed to examine the effects on sorting speed of correlated and orthogonal variation in the second dimension (the dimension by which S was *not* to sort), and how these effects were related to each other and to the nature of the particular pair of dimensions employed.

Dimensions such as value and chroma varying in two separate Munsell color chips or the size of a circle and the tilt of a diameter drawn inside it produced neither a gain in speed with correlated dimensions nor a loss in speed with orthogonal dimensions. With these "nonintegral," or "perceptually independent," dimensions, Ss were thus able to attend selectively to one dimension and ignore the other when the task so demanded (i.e., when the two dimensions varied orthogonally), but were also *unable* to use the extra

information provided by a perfectly correlated second dimension to increase sorting speed. On the other hand, dimensions such as value and chroma varying in a single Munsell color chip or the vertical and horizontal position of a dot on the card produced both a gain in sorting speed with correlated dimensions and a loss in speed (interference) with orthogonal dimensions. This pattern of results for "integral" dimensions indicates that S's attention was mandatorily distributed over both dimensions.

Sequential Effects

The card-sorting task has proven to be a powerful technique for examining interactions among stimulus dimensions. Its weakness, however, is that it does not allow a detailed examination of individual responses *within* the sequence.

Recent studies have shown that choice reaction time (RT) to an individual stimulus in a series is influenced by the nature of the immediately preceding stimulus, particularly at a very short interstimulus interval (ISI). In particular, responses to repeated stimuli are often faster than responses to nonrepeated stimuli. This "repetition effect" was first reported by Hyman (1953) and was later confirmed by Bertelson (1961), who varied the repetition probability of equiprobable alternatives in a two-choice speeded classification task and found that the shortest total sorting time was to the sequence having the highest proportion of repetitions. Subsequent research has shown that the repetition effect decreases with increasing ISI (Bertelson, 1961; Bertelson & Renkin, 1966; Hale, 1967; Smith, 1968), even reversing at long enough intervals (Williams, 1966; Doherty, 1968; Entus & Bindra, 1970). The difference in RT between repetitions and nonrepetitions has been found to increase for a fixed ISI, or to persist as ISI increases,

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Fig. 1. The primary stimuli used in the present experiment. The scale uses an arbitrary unit of measurement to indicate the basic relationships among the stimuli. In the projected image of each stimulus, one unit was equal to 1.59 mm.

when either the number of stimulus alternatives is increased (Smith, 1968; Hyman & Umiltá, 1969; Schvaneveldt & Chase, 1969) or the probability of repetition is increased (Hyman, 1953; Bertelson, 1961; Moss, Engel, & Faberman, 1967; Hyman & Umiltá, 1969).

Purpose

The present study is designed to approximate the card-sorting task as closely as possible, while permitting measures of discrete RTs within the stimulus sequence, so that the growing body of research on sequential effects can be related to the study of the perceived structure of multidimensional stimuli. Two stimulus dimensions are manipulated so as to examine the effects of variation in one dimension upon the processing of the other dimension.

The two principal empirical phenomena in the speeded classification of integral stimulus dimensions are the gain in sorting speed with redundant dimensions and the loss in speed with orthogonal dimensions. Of particular interest in the present study is the interference phenomenon: Does the introduction of variation in the irrelevant dimension produce a general slowing of the decision process for all stimuli in the sequence, or is processing time a function of the particular sequential structure within the stimulus series? Other questions of interest are how sequential structure is related to redundancy gains, whether the redundancy and interference effects can be explained by similar principles, and how sequential effects are influenced by the dimensional structure of the stimulus set.

METHOD

Subjects

Four volunteers from the New Haven area, aged 21 to 25 years, served as Ss in the present experiment. Total testing time ranged from 16 to 19 h, for which each S was paid \$2 per hour.

General Procedure

S's task was to classify as quickly as possible, while trying to

avoid errors, stimuli back-projected one at a time on a small screen. S responded to each stimulus by pressing one of two levers according to the S-R mapping defined by exemplars present throughout the trial. The response category chosen and the time required to respond were automatically punched on paper tape after each response. Stimuli were rectangles (black outlines drawn on white backgrounds), varying dichotomously within any one 240-item sequence in height alone, width alone, or both dimensions. Thus, when only one dimension varied in the sequence, or when both dimensions varied in a perfectly correlated fashion, there was a 2 → 2 S-R mapping, with a separate response for each of two different stimuli. Varying both dimensions in an orthogonal fashion produced a set of four stimuli. S used a 4 → 2 S-R mapping in this case, basing his responses on one dimension only.

Apparatus

Sequences of stimuli were photographed on 16-mm film and shown by a high-speed projector (Perceptual Development Laboratories' Perceptoscope Mark II, Model 5102-2). Pressing a response key, whether correct or incorrect, advanced the film from a stimulus frame to a blank (white) frame after a 40-msec delay. The blank frame remained on for a fixed interval, and was followed by the next stimulus-response cycle.

S was seated at a table in a 2.13-m square soundproof room, approximately 1.0 m from the back-projection screen, which was at eye level. On the table and just below the screen was a platform which held the stimulus exemplars during each trial. Directly in front of S and attached to the table was the response box, consisting of two pushbutton switches and two hinged levers which could be used to depress the buttons. Ss were permitted either to press the buttons directly or to use the levers, the latter requiring less force to operate. In either case, S used his left hand to operate the left key, his right hand to operate the right key.

BRS Foringer (Digibit) logic modules were used to advance the projector, control the delay between stimuli, measure the response time from stimulus onset to response onset, and punch the coded response and RT on paper tape.

Response-Stimulus Interval (RSI)

Each sequence used a fixed RSI of 82, 580, or 1,080 msec, measured from the onset of a keypress response to the onset of the next stimulus frame.

Conditions

The following description of experimental conditions refers to the set of stimuli shown in Fig. 1.

Control Conditions. In the four control conditions, one dimension varied while the other was held constant: (1) w/h-1—Stimulus C vs Stimulus D of Fig. 1; S sorted by width, with height held constant at the smaller level. (2) w/h-2—Stimulus A vs Stimulus B; S sorted by width, with height held constant at the greater level. (3) h/w-1—Stimulus A vs Stimulus C; S sorted by height, with width held constant at the smaller level. (4) h/w-2—Stimulus B vs Stimulus D; S sorted by height, with width held constant at the greater level.

Redundant Conditions. In the two redundant conditions, both dimensions varied, but in a perfectly correlated fashion. S could sort by either dimension or by both dimensions: (5) wh-1—Stimulus A vs Stimulus D; the two stimuli were equal in area. (6) wh-2—Stimulus B vs Stimulus C; the two stimuli had the same shape ($h/w = 1/2$).

Orthogonal Conditions. In these conditions, both dimensions varied, in an orthogonal fashion, producing four different stimuli in the sequence. S's task was to sort by one dimension, ignoring the irrelevant variation in the other dimension: (7) w(h)—Stimuli A and C vs Stimuli B and D; S sorted by w, with h also varying. (8) h(w)—Stimuli A and B vs Stimuli C and D; S sorted by h, with w also varying.

Discriminability Conditions. Two additional conditions, "w/h-hard" and "w/h-easy," were included to test directly the

effects of stimulus discriminability. With h/w ratios of 9/19 vs 9/21 and 9/16 vs 9/24, respectively, these conditions, along with w/h-1, form a set of three conditions in which S sorts by width, with height held constant at the smaller level and pairs varying in discriminability.

Stimulus Sequences

A single stimulus order was used for all conditions using only 2 different stimuli, and another order for the 4-stimulus (orthogonal) conditions. A 96-item order was first generated for both the 2- and 4-stimulus conditions, such that stimuli occurred equally often, each stimulus following itself and the other item(s) an equal number of times (24 in the 2-stimulus order, 6 in the 4-stimulus order). Thus, the proportion of repetitions in the 2-stimulus order was 0.50, and in the 4-stimulus order, 0.25. The 24 repetitions of each item in the 2-stimulus order consisted of two runs of Length 4, five runs of Length 3, and eight runs of Length 2. The 6 repetitions of each item in the 4-stimulus order consisted of one run of Length 3 and four runs of Length 2.

Each 240-item film began with 48 warm-up stimuli, consisting of the last half of the appropriate 96-item order. The warm-up stimuli were followed by two complete runs through the 96-item order. Only these last 192 responses were included in the final data analysis.

In order to prevent S from learning specific characteristics of the stimulus orders, the films were run in reverse on half of the trials.

Order of Presentation of Conditions and RSIs

One trial consisted of one 240-stimulus film. A block of trials consisted of 30 films: each of the 10 conditions at each of the 3 RSIs. The order of presentation of the 30 films within a block was such that the same condition never was presented on two consecutive trials, and that all 10 conditions appeared once before any appeared twice, all appeared twice before any appeared three times, etc. The same was true for the 3 RSIs.

Each S was given four different blocks over the 16-19-h test period. The first block was used to familiarize S with the conditions and RSIs and with the characteristics of the response apparatus, and to enable S to overcome the tendency to correct error responses.

Each test session began with three warm-up trials, one at each RSI, the conditions being chosen at random.

Instructions to Subjects

Before each S began the experiment, he was shown the projection and control apparatus, while its general nature and function were explained. After being seated at the screen, S was told that sequences of rectangles would be projected, one figure at a time, and that he was to respond to each of them by pressing one of the two buttons or levers as quickly as possible. All 10 conditions were then demonstrated, using the exemplars, and the nature of the RSI variation explained. S was told to avoid making more than 15 errors on any trial, and was reminded after every few trials to respond as quickly as possible without making too many errors. Speed was emphasized over accuracy.

Test Session

Each trial was begun by placing the appropriate exemplars on the stand and advancing the film to the first stimulus in the sequence. E then left the room and S began responding whenever he was ready, continuing until all 240 stimuli had been presented. An average trial with RSI = 82 msec was approximately 2 min long; with RSI = 580 msec, about 4 min long; and with RSI = 1,080 msec, about 8 min long. After a trial, E changed the film, reset the timing circuit, recorded the condition and the RSI on the punched paper tape, and began the next trial. There was a period of about 2 min between trials. S was allowed to take a 5-min break between trials as often as he wished, and to terminate the session at any point. Sessions lasted from 2 to 5 h.

Data Analysis

Sequential Analyses. A computer program was written to read the responses and the RT data from the punched tapes, along with a standard tape on which the stimulus sequence was punched. The program then calculated the number of errors in a trial, the number of occurrences of all possible stimulus sequences up to five in length for the 2-stimulus trials, and up to three in length for the 4-stimulus trials, and the mean and variance of the RT to the last item in each of these possible sequences. These analyses were first performed on all of the last 192 stimuli and responses on the tape, then repeated after eliminating error responses and responses immediately following errors. Each 240-stimulus trial was analyzed separately, the results later being combined for statistical analysis.

Statistical Analyses. Unless otherwise specified, the entry in each cell of the 3-, 4-, and 5-factor analyses of variance performed on several different combinations of the data was a mean RT extracted by the computer treatment described in the previous section. Significance tests used as error terms the interactions with Ss of the factors being tested. Each analysis will be described in conjunction with the results. The primary consideration, however, in a design of this complexity, is not taken to be the significance level of each test, but rather the structure of the entire pattern of results and its relation to previous findings.

Errors. Errors were few, averaging 6.1% for RSI = 82 msec, 4.5% for RSI = 580 msec, and 3.8% for RSI = 1,080 msec. Other than the decline in error rate with increasing RSI, no meaningful relationship was found between errors and either RT or the several independent variables used in the present study. Therefore, error data will not be discussed further.

RESULTS

Removal of Error Data

The mean time taken to respond to an item in the 240-stimulus sequence in the present experiment is the response measure most analogous to total sorting time in card sorting. Whereas error responses are necessarily included in total sorting time, however, error responses and responses following errors are generally excluded when examining the effects of stimulus sequences (e.g., Kornblum, 1968). Since the total pattern of results in the present experiment was identical with and without the inclusion of errors and responses immediately following errors, it is concluded that the corrected data can be used to analyze sequential effects.

Effects of Conditions

Table 1 shows the mean RT for each condition at each RSI. A 4-way analysis of variance (Ss by RSI by Conditions by Blocks) performed on these data showed both RSI [$F(2,6) = 5.14, p < .05$] and conditions [$F(9,27) = 17.88, p < .001$] to be significant sources of variance. No other main effects were significant, nor were any interaction terms.

Since the interaction between conditions and RSIs was not a significant source of variance, the data were summed over RSIs to compare specific pairs of conditions. These comparisons showed: (1) that there was significant interference produced in both orthogonal tasks; (2) that the attempt to vary discriminability along a single dimension was successful; and (3) that neither wh-1 nor wh-2 produced a significant redundancy gain

Table 1
Mean Reaction Time in Milliseconds for Each Condition at Each RSI (With Error Responses and Responses Immediately Following Errors Removed)

Conditions	RSI (msec)		
	82	580	1080
w/h-1	417	387	385
w/h-2	418	391	382
h/w-1	433	403	404
h/w-2	432	406	397
wh-1	415	378	376
wh-2	408	373	381
w/h-easy	393	340	348
w/h-hard	491	454	444
w(h)	469	433	420
h(w)	493	440	434

when compared with the best of the four control conditions of each S.

Except for the lack of a significant redundancy gain in mean RT on either wh-1 or wh-2,¹ the results of the present experiment indicate that the stimulus dimensions of height and width of rectangles are not processed independently of one another. Particularly important is the fact that despite the fixed position of the stimuli from one item to the next, S was not able to ignore the variation in the irrelevant dimension, and apparently was unable to avoid perceiving the rectangle figures as wholes.

2-Stimulus Conditions

RSI and Sequential Effects. Figure 2 shows mean RT for both repetitions and nonrepetitions plotted against RSI, with data averaged over all eight 2-stimulus conditions. A 4-way analysis of variance (Ss by Conditions by RSI by Blocks) was performed for both repetitions and nonrepetitions. RSI was a significant source of variance [$F(2,6) = 7.82$, $p < .025$] for nonrepetitions, but was not significant [$F(2,6) = 1.70$] for repetitions. A linear trend analysis further showed nonrepetitions to be significant ($p < .01$), but was not significant for repetitions. Neither residual trend was significant.

These results may best be summarized as demonstrating an increasing amount of interference as RSI decreased, whenever S responded to a change in stimuli. The RSI range employed in the present experiment had no significant effect upon RT to repeated stimuli.

Conditions and Sequential Effects. In a 5-way analysis of variance (Ss by Blocks by Conditions by RSI by Rep Effect) performed on Conditions w/h-1, w/h-easy, and w/h-hard, the Conditions by Rep Effect and the Conditions by RSI by Rep Effect interactions both failed to reach significance. Discriminability, therefore, affected neither the distance between the repetition and nonrepetition curves nor the difference in slope between them.

A similar 5-way analysis of variance was then performed on all eight 2-stimulus conditions. Again, neither the repetition effect nor its interaction with RSI was significantly affected by variations in conditions.

4-Stimulus Conditions

The 4 → 2 S-R mapping in the orthogonal conditions makes possible a partitioning of the repetition effect into its stimulus and response components.

Table 2 lists the five possible types of second-order transitions in the orthogonal conditions, with reference to the stimulus labels given in Fig. 1. A 5-way analysis of variance (Ss by Blocks by Conditions by RSI by Transitions) performed on the orthogonal data showed both RSI and transitions to be significant sources of variance [$F(2,6) = 6.60$, $p < .05$, and $F(4,12) = 9.98$, $p < .001$, respectively], as was their interaction [$F(8,24) = 8.83$, $p < .001$]. No other main effects or interactions were significant.

Since the dimension by which S sorted was not a significant source of variance, data from w(h) and h(w) were combined in order to examine specific transition effects. Figure 3 plots mean RT against RSI for each of the five transitions separately. Scheffé tests on pairs of means showed that the shape same, the area same, and the 1-dim'l S & R change transitions did not differ significantly from one another. All three, however, were processed more slowly than either the S & R rep or the S change, R rep transitions ($p < .01$). The S change, R rep transition was also significantly slower than the S & R rep transition. There is evidence, therefore, for a stimulus repetition effect independent of response repetition. Averaged over RSIs, it took 48 msec longer

Fig. 2. Mean reaction time for repetitions and nonrepetitions at each RSI. Data are averaged over all eight 2-stimulus conditions.

to make a repeated response to a new stimulus than it did to make a repeated response to a repeated stimulus. That the repetition effect was not *entirely* due to stimulus repetition is indicated by the fact that it took an average of 67 msec longer to respond to a change in the relevant dimension, requiring a change in response, than it did to respond when the change was in the irrelevant dimension, requiring a repeated response.

Furthermore, the difference between S & R rep and S change, R rep (representing the stimulus component of the repetition effect) was approximately 40% of the difference between S & R rep and 1-dim'l S & R change (representing the stimulus component *plus* the response component of the repetition effect) for all three RSIs. Thus, as RSI increased, the stimulus component and the response component decreased at about the same rate.

Relation Between 2- and 4-Stimulus Conditions

Direct comparisons can be made between the data from the 2-stimulus conditions and the data from the 4-stimulus conditions. A repetition in the control and redundant conditions is analogous to a S & R rep in the orthogonal conditions. Similarly, a nonrepetition in the control and redundant conditions is analogous to the R change transitions in the orthogonal conditions. Figure 4 plots mean RT of repetitions and nonrepetitions for the control and redundant conditions, along with analogous transitions for the orthogonal conditions, against RSI.

Table 2
Second-Order Transitions in the Two Orthogonal Conditions

Stimulus	Response	Description	w(h)	h(w)
Same*	Same	S & R Rep	A-A	A-A
			B-B	B-B
			C-C	C-C
			D-D	D-D
Diff	Same	S Change R Rep	A-C	A-B
			C-A	B-A
			B-D	C-D
			D-B	D-C
Diff	Diff	1-Dim'l S & R Change	A-B	A-C
			B-A	C-A
			C-D	B-D
			D-C	D-B
Diff	Diff	2-Dim'l S & R Change (Area Same)	A-D	A-D
			D-A	D-A
Diff	Diff	2-Dim'l S & R Change (Shape Same)	B-C	B-C
			C-B	C-B

Note—Columns 1 and 2 tell whether the stimulus and response, respectively, are the same as or different from the immediately preceding stimulus and response. Column 3 describes the transition. Columns 4 and 5 give the specific stimuli involved in the transitions, using the labels given in Fig. 1. The first stimulus listed is number $n - 1$ in the sequence, the second is n .
*Same as immediately preceding stimulus.

Fig. 3. Mean reaction time for transitions in the orthogonal conditions, at each RSI. Data are averaged over Conditions w(h) and h(w).

Fig. 4. Mean reaction time for repetitions and nonrepetitions for control and orthogonal conditions at each RSI.

It is apparent from Fig. 4 that both RSI and the number of stimulus alternatives have their primary effect on nonrepetitions. Furthermore, since the nonrepetition curves are essentially parallel, these two factors appear to act independently of one another.

Individual Differences

Table 3 shows the difference between S & R change and S & R rep for each S at each RSI. Although Ss varied widely in their susceptibility to the repetition effect, all Ss were consistent in demonstrating a smaller effect with increasing RSI. All Ss showed a larger effect in the 4-stimulus conditions than in the 2-stimulus conditions. With respect to the size of the repetition effect shown by each S, Ss fell in the same order in the 4-stimulus conditions as they did in the 2-stimulus conditions.

Table 3
Repetition Effects for Individual Subjects at Each RSI

S	RSI (msec)	(S & R Change) – (S & R Rep)	
		Two-Stimulus Conditions	Four-Stimulus Conditions
1	82	+220	+273
	580	+122	+211
	1080	+78	+97
2	82	+76	+130
	580	+51	+97
	1080	+28	+66
3	82	+22	+70
	580	–1	+37
	1080	–22	+5
4	82	+104	+174
	580	+56	+98
	1080	+21	+58

Note—Mean RT is in milliseconds. Data are averaged over all eight two-stimulus conditions and over both four-stimulus conditions. S & R change for the four-stimulus conditions is the average of the 1-dim'l S & R change, area same, and shape same transitions.

DISCUSSION

Processing Multidimensional Stimuli

Ss apparently processed as wholes the stimuli employed in the present experiment. Height and width of rectangles produced the pattern of results which Garner and Felfoldy (1970) have described as indicating dimensional integrality—a gain in processing speed when combined redundantly and a loss in speed when combined orthogonally, with responses based on a single stimulus dimension. However, the present results indicate that dimensional integrality produces these two effects in two different ways.

Dimensional redundancy (along with stimulus discriminability on a single dimension) was shown not to interact with sequential effects. The reduction in RT produced by adding redundant information or by directly increasing stimulus discriminability was due to faster responses to each individual item in the stimulus sequence, regardless of the nature of the preceding item.

The interference phenomenon, however, appears to be directly attributable to the changes in sequential structure introduced by adding stimulus alternatives. With a 2 → 2 S-R mapping, 50% of the items in the sequence represented S & R rep transitions. The remaining 50% were S & R change transitions. The addition of two stimulus alternatives created a 4 → 2 S-R mapping, thereby reducing to 25% the S & R rep transitions. RT to these items was not significantly increased by the presence of extra stimulus alternatives. Part of the interference effect is explained by those items (25%) which are S & R rep transitions in a 2 → 2 S-R mapping but which become the slower S change, R rep transitions in a 4 → 2 mapping. Ss are not able to ignore the change in the irrelevant stimulus dimension, and so lose the advantage of a repeated stimulus. While

the *percentage* of S & R change transitions did not differ between the 2 → 2 and the 4 → 2 mappings, the greater number of alternatives did increase RT to these items, accounting for the remainder of the interference effect. In addition, the fact that RT to the S & R change transitions was not affected by the *number* of dimensions by which adjacent items in the sequence differed further supports the argument that the rectangle stimuli were processed as wholes.

Theories of Serial Choice RT

Bertelson (1963) proposed a two-stage model of serial choice RT to account for the repetition effect. As each stimulus is presented, according to Bertelson, it is first compared to a memory trace of the previous item. If a match occurs, S merely repeats his previous response. If no match occurs, or if the trace is unavailable due to decay, S must classify the stimulus by searching through the entire set of stimulus alternatives in memory. Bertelson suggests that the initial matching stage functions independently of the number of stimulus alternatives, predicting the present finding that number of stimulus alternatives has no effect upon RT to repetitions. The search process must be used to classify nonrepetitions, however, with search time directly related to the size of the stimulus set. The present results support this prediction. Bertelson's trace decay hypothesis also predicts an interaction between RSI and the repetition effect. As the previous trace decays, S must increasingly resort to the slower classification process for all items, leading to the convergence of repetitions and nonrepetitions as RSI increases.

An alternative to the two-stage model has been proposed by Smith, Chase, and Smith (1973). According to Smith et al, *every* stimulus is classified by a serial search process, the order of which is determined probabilistically by the recency of occurrence of stimulus items. The more recently an item has appeared in the sequence, the more likely it is to be searched early in the classification process. The hypothesis further assumes that S uses the RSI to rehearse items in preparation for the next stimulus. The longer the RSI, the more rehearsal tends to dominate over recency in determining the search order. If the rehearsed item differs from the previous item with some probability, the repetition effect will be reduced. Thus, the Smith et al model is able to account for the decrease in the repetition effect with increasing RSI.

Although the fading memory trace hypothesis and the rehearsal hypothesis both predict an RSI by Repetition Effect interaction, neither adequately predicts the particular *nature* of the interaction found in the present experiment. Both hypotheses suggest that as RSI increases, the probability that the previous item is the first item searched decreases. Consequently, items representing nonrepetitions tend to be searched earlier in the classification process. Thus, the two hypotheses predict a decline in RT to nonrepetitions as well as an

increase in RT to repetitions as RSI increases. Furthermore, given the simplifying assumptions that no item in memory is searched twice, that search times are equal for all items, and that lag time between items searched is constant, a serial memory search model would predict that the slope of the RT by RSI function for repetitions is much more sensitive to the number of stimulus alternatives than is the slope for nonrepetitions. The present data reveal no interaction between RSI and number of alternatives and no increase in RT to repetitions with increasing RSI. Systematic exploration of the interactions among the known parameters of the repetition effect is critical to the development of an adequate process model of serial choice RT.

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NOTE

1. Ten additional Ss were run in a second experiment using only the 82-msec RSI and only the four control and the two redundant conditions. The mean RT of the best of the four control conditions for each S was found to be longer ($p < .01$) than the mean of either redundant condition. The redundant conditions did not differ significantly from one another.

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