Examining the Spacing Effect in Advertising: Encoding Variability, Retrieval Processes, and Their Interaction

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Recall of print material benefits from spacing repetitions of that material, an effect often attributed to varied encodings induced by changes in contextual cues. We examined an alternative explanation: retrieving earlier presentations during later presentations strengthens memory traces, the more so the greater the difficulty of such retrieval. In four experiments we found that (*a*) study-phase retrieval contributes to the benefits of spacing and (*b*) inducing variation via changes in ad formatting and content can be counterproductive at long spacing intervals, apparently because such changes decrease the likelihood that earlier presentations will be retrieved during later presentations.

Marketers have long known that repetition of an advertisement is critical if people are later to recall the advertised product or service. It also matters, however, how and when an ad is repeated. Spacing the repetitions of an ad, for example, rather than massing them, can increase later recall—and, hence, advertising effectiveness—quite dramatically (e.g., Heflin and Haygood 1985; Singh et al. 1994; Zielske 1959). Clarifying the memory dynamics that underlie such spacing effects is one goal of this article. Another is to explore how those dynamics are influenced by variations of a given ad across repetitions.

The spacing effect has a long history in both laboratory and applied research. It is a robust and general effect, one that has been demonstrated with a wide range of materials, including words, sentences, text, and photos (for reviews, see Crowder 1976; Dempster 1996; Hintzman 1976). It also occurs over time intervals from seconds (Peterson and Peterson 1959) to months (Bahrick et al. 1993).

Notwithstanding its importance in the memory literature, research on the effects of spacing in an advertising context is limited. Zielske (1959) showed that longer lags improved message retention, and Strong (1977) demonstrated that showing flights of massed print ads improved free recall. Heflin and Haygood (1985) found that moderately spaced television ads resulted in better free and cued recall than massed ads or highly spaced ads. Singh et al. (1994) found that spacing ads protects against forgetting on delayed recall tests.

EXPLANATIONS OF THE SPACING EFFECT

Many cognitive mechanisms have been proposed to account for the benefits of spacing, including consolidation (Landauer 1969), encoding variability (Estes 1955; Johnston and Uhl 1976), deficient processing (e.g., Greene 1989; Zimmerman 1975), and study-phase retrieval (Murray 1983; Murray and Bjork 1998; Thios and D'Agostino 1976). However, the two most influential mechanisms are encoding variability and study-phase retrieval.

Encoding Variability

Variation in how information is encoded is assumed to enhance subsequent recall because it results in more multifaceted memory representations, thus multiplying access routes to that information when it is to be recalled. The encoding variability explanation of the spacing effect is that spacing can increase encoding variability and thus increase

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recall, inasmuch as spacing changes a learner's cognitive environment (Johnston and Uhl 1976). During the first presentation (P1) of a stimulus (e.g., information to be learned), contextual cues encourage a person to encode it in relation to certain other then current information. If the stimulus is presented for a second time immediately after P1, contextual cues have not changed, and the encoding operations at the time of the second presentation (P2) mimic those engaged during the encoding of P1—meaning that no new encoding will take place. If time and intervening events occur between P1 and P2, however, then the change in context and in the learner's mental set is likely to result in a second encoding that differs from the first, increasing later recall.

In the psychology literature, encoding variability is often cited as the mechanism that drives the spacing effect (see, e.g., D'Agostino and DeRemer 1973; Estes 1955; Glenberg 1979; Johnston and Uhl 1976). The encoding variability explanation also appears in the marketing literature. Singh et al. (1994), for example, claim that encoding variability is responsible for preventing a decline in recall rates for television ads when recall is tested at long delays. They posit that the longer interval or lag between ads in their experiment allowed for a variable encoding that prevented recall rates from declining. Burnkrant and Unnava (1987) also draw on the theory of encoding variability to explain the benefits to recall of showing multiple variations of given ad. Based on their results, they argue that varied executions of their ads induced more variable encoding than did exact repetitions, which, in turn, produced better recall.

Study-Phase Retrieval

Another explanation for spacing effects is the mechanism of study-phase retrieval. The name study-phase retrieval derives from word pair experiments in which participants first complete a study phase in which they learn the word pairs and then move on to a test phase assessing their recall of the pairs. The study-phase retrieval explanation of spacing posits that during the study phase, a second presentation of a stimulus "allow[s] active retrieval of old information stored during the first presentation" (Thios and D'Agostino 1976, 529).

The study-phase retrieval explanation of spacing rests on the fact the retrieval is a memory modifier: the act of retrieval is itself a learning event in the sense that the retrieved information becomes more recallable in the future than it would have been without having been retrieved (Bjork 1975). Thus, if P2 encourages retrieval of P1, recall for P1 should be enhanced. A second relevant finding is that a successful act of retrieval is a more potent learning event when it is more difficult. One argument as to why later recall benefits more from a difficult act of retrieval than from a less difficult act is that the processes engaged overlap more—that is, are better practice for—the retrieval processes that will be needed at the time of a later test.

This retrieval practice idea (Bjork 1988) predicts that the longer the interval between P1 and P2, the greater the benefit of the retrieval of P1 at the time of P2—but only up to the point that such retrieval starts to fail, after which the recall of P1 recall should suffer accordingly. A recent meta-analysis of the spacing effect in verbal learning suggests that similar retrieval processes at study can explain a variety of different results (Janiszewski, Noel, and Sawyer 2003).

Comparing Encoding Variability and Study-Phase Retrieval

In order to use spacing to increase recall effectively, an understanding of the cognitive processes responsible for its benefits is critical. Maximization of recall based on encoding variability would call for P2 to be encoded as differently as possible from P1. The best way to achieve such an encoding difference would be to create conditions such that P1 is not retrievable at the time of P2, thus creating the opportunity for an entirely unique encoding of P2. This description follows Bower's (1972) explanation of encoding variability deriving from a fluctuation of contextual elements in a given learning situation. If none of the contextual elements present at P2 are associated with the stimulus, it would allow for the greatest potential new learning. However, such a solution would produce the worst conditions for inducing study-phase retrieval because a person would lack the cues to retrieve P1. If retrieval of P1 is not successful, later recall should also not benefit. It is only with a difficult, but successful, retrieval of P1 that later recall of P1 should maximally increase.

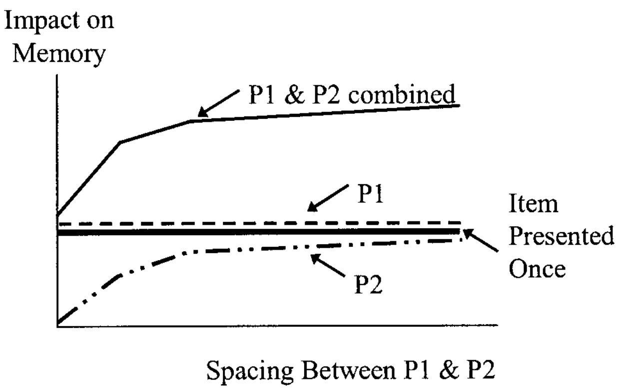
Encoding variability and study-phase retrieval ideas make different predictions as to how the effectiveness of P1 and P2 vary with spacing (Murray 1983; Murray and Bjork 1998). The encoding variability idea asserts that the encoding processes at P2 are ineffective at short intervals because the encoding context of P2 is so similar to that of P1 but that gradually these processes become more effective as spacing increases, thus increasing the change in the contextual information present at P2. Their greater effectiveness results in a cumulative relationship between the impact of P1 and P2 on later recall.

When the same information is repeated twice, it is impossible to identify the extent to which P1 and P2 are recallable at the time of a subsequent test. However, figures 1 and 2 illustrate what we might expect from an experiment that was able to differentiate between the impact of P1 and P2 on later recall. Figure 1 shows the theoretical contribution of P1 and P2 implied by an encoding-variability explanation of spacing. The effect of P1 should be about equal to that of a single presentation because the first presentation is a new encoding. If P2 were to follow P1 with no delay, we would not expect much effect of P2 because a person's cognitive environment would not have changed enough to produce much variation in encoding. But, as the space between presentations increases and the encoding becomes more variable, the effect of P2 should increase to the point where it is comparable to a new encoding.

Although it is based on different logic, deficient processing theory (Greene 1989; Zimmerman 1975) makes the

FIGURE 1

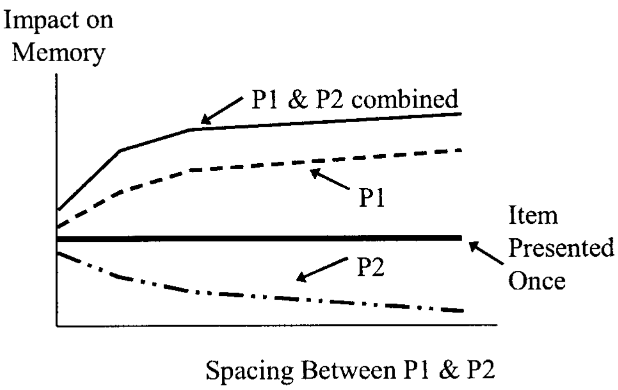
THEORETICAL PREDICTIONS BASED ON ENCODING VARIABILITY



NOTE.—Theoretical impact of the first and second presentations (P1 and P2) of a stimulus on memory, based on an encoding variability explanation, is illustrated (adapted from Murray and Bjork 1998). The solid horizontal line represents the impact of once-presented items to serve as a baseline.

FIGURE 2

THEORETICAL PREDICTIONS BASED ON STUDY-PHASE RETRIEVAL



NOTE.—Theoretical impact of the first and second presentations (P1 and P2) of a stimulus on memory, based on a study-phase retrieval explanation, is illustrated (adapted from Murray and Bjork 1998). The solid horizontal line represents the impact of once-presented items to serve as a baseline.

same predictions for P1 and P2 as encoding variability. The impact of P1 does not depend on the size of the P1–P2 interval. However, at short intervals people process P2 less because the strong representation of P1 creates a false belief that the material has been learned. With greater spacing, they become less confident of their knowledge and allocate more resources to the P2 material. The resulting pattern is identical to that shown in figure 1.

Study-phase retrieval theory would predict an interdependent, rather than cumulative, relationship between the encoding of the P1 and P2. Figure 2 illustrates these theoretical predictions. The effectiveness of P1 would get little or no boost at short P1–P2 intervals because the automatic retrieval of P1 caused at P2 is not sufficiently difficult to add significantly to the encoding achieved at the time of P1. But when the P1–P2 interval is longer, the retrieval at P2 is more difficult and involved, making its strengthening effect on P1 greater. In short, P2 serves as a cue to retrieve P1, a retrieval that strengthens the encoding of P1 (thereby increasing its impact compared to a baseline of an item presented once). At the same time, the increased processing of P1 at long spacing intervals competes with the encoding of P2. Cognitive resources are drawn from the encoding of P2, reducing its ultimate impact on the retention of the material (thereby decreasing its impact as compared to a baseline of an item presented once). Although an explanation based on encoding variability predicts that P2 becomes a more potent contributor to the recall of repeated information as spacing increases, one based on study-phase retrieval predicts that the P1 event becomes more potent with spacing.

Differentiating the Impact of the Two Presentations

Empirically, however, when the same information is repeated, it is impossible to determine if spacing benefits recall of P1, as predicted by study-phase retrieval, or P2 as predicted by encoding variability. In the present research, we adopt an approach developed by Murray and Bjork (1998) in the context of paired-associate learning. In this paradigm, a given stimulus word (A) is paired with a response word (B) for study. That stimulus word either is not presented again or is presented again with either the same response or a different response, creating conditions AB-AB or AB-AD. For stimuli shown with two different responses (AB-AD), the B response represents P1 and the D response represents P2. By comparing delayed recall of the B and D responses in the AB-AD condition it is possible to determine which presentation, P1 or P2, benefits from spacing and thus determine whether encoding variability or study-phase retrieval is responsible for the spacing effect.

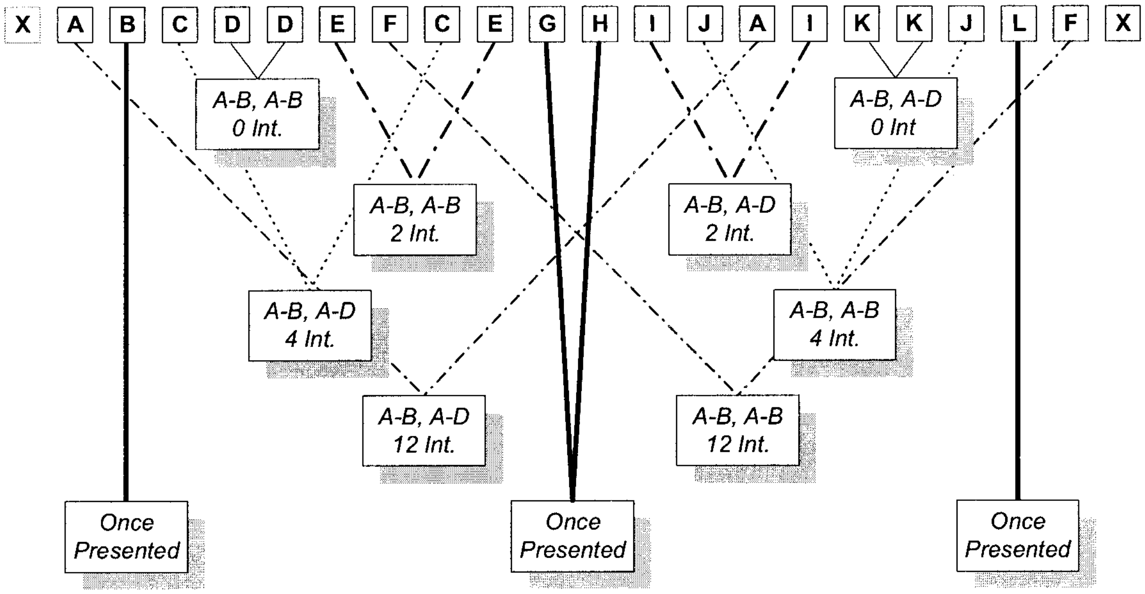
Determining the mechanism responsible for the spacing effect is important for two key reasons. One reason is a practical one. The two mechanisms have different implications for how one should construct and space advertisements. A second reason is theoretical: encoding variability and retrieval as a learning event are each key processes in the functioning of human memory and knowing how they interact is important for the understanding of human memory more broadly.

EXPERIMENT 1

This experiment used an AB-AB/AB-AD design to assess the relative contribution of P1 and P2 on final recall. In experiment 1 the stimuli were print ads for fictitious brands. An initial study phase was followed by an unrelated, but distracting, activity, which was followed in turn by a cued recall test of participants' ability to recall the brand names.

FIGURE 3

SAMPLE ORDER OF ADS FROM ONE BOOKLET



NOTE.—Ads are labeled A–L with the conditions marked below them.

Method

Participants. In total, 96 undergraduates from introductory psychology courses at a large West Coast university participated as partial fulfillment of course requirements.

Materials. The ads were structured so that each product and slogan (A) were paired with one or more brand names (B or D). The ads were shown to each participant in a 22-page booklet, one ad per page. A total of 14 different products were advertised—12 target products and two additional products, which were advertised first and last in each booklet and were not scored.

Design. Three independent variables were manipulated within subjects: repetition, spacing, and semantic relatedness. Repetition varied in three ways; products were shown only once, repeated with the same brand name (AB-AB) or repeated with a different brand name (AB-AD), making a total of 16 different target brands. For the repeated product ads, spacing was manipulated by the number of ads appearing between P1 and P2 (0, 2, 4, and 12 intervening ads).

Because some real brand names have a semantic relationship with the product (e.g., Trimlife diet pills), semantic relationship was manipulated by creating brand names that were either semantically related or arbitrary with respect to the product. A separate group of 27 participants rated the brand names for semantic relatedness to the product.

A 12 × 12 Latin square was used to counterbalance the within-subjects presentation of the ads across the 12 repetition/spacing conditions to eliminate presentation-order effects. In any group of 12 participants each of the 12 target ads appeared in every condition, and each spacing variation was shown once in each position in the booklet. Figure 3 shows a sample ordering of ads in one booklet. To rotate the order of the conditions between subjects, eight randomly chosen Latin squares were used for a total of 96 different orderings of ads. The semantic relationship of brand name was also fully counterbalanced over the eight Latin squares.

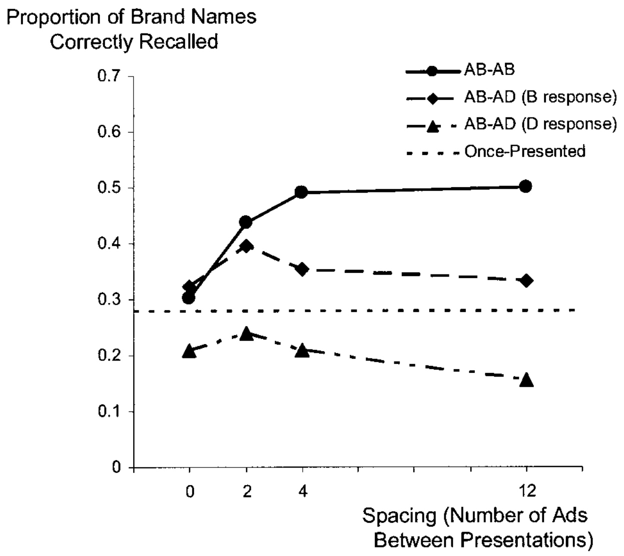
Procedure. During the study phase, participants read each ad in the booklet for 20 sec. with a taped prompt alerting participants when to turn to the next ad. Then they were given an 8 min. distracter task, which asked them to list every teacher that they could remember having from kindergarten through twelfth grade. Next, participants completed a cued recall test on which cues consisted of the product slogan or tagline along with the picture from each ad. Participants had two lines to write in any brand(s) they remembered having been associated with each slogan-picture cue.

Results

The data were analyzed with a within-subjects analysis of variance (including the Latin-square counterbalancing factor). The proportion of participants who correctly recalled brand names on the cued-recall test is plotted in figure 4 as a function of the spacing of presentations. As is apparent from figure 4, the main effects of repetition and spacing were both significant ($F(3, 285) = 12.32$, $p < .0001$, and $F(4, 475) = 3.75$, $p < .01$, respectively).

FIGURE 4

RECALL OF BRAND NAMES—EXPERIMENT 1



NOTE.—Mean proportion correct recall for the repeated conditions of experiment 1 is plotted as a function of the spacing interval. The once-presented baseline is the mean proportion of correct recall for all single presentations.

Semantic relatedness of the brand name did not have a main effect on recall rates ($F(1, 95) = .00$, $p = .99$), nor did it interact with repetition ($F(3, 285) = 2.07$, $p = .10$) or spacing ($F(4, 475) = 1.41$, $p = .23$), so the results are shown collapsed over the levels of this variable.

Not surprisingly, the AB-AB condition produced better recall than did the AB (once-presented) condition. A Tukey test (at the 5% level) revealed that in the AB-AB condition, recall of brand names repeated after 2, 4, or 12 intervening items ($M = .44$, SD = .50, $M = .49$, SD = .50, and $M = .50$, SD = .50, respectively) was significantly higher in each case than recall for the presentations with zero intervening items ($M = .30$, SD = .46). In the AB-AD condition, the proportion of correctly recalled B responses ($M = .35$, SD = .48), which corresponds to P1, was significantly higher than the recall of items presented once ($M = .28$, SD = .45) and was also higher than D recall ($M = .19$, SD = .45), which corresponds to P2. Furthermore, D recall was significantly lower than recall of items presented once. However, the recall of B or D responses did not differ significantly across the four levels of spacing.

Discussion

As expected, the spacing effect was demonstrated in this experiment. Basically, an ad that was repeated at a wide spacing was easier to recall than one that was given adjacent presentations. Most importantly, the results of the AB-AD condition permit an assessment of the relative contributions of P1 and P2 and thus the ability to draw conclusions about the nature of the underlying cause of the spacing effect. If encoding variability were responsible for the spacing effect, we would see recall for B items in the AB-AD condition equal to or less than that of once-presented items, because P1 encoding would be the same as the encoding of a single presentation. Moreover, because the second encoding would not vary much from the first, recall for D items in this condition should be quite low when no ads come between P1 and P2. As spacing increases, allowing time and intervening items to increasingly vary the encoding of P2, P2 recall should increase monotonically.

The results, however, do not match this pattern. Instead, the level of B recall exceeded the level of both once-presented items and the D items in the AB-AD condition. It might be tempting to explain this result in terms of proactive interference; in other words, participants saw the first brand name (B) and this interfered with their learning of the second name (D). Although this explanation would account for lower recall of the D response it cannot explain why recall for the B response was actually higher than for brands shown only once. Some mechanism was acting on P1 for the spaced ads that increased its recall. As P2 moved to a later point in the sequence, recall of P1 improved, meaning that when P2 was presented some process was engaged that accessed and changed the memorized representation of P1. Overall, the results are quite consistent with the pattern predicted by study-phase retrieval. Importantly, the pattern of findings does not match the pattern predicted by the encoding variability hypothesis, which has been the dominant explanation of the advantages of spacing in the marketing literature.

EXPERIMENT 2

Although experiment 1 supports the idea that study-phase retrieval plays a key role in the effects of spacing, it does not rule out the possibility that encoding variability plays a secondary role. Furthermore, the evidence from experiment 1 that the recall of ads benefits from study-phase retrieval has important implications with respect to ad variation. Even if encoding variability is not the main contributor to the spacing effect, it is possible that inducing variation may increase the benefits of spacing. In fact, Unnava and Burnkrant's (1991) finding that variation improves recall offers some support for the idea that spacing and induced variation might bear a symbiotic relationship to each other: to the extent that induced variation increases the difficulty of study-phase retrieval, it may also increase the potency of such retrieval, at least when such retrieval is successful.

There are reasons to expect, however, that spacing and induced variation might interact in their effects on later recall. Study-phase retrieval is a process whereby P2 triggers retrieval of P1. To the extent that changes from the first to second presentation of an item—that is, induced variation—reduce the number of cues available for retrieving P1, retrieval of P1 will not be triggered. Thus, for ads repeated after short lags, where study-phase retrieval would tend to be easy and, therefore, not very effective, variation might not only have benefits in its own right but also increase the difficulty of retrieving the first ad and, hence, the benefits of such study-phase retrieval. When ads are repeated after longer lags, on the other hand, variation may prevent the repetition from triggering reference to P1 and hence the benefits of its retrieval.

Predictions can be made based on two assumptions: either (1) that the effects of spacing and induced variation are cumulative or (2) that the benefits of spacing and induced variation interact as suggested above. Experiment 2 was designed to test these competing predictions. In order to include a spacing interval long enough to make it probable that a repeated ad, in a changed format, would not induce a retrieval of the first ad, experiment 2 used two booklets, studied 8 min. apart, with some ads repeated in both booklets.

Method

Participants. Seventy-four undergraduates from introductory psychology courses at a large West Coast university participated as partial fulfillment of course requirements.

Design. The design was similar to that of experiment 1, with a few key differences. First, only one brand name (not two) appeared for any given target product. The AB-AD condition was replaced with an AB-AB condition in which two variations of an ad were shown for the same product. Second, all brand names in experiment 2 were semantically unrelated to the product advertised. Third, ads were repeated both between and within booklets.

These changes resulted in an experimental design in which repetition, variation, and spacing were manipulated within subjects. Repetition was manipulated by showing a participant an ad for a given product once or twice. Variation was manipulated within the repeated-ad conditions: the second ad shown for a product was either identical to, or a variation of, the first ad. For the repeated ads, the two presentations of a given ad were separated by 0, 2, or 4 intervening ads within a booklet, or 10 min. between booklets. Specific item and order effects were counterbalanced using four 12 × 12 Latin squares so that every ad appeared in every condition and in every position across participants.

Materials. Forty-eight different sequences of ads were presented in two 12-page booklets. The products were identical to those in experiment 1. The brand names were held constant for each product, but the ads were varied, appearing in two possible layouts to allow for the manipulation of variation. Layout A was identical to that used for all ads in experiment 1. Layout B presented the same brand name, features, and slogan, but with different fonts and pictures. To eliminate order effects, layout A occurred first for half of the ad repetitions in the variation condition, and layout B occurred first for the other half. Half the ads that were repeated exactly or shown only once appeared in layout A; the rest appeared in layout B.

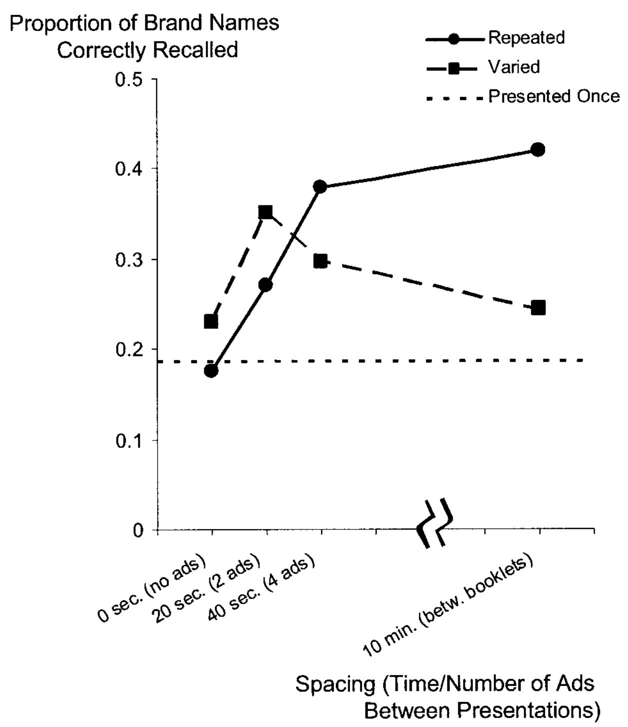
Procedure. The ads were presented in two separate booklets. Participants were given 10 sec. to study each ad, and a taped prompt alerted each participant when to turn to the next ad. For the second part of the study phase, participants were asked to recall their teachers from kindergarten through twelfth grade as an 8 min. filler task. The participants were then given a second booklet of ads and asked to follow the same procedure as for the first booklet. After completing the second booklet, participants were given five difficult mazes to solve as a 5 min. distracter task. Finally, they completed a cued recall test of the brand names of the products presented in both booklets. On this test the cue consisted of the product type (e.g., camera or stapler) and slogan rather than the picture and slogan as in experiment 1 (a change motivated by the fact that two different pictures were shown in the varied-ads condition).

Results and Discussion

The data were analyzed using a within-subjects analysis of variance. The proportion of participants that could recall brand names on the final test is plotted in figure 5 as a function of presentation condition. The level of recall for pairs of ads presented in the first booklet did not differ significantly from recall of those presented in the second

FIGURE 5

RECALL OF BRAND NAMES—EXPERIMENT 2



NOTE.—Mean proportion correct recall for the repeated conditions of experiment 2 is plotted as a function of the spacing interval. The once-presented baseline is the mean proportion of correct recall for all single presentations. The *x*-axis shows the spacing interval.

booklets ($F(1, 73) = .00$, $p = .97$), so the results for the within-booklet conditions are shown collapsed over booklet.

Overall, there was a significant main effect of spacing: spaced repetitions were remembered better than ads repeated back to back ($F(3, 219) = 3.01$, $p < .05$). There was no significant main effect of variation of the ads ($F(1, 73) = .55$, $p = .46$), but, importantly, the interaction between spacing and variation was significant ($F(3, 218) = 2.91$, $p < .05$). Varied repetitions produced better recall than did exact repetitions at the short spacing intervals, but exact repetitions produced better recall at the longer between-booklet interval. This pattern is consistent with the idea that recall can suffer if variation across ads prevents reference to a prior ad and, hence, impedes study-phase retrieval.

EXPERIMENT 3

The critical assumption underlying the explanation of the interaction between variation and spacing that was observed in experiment 2 is that variation, given a long enough spacing interval, decreases the likelihood that a repetition cues recovery of the first presentation. Experiment 2 was not designed, however, to provide a direct measure of the influence of variation on the extent to which an ad repeated in booklet 2 was recognized as a product advertised in booklet 1. Experiment 3 was carried out to provide direct evidence relevant to the influence of variation on recognition—and, hence, the possibility of study-phase retrieval—during booklet 2.

Method

Participants. Seventy-four undergraduates from introductory psychology courses at a large West Coast university participated as partial fulfillment of course requirements.

Design, Materials, and Procedure. The design and materials were identical to those used in experiment 2. The participants followed a procedure identical to that of experiment 2 until they reached the second ad in the second booklet. For half of the participants the ad in question was a variation of an ad they had seen in the first booklet; for the rest, it was an exact repetition. At this point the procedure was interrupted and the participants were asked if they had seen an ad for the same product in the first booklet. If they answered yes, they were then asked whether the ad they saw earlier had the same brand name. Although, in fact, the brand name for a given product was always the same in both ads, the question was included as a means of detecting uncertainly or confusion on the participants' part that might arise from difficulty retrieving details of the earlier presentation in booklet 1.

Results and Discussion

All of the participants in the exact-repetition condition reported seeing an ad for the same product in the earlier booklet, whereas only about half (47%) of the participants in the varied-repetition conditions reported seeing such an ad earlier ($\chi^2 = 10.90$, $p < .01$). Of the participants who reported seeing an ad for the product before, only 20% of those in the exact-repetition condition believed the first ad was for a different brand, whereas 57% of those in the varied ad condition thought it was for a different brand ($\chi^2 = 3.04$, $p = .08$).

To check whether the false-positive rate was sufficient to explain these results, five additional participants followed the exact same procedures but were shown a new ad, rather than a repeated ad, as the second ad in the second booklet. None of these participants reported seeing an ad for the same product during the experiment. In total, then, experiment 3 results are entirely consistent with the notion that an exact repetition of an ad is easy to detect after a 10 min. interval, but 10 min. is long enough for participants to have difficulty recognizing a varied repetition as a repetition.

EXPERIMENT 4

Experiment 2 suggests that exactly repeated ads are better recalled than varied ads when the lag between two presentations is of a moderate length. Experiment 3 provides evidence that participants have greater difficulty retrieving varied ads than retrieving exactly repeated ads at P2 when P2 occurs at a 10 min. lag. Although these two experiments provide support for the importance of study-phase retrieval in producing the spacing effect, they do not rule out the possibility that encoding variability could function to improve recall still further. It is possible that the visual variation of the ad layout exceeded the level of variation that might be most effective, in essence exceeding the boundary conditions within which encoding variability would be most beneficial. Perhaps a more subtle variation manipulation would uncover a benefit of encoding variability on recall. Experiment 4 was designed to explore this question in the context of a variation in presentation medium across repeated ads for a given product. Digital presentation of ads on a computer was chosen as the second medium for this experiment.

If encoding variability is partly due to a change in cognitive environment, then showing ads in two different media should alter participants' mental set when the second ad is presented, encouraging a more varied encoding of exactly repeated ads. This variation is more subtle than that induced by changing the ad layout and should not exceed the limits within which encoding variability might improve recall. If such contextual variation improves encoding, we might expect to see the best recall for exactly repeated ads shown in two different media, followed by recall of exactly repeated ads shown in the same media. Furthermore, we might expect this added level of variation to lower recall of ads shown in varied executions across two media when compared to varied ads presented twice in the same medium. If, however, this contextual variation has no effect on recall, it would be additional evidence that study-phase retrieval, not encoding variability, is the principal mechanism behind the spacing effect.

In an effort to generalize our findings from the first three experiments we also added an additional dependent variable: recognition. Recognition is an easier task than cued recall because the cue in recognition is the stimulus itself. Participants can base their answers on an overall judgment of familiarity, without the need to recover episodic information about a prior presentation. Increased spacing should increase recognition for brand names due to retrieval at the time the second presentation. Although variation may disrupt this retrieval, the encoding variability induced by variation may increase familiarity judgments of the brands, thus bringing recognition levels for varied presentations up to the levels of recognition for ads that are exactly repeated at longer lags. For ads repeated at shorter lags we would expect recognition results to match the pattern of recall results with varied ads enjoying an advantage.

Method

Participants. Ninety-six undergraduates from an introductory marketing course at a large West Coast university participated as partial fulfillment of course requirements.

Design. The design was identical to that used in experiment 2 with the addition of a variable: presentation medium. Participants were assigned randomly to the four modality groups (booklets, computer presentation, or a combination). Thus, repetition, variation, and spacing were manipulated within subjects (in a manner identical to that used in experiment 2), and presentation medium was manipulated between subjects. Specific item and order effects were counterbalanced using two 12 × 12 Latin squares so that each of the 12 target ads appeared in every condition and in every position across participants.

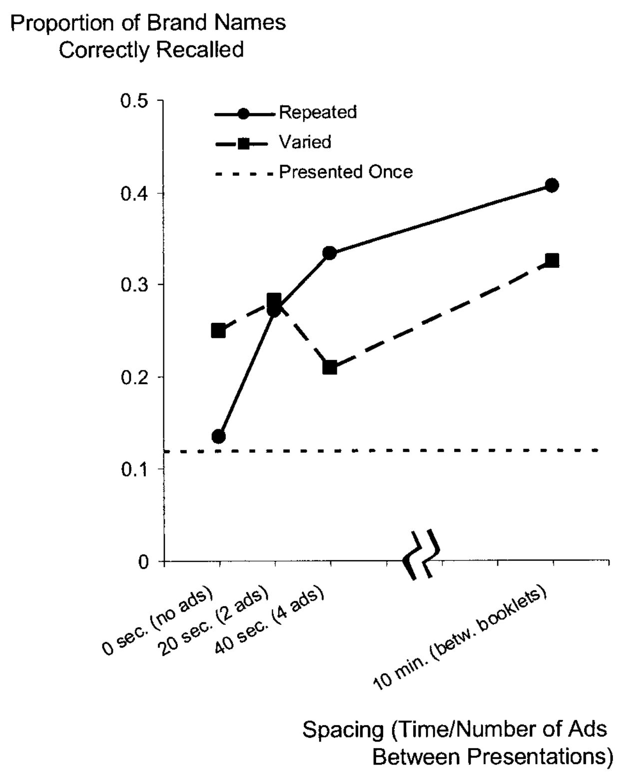
Materials and Procedure. A different sequence of ads was presented to participants in four possible combinations of media: two 12-page booklets, a 12-page booklet followed by a corresponding sequence on a computer screen, the computer sequence followed by the booklet, and two sequences, one after the other, on a computer. The ads were identical to those in experiment 2. Experiment 4 followed the same procedure as experiment 2 except for the difference in presentation modality. In addition to the cued recall test administered in experiment 2, participants also received a recognition test that consisted of yes/no recognition questions and included the 12 target brand names in addition to six foils that had never been presented.

Results and Discussion

Recall Results. The recognition and recall data were analyzed with separate mixed analyses of variance. The proportion of correctly recalled brands on the final test is plotted in figure 6 as a function of spacing. The level of recall for ads presented on the computer did not differ significantly from recall of those presented in booklets or those presented in both media ($F(3, 725) = 1.20, p = .31$), nor did medium

FIGURE 6

RECALL OF BRAND NAMES—EXPERIMENT 4



NOTE.—Mean proportion correct recall for the repeated conditions of experiment 4 is plotted as a function of the spacing interval. The once-presented baseline is the mean proportion of correct recall for all single presentations. The *x*-axis shows the spacing interval.

interact with spacing ($F(9, 725) = 1.07, p = .38$) or variation ($F(3, 725) = 1.32, p = .27$), so the results are shown collapsed across medium.

Overall, there was a significant main effect of spacing: spaced ads were recalled better than ads shown close together ($F(3, 380) = 4.11, p < .01$). There was no significant main effect of variation ($F(1, 190) = .34, p = .56$), but, as in experiment 2, the interaction between spacing and variation was significant ($F(3, 190) = 6.96, p < .001$). Varied repetitions produced better recall than did exact repetitions at the short spacing intervals, but exact repetitions produced better recall at the longer between-phase interval. This pattern replicates experiment 2 results and suggests that recall can suffer if variation across ads prevents study-phase retrieval.

An additional analysis comparing recall of ads repeated at a 10 min. lag across different media (computer-booklet and booklet-computer, $M = .36$) to recall of ads repeated in the same medium (booklet-booklet and computer-computer, $M = .36$) reveals no effect of mixing media on recall ($F(1, 188) = .00, p = 1.00$) nor any interaction between mixed media and variation ($F(1, 188) = .09, p = .76$).

These results do not suggest that a change in cognitive environment enhances the benefit of spacing on recall. However, they are consistent with the idea that study-phase retrieval processes lead to improved recall of spaced ads and that these processes are not disrupted nor enhanced by subtle changes to a person's cognitive environment.

Recognition Results. The proportion of correctly recognized brand names is plotted in figure 7 as a function of presentation condition. They show a different pattern from that of the recall data. The level of recognition for ads presented on the computer did not differ significantly from recognition of those presented in booklets or those presented in both media ($F(3, 725) = 1.11$, $p = .34$), nor did medium interact with spacing ($F(9, 725) = .64$, $p = .76$) or variation ($F(3, 725) = .94$, $p = .42$), so the results are shown collapsed across medium.

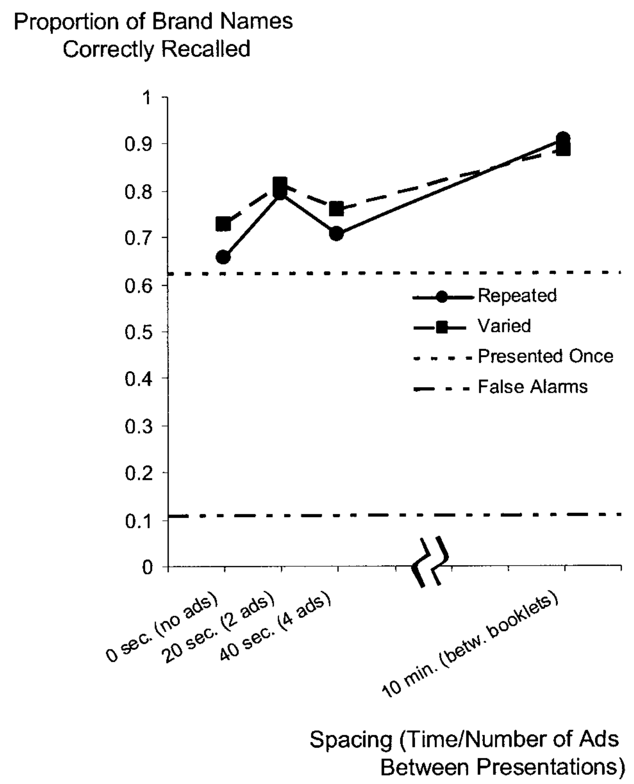
Overall, there was a significant main effect of spacing: spaced repetitions resulted in better recognition than did massed repetitions ($F(3, 380) = 10.12$, $p < .0001$). There was no significant main effect of variation ($F(1, 190) = 1.00$, $p = .32$), and, unlike the recall results, there was not an apparent interaction between spacing and variation, ($F(3, 380) = .45$, $p = .72$). Unlike the recall results, there was no benefit to recognition of varied repetitions at the short spacing intervals, nor was there a benefit of exact repetitions at the longer between-phase interval.

An additional analysis comparing recognition of the ads repeated at a 10 min. delay across different media (computer-booklet or booklet-computer, $M = .92$) to recognition of ads repeated in the same medium (booklet-booklet or computer-computer, $M = .88$) reveals no effect of mixing media on recall ($F(1, 188) = .22$, $p = .64$) nor any interaction between mixed media and variation ($F(1, 188) = 2.00$, $p = .16$). These results do not support the idea that a change in cognitive environment enhances or detracts from the benefit of spacing on recognition.

Overall, the recognition test, not surprisingly, produced a higher level of performance than did the recall test. Furthermore, the benefit to recall created by variation of ads shown at shorter intervals is not found in recognition. Because recognition is an easier task, a more effortful encoding caused by a retrieval made more difficult due to variation may not provide as much benefit as it does in the more difficult cued recall task. Additionally, conditions of a cued recall test more closely match the process of study-phase retrieval than do the conditions of a recognition test. Thus, study-phase retrieval may serve as better practice for later retrieval than for later recognition. Finally, recognition is not harmed by variation in ads shown at longer intervals (across phases). Ad recognition is based on familiarity as well as the ability to retrieve episodic information about having seen an ad. Therefore, the failure of a second presentation to cue retrieval of an earlier presentation may be less harmful to recognition than it is to cued recall, which depends entirely on retrieval of information from memory.

FIGURE 7

RECOGNITION OF BRAND NAMES—EXPERIMENT 4



NOTE.—Mean proportion correct recognition for the repeated conditions of experiment 4 is plotted as a function of the spacing interval. The once-presented baseline is the mean proportion of correct recall for all single presentations. The false alarms are the mean proportion of not presented brand names that were falsely identified as having been shown in the experiment. The *x*-axis shows the spacing interval.

GENERAL DISCUSSION

Several findings from the present research merit comment. First, the results of experiments 1, 2, and 4 constitute evidence that the benefits of spacing repetitions of advertising materials derive primarily from study-phase retrieval processes, not from encoding variability. Although encoding variability may be a factor in the later recall of advertisements, it cannot, by itself, account for these results.

A second important finding is that, across repetitions of advertisements for a given product, varying the format of an ad interacts with the spacing of repetitions in its effects on later recall. As demonstrated in experiments 2 and 4, variation helps at short spacing intervals, but hurts at long intervals. The most straightforward interpretation of these findings is that variation does help later recall but that variation can be counterproductive under conditions where such an ad variation fails to cue the retrieval of an earlier ad. Apparently, even the 10 min. lag between ads in experiments 2 and 4 was enough, in the varied-repetition condition, to decrease the frequency of study-phase retrieval at the time of the second presentation, resulting in poorer recall of items in that condition than in the exact-repetition condition. Importantly, the results of experiment 3 confirm that participants were indeed less able to recognize varied ads as repetitions in the 10 min. delay condition. Up to a point, variation can make study-phase retrieval more effective by making it more difficult and involved—and, hence, more effective in supporting subsequent recall. For study-phase retrieval to be effective, however, retrieval must be possible, if effortful. At the point that induced variation results in a failure of retrieval, it becomes counterproductive.

A third finding is that recognition may not suffer from variation as does cued recall. Experiment 4 shows that, contrary to recall results, recognition levels of varied ads shown at moderate lags are comparable to recognition levels of exactly repeated ads shown at the same lags. It is possible that a variable encoding increased the familiarity of brand names, thus aiding recognition, even though it disrupted study-phase retrieval for a certain percentage of ads shown.

These experiments all focused on short or moderate time lags between ad presentations. These lags are consistent with the presentation pattern of ads that a person would encounter when reading through a fashion magazine, browsing an Internet site or waiting for a movie to start. However, this work does not address ad repetitions shown at longer lags, such as would occur in television advertising. It is possible that cognitive mechanisms for encoding ads would operate differently in environments where smaller groups of ads are shown over longer periods of time. Although the pattern of memory effects is remarkably similar at different time scales (Bahrick et al. 1993; Peterson and Peterson 1959), the generality of the present results need to be verified for other temporal intervals.

Another important area for further exploration pertains to the effects of encoding variability and study-phase retrieval on memory for ads shown multiple times or ads touting products for which a robust memory representation already exists (as opposed to new products). It may be that study-phase retrieval and encoding variability play different roles in the initial stages of learning than they do later on. As the number of ads shown or prior product knowledge increases, induced variability may become more important for additional learning because retrieval of prior ads is easier.

The present research, by providing evidence for the role of study-phase retrieval in the spacing effect and by demonstrating that variation can hurt recall under certain circumstances, is a significant step in understanding the cognitive mechanisms behind the benefits of spacing to-be-learned material. It is important to mention, too, that the study-phase retrieval idea can help make sense of past research on the spacing effect that seems contradictory. Schumann, Petty, and Clemons (1990) compared recall of varied and identically repeated ads and found virtually no differences in recall of varied compared to identically repeated ads. Unnava and Burnkrant (1991), in contrast, found recall of varied ads to be higher than recall of identically repeated ads at a lag of nine intervening ads. Based on the results of experiments 2 and 4 in this article, such a lag is not likely to disrupt retrieval processes and in fact may be an optimal point in terms of combining the benefits of study-phase retrieval and encoding variability. In Schumann et al.'s research, an ad was shown four or eight times (depending on condition), which may have reduced the benefit of retrieving prior exposures from memory (as the retrieval process became easier). Conversely, easier retrieval would mean that variations would more likely be retrieved after the second or third exposure, thus bringing recall rates to similar levels in the two conditions. However, neither study used more than one ad and neither varied the spacing of exposures.

CONCLUDING COMMENT

The dynamics of human memory are complex, multifaceted, and quite unlike the dynamics of man-made memory devices, such as a videotape recorder or a computer's hard drive. They are only now becoming understood. Research on metacognitive processes has demonstrated that the mental model humans have of how their own memories work is often oversimplified and sometimes altogether incorrect (see, e.g., Bjork 1999). To optimize the effectiveness of advertising, therefore, may require overcoming, not drawing on, our common sense and intuition.

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