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UPON AWARENESS AND ATTITUDES.

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UPON AWARENESS AND ATTITUDES

DISSERTATION

Presented in Partial Fulfillment of the Requirements for
the Degree Doctor of Philosophy in the Graduate
School of The Ohio State University

By

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1967

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CHAPTER I

INTRODUCTION

This study examines the effects of repeated exposures on awareness of and attitudes toward advertising communications. In addition, it is hypothesized that a mathematical model representing the classical learning curve provides an accurate description of the effects of repetition on awareness of advertising.

"Over the years, one of the most controversial and elusive questions in advertising concerns how frequently an advertising message should be transmitted to the consumer."¹ Experts in marketing seem to agree that some repetition is nearly always beneficial to a campaign. Research studies tend to support the thesis that advertising repetition and continuity

are valuable from any point of view: awareness, attitudes, or sales. After reviewing some of the pertinent literature, Lucas and Britt point out that succeeding advertisements are effective by building up weak impressions to a level leading to buying interest. Engel, et al. suggest that repetition can contribute toward strengthening a predisposition to think about and act favorably toward a brand, product, or retail outlet.

Once one goes beyond this apparent agreement on the general desirability of repeated advertising the opinions are no longer unanimous. According to Julian Simon, "There is no piece of conclusive evidence to support the general belief that

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economies of scale exist in advertising." The issue was defined in a recent article in Media-Scope, "Repetition in advertising is accepted and unquestioned as a necessary preliminary to product sales; but, exactly how much is enough, and at what point its efficiency breaks into a plateau is a difficult, and certainly a crucial question." 6

What is the best frequency of advertisements? How does repetition of the same advertisement in the same vehicle affect awareness, attitudes, and sales? Can repetition be overdone? Do ads "wear out"? Marketing strategists continually face these perplexing questions. Unfortunately, the present state of knowledge does not provide the advertising practitioner with sufficient unambiguous guidelines. Approval of major advertising expenditures is one of the most important decisions that face advertising planners, and media scheduling is a major component of these decisions. If optimum media scheduling is ever to be achieved, then answers to the above questions must be obtained. For this reason, an experimental study was conducted which investigated some of the parameters associated with the repetition of advertising.

6"Can Ad-Deprived Products Survive?" Media-Scope, April 1964, 8, 62-66.
REVIEW OF THE LITERATURE

Most human behavior is learned. "Learning so pervades human activity that any curiosity about the nature of man and his behavior leads sooner or later to inquiry about how his habits are formed, how his skills are acquired, how his preferences and tastes develop, how his knowledge is obtained and put to use." It is not surprising, therefore, to discover that much of psychological research is concerned with the study of learning.

There is probably no other field in psychology which has generated the volume of research as has the study of learning. It is disappointing, therefore, to discover that very few theories or principles of learning are unequivocal and widely accepted. One of the unique areas where research findings tend to approach the level of principles is memory. One of the so-called "laws" of memory is that, "The strength of an association depends directly on the frequency with which it has occurred." Since the early days


of research in learning a major experimental variable of interest to psychologists has been the number of practice trials, or repetition.

This literature review relating to the effects of repetition will provide the necessary theoretical background for the hypotheses which then follow. The discussion covers four areas of subject matter: (1) Repetition and Memory; (2) Mathematical Models; (3) Repetition and Attitudes; and (4) Applications in Advertising.

Repetition and Memory

Retention was one of the first aspects of human learning to be studied by laboratory methods. In 1885 Ebbinghaus published the results of a long series of experiments which he made upon himself. These studies, on the memorizing of nonsense syllables, are a landmark in experimental psychology because they introduced experimental procedures to the study of human verbal learning.

One of the problems investigated by Ebbinghaus was the effects of lapse of time on memory. The results of this research yielded the famous "forgetting curve." The most important feature of this curve is that most forgetting occurs very shortly after the original learning.
Besides the effects of time lapse, Ebbinghaus was concerned with appraising the consequences of different amounts of repetition on memory. He found that the amount of time necessary to relearn a series of nonsense syllables was directly proportional to the number of times the series was repeated during the original learning session.\(^9\)

Ebbinghaus has inspired many psychologists to this day. Krueger,\(^{10}\) Cantril and Allport,\(^{11}\) Zielske,\(^{12}\) and Hellyer, among many others, have replicated the now classical effects of repetition with a wide variety of stimulus materials. The results of this research confirm the conclusions that recall improves with an increase in the number of repetitions and with briefer intervals of delay.

Benton Underwood is among the many current

\(^{9}\)Ibid.


\(^{13}\)S. Hellyer, "Frequency of Stimulus Presentation and Short-Term Decrement in Recall," *Journal of Educational Psychology*, 1962, 64, 650.
psychologists studying the dynamics of memory. His theory suggests that forgetting is a result of interference between the various associations stored in the memory system.\textsuperscript{14} He has demonstrated this principle in several experiments.\textsuperscript{15} This research led Underwood to the conclusion that "Perhaps the results...are merely another illustration of the fact that periodic repetition or use of an item makes it resistant to forgetting."\textsuperscript{16} The more frequently an item is used the greater its resistance to the effects of interfering associations.

Hilgard and Bower effectively summarize this research, "The more times a target item is presented and rehearsed..., the better is the recall of the target item at every retention test interval."\textsuperscript{17} This theoretical principle is the basis for the hypotheses which relate repetition to awareness in this study.


\textsuperscript{16}Underwood (1964), \textit{op. cit.}

Mathematical Models

As a field of science progresses, it is common for theorists to attempt to stipulate their propositions in quantitative language. This trend toward the development of mathematical theories has not escaped the psychology of learning.

Ebbinghaus applied mathematics to the forgetting curves he obtained. He proposed that the proportion of material forgotten over time increases as the logarithm of the time since initial learning.\(^{18}\) Thorndike, influenced by Cattell, applied statistical models to his significant experiments in animal psychology.\(^{19}\) Since these early applications of mathematics to learning, this area has developed into an important sphere of activity in psychology.

Around the turn of the century, there was considerable debate about which of several different functions was the most appropriate. Each of the various so-called "learning functions" was tested by curve-fitting procedures. The number of free,

\(^{18}\)E. Ebbinghaus, Memory, Publication of Columbia Teachers College (New York: Columbia University, 1913).

arbitrary, and unexplained parameters was unlimited. Thurstone was the first to develop a "rational" learning function which was based upon a set of axioms derived from psychology.\textsuperscript{20} These parameters, specifically identified in psychological terms, represented a significant improvement over the curve-fitting procedures typical of the previous two decades. Furthermore, Thurstone incorporated the number of repetitions into his model. His theory predicted the probability of a correct response in terms of the number of practice trials.\textsuperscript{21} This theoretical model was extended by Gulliksen,\textsuperscript{22} and Wiley and Wiley.\textsuperscript{23}

Perhaps the most significant researcher in the area of learning theory was Clark Hull. He was trained as an engineer prior to becoming a psychologist, and the engineer's perspective is

\begin{footnotes}


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clearly evident in his work. Hull endeavored to develop a theory of learning based on a mathematical logic, deduced from a formal, elaborate, and rigorous system of postulates. As part of his work, he attempted to restate Ebbinghaus' findings in more precise terms.

A key variable in Hull's system was termed "habit strength." This was defined as an associative bond connecting a stimulus and a response. According to Hull, this connection is a direct function of the number of reinforced trials. Habit strength was characterized by the following mathematical formulation:

\[ H = M(1 - e^{-in}) \]

where: 
- \( H \) = habit strength,
- \( M \) = maximum strength of the habit
- \( e \) = the base of the natural logarithm
- \( n \) = the number of practice trials
- \( i \) = the rate of learning.

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24 C. L. Hull, Essentials of Behavior (New Haven, Conn.: Yale University, 1951).
Hull's theories still guide the research of many current experimental psychologists. The theory has had, of course, several revisions. Since Hull's death, the chief innovator and contributor involved in extending Hull's theory has been Kenneth Spence.\textsuperscript{25}

A modification of the above model provides the mathematical function which is employed in the second hypothesis in this study. This model is described, along with the associated hypothesis, in a later section.

Repetition and Attitudes

Besides affecting awareness of a communication, repetition may also affect attitudes toward a communication. A positive increment in awareness due to repetition is not necessarily associated with a similar positive change in attitudes. Repetition may result in negative attitude change. Some research has been focused on this effect.

In one study, subjects were read a series of

\textsuperscript{25}K. W. Spence, \textit{Behavior Theory and Conditioning} (New Haven, Conn.: Yale University, 1956).
numbers. Then, they were asked to choose one of the numbers they had heard. The proportion of times that each number occurred in the series was controlled. It seems that the relationship between the proportion of exposures and the proportion of choices is positive and linear, up to a point. Repetition consisting of fifty per cent of all exposures seemed to have a negative effect. This study is important because the "density" of presentations (i.e. the proportion of exposures of a message) is the major independent variable, rather than "frequency" (i.e. the number of exposures). The third hypothesis in this study is based upon the effects of density on attitudes, and thus attempts to replicate these findings.

Other research has been primarily directed toward attitude changes due to frequency. Working with nonsense syllables, Becknell, et al.27 found that women more often chose nylon stockings from


boxes marked with syllables previously exposed at a high frequency than from boxes labeled with low-frequency syllables. Cromwell and Kunkel report that each successive repetition had the effect of causing the audience to diverge more and more from its original attitude and in the direction intended by the speaker.  

Not all authors agree, however, on the positive effects of repetition on attitudes. Hovland noted that if conditions are right, repetition does bring stronger habits. If they are not right, such as when the response is not rewarded, extinction may be the result. According to Hovland, it appears that "too frequent repetition without any reward leads to loss of attention, boredom, and disregard of the communication."  

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30 C. I. Hovland, et al., Communication and Persuasion (New Haven, Conn.: Yale University, 1953).
The data on the effects of repeated exposure upon attitudes are inconclusive and inconsistent. Annis and Meier\textsuperscript{31} found no difference between seven and fifteen exposures to newspaper editorials. Hovland, \textit{et al.}\textsuperscript{32} found that exposure to two films produced results no better than exposure to a single film. In apparent contradiction to these findings, Peterson and Thurstone\textsuperscript{33} found that repeated exposures to films on the same topic were consistently better than a single exposure. This finding is partially substantiated in the classical research conducted by Lazarsfeld and his colleagues.\textsuperscript{34}

These contradictory findings regarding repetition and attitudes toward a communication are difficult to reconcile. The fourth hypothesis relates to this


\textsuperscript{33}R. C. Peterson and L. L. Thurstone, \textit{Motion Pictures and the Social Attitudes of Children} (New York: Macmillan, 1933).

\textsuperscript{34}P. F. Lazarsfeld, \textit{et al.}, \textit{The People's Choice} (New York: Columbia University, 1948).
topic and, hopefully, will clarify the present dilemma.

Another effect of repetition investigated by a small group of psychologists is termed satiation. This refers to the apparent loss of meaning of a message due to repetition. Only a few researchers have confirmed this effect experimentally. As long ago as 1919, Bassett and Warne demonstrated that the meaning of a familiar monosyllabic noun repeated aloud for several seconds loses its meaning.

Lambert and Jakobovits studied satiation using Osgood's Semantic Differential scale to measure meaning previous to and following repetition. They discovered that the meaning of a stimulus word disappears with repetition.

These authors have viewed satiation as a cognitive form of the more general phenomenon of

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extinction. They have argued that "the continuous consideration of a stimulus word repeatedly calls into activity the mediation processes which have become identified with the meaning of that word, until the likelihood of their further elicitation is reduced or suppressed." 37 If the concept of satiation has generality, they claim that "Its effects should be discernible in all cases where repeated stimulation can presumably affect the mediation processes underlying symbols of various types." 38

However, attempts at verifying the generalizability of satiation to something other than verbal stimuli have not been successful. Messer, et al. 39 found satiation of words but not of numbers. Schwartz and Novick 40 failed to find satiation with pictures.

37 Ibid.
38 Ibid.
Some authors have questioned the experimental procedures of the satiation researchers (Yelen and Schulz,41 and Amster,42 and Schulz, et al.43). So far the findings are not sufficiently clear to adequately illuminate the overall problem of repetition and meaning. Further work is needed. The final hypothesis of this research project correlates repetition with ratings on a Semantic Differential scale. An answer to whether repetition of advertisements results in loss of meaning may be obtained.

Applications in Advertising Research

Advertising Repetition and Awareness. There is little reason to doubt that the recall of advertising follows the now classical "learning curves" described


by psychologists. Probably the first advertising study specifically oriented toward the problem of retention was conducted by Edward K. Strong. He replicated Ebbinghaus' "forgetting curves," but used advertisements rather than nonsense syllables. Adams studied the relationship between repetition and relearning. He concluded that the rate of forgetting for advertisements varies inversely with the number of repeated exposures during the original learning experience.

In a more recent study, Zielske duplicated Ebbinghaus' forgetting curves with direct mail advertising. In 1959, he evaluated the effectiveness of various advertising schedules. One to thirteen advertisements were mailed at weekly or monthly intervals. Housewives were tested for recall of the advertising after the last ad had arrived. The loss

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of retention following the last exposure followed the pattern expected by the classical forgetting curve. Zielske's data indicate further that as the number of exposures is increased there is an increase both in the size of the audience aware of the advertisement and in the time interval the advertisement is remembered.

BBDO\textsuperscript{47} conducted a study of a one-month television spot campaign. The percentage able to recall the advertised brand continued to increase throughout the entire period. Another study\textsuperscript{48} also examined the correlation between the number of television commercials seen and brand awareness measured by unaided recall. Brand awareness increased from twenty per cent for those not exposed to the commercial to ninety-two per cent for those viewing three or more commercials.

Rather than the brief time intervals typical of the above studies, there are several published reports where actual campaigns were evaluated for

\textsuperscript{47} BBDO Research Department, Unpublished Memorandum, January 27, 1961, Batten, Barton, Durstine & Osborn, New York.

an extended period of time. McGraw-Hill\(^ {49}\) followed a campaign through a six year period. Recognition of a company name continued to rise for two years. Then advertising was stopped. Three years later recognition decreased to a point even lower than the level at the outset of the campaign.

**Advertising Repetition and Attitudes.** Besides awareness, a considerable number of studies in advertising have attended to the problem of attitudes. In 1959, Alfred Politz\(^ {50}\) conducted a study for the *Saturday Evening Post*. He found that before exposure, 9.1 per cent of the readers said they would buy the brand in question. This increased to 11.3 per cent after one exposure, and to 13.8 per cent after two exposures. A study by the National Broadcasting Company\(^ {51}\) showed that viewers exposed to three


\(^{51}\)Wachsler, *op. cit.*
commercials liked the advertisement better than viewers exposed only once to the advertising. Research reported in Media-Scope\textsuperscript{52} and by Carrick\textsuperscript{53} substantiate these results.

Other research suggests, however, that repetition can have a boomerang effect. Capitman\textsuperscript{54}, for example, reports a decline in preference after the fourth exposure to the same commercial. A weak commercial, according to another study,\textsuperscript{55} appears to be especially vulnerable to negative effects of repetition.

Advertising Repetition and Sales. Finally, what is the relationship between repeated advertising and purchase behavior? It is logical to hypothesize a positive relationship between repetition and sales. The relevant research seems to support this contention.

One of the most extensive reports of repetition

\textsuperscript{52}"Frequency in Broadcast Advertising," Media-Scope, March 1962, 6, 57-64.


\textsuperscript{54}Media-Scope (1962), op. cit.

\textsuperscript{55}Ibid.
was conducted by John Stewart.\textsuperscript{56} He evaluated the benefits of extended repetition of the same advertisements for two new products. Advertising was confined to a daily newspaper which agreed to run a complicated "split-run" schedule. He concluded that considerable repetition is necessary if high brand awareness is to be achieved. Even more important, Stewart stated that at least fifteen consecutive advertising exposures were the most efficient in terms of lowest costs per additional sales.

In 1962, Starch\textsuperscript{57} did a study of repetition of magazine advertising and sales. His data are based upon five years of research concerning 105 brands in thirteen product categories. He concluded that the cross-over point from a decrease to an increase in purchases is at four pages a year. Another study by the National Broadcasting Company\textsuperscript{58} also showed a positive relationship between frequency of viewing a commercial and product purchases.


However, in another study, Starch found that coupon inquiries from successive advertisements exhibited a decline.

One major criticism of the above research on purchasing is that it is correlational. The conclusion that repeated advertising led to sales is questionable. In one of the few reported studies which employed a well-controlled experimental design to evaluate the effects of advertising on sales, Du Pont found that purchases of "Teflon" cookware were significantly higher in areas where high advertising expenditures were maintained.

Another major criticism of the research on repetition and sales is that an advertisement may be repeated in a medium, but it is highly unlikely that the same people will again be exposed to that ad. The results of a readership survey in two industrial magazines showed that a repeated

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59 Starch, op. cit.


61 "The Effectiveness of Repeated Advertisements," Industrial Marketing, 1947, 32, Nos. 9, 10, 11.
advertisement is "seen by at least as many new readers, or readers who don't recall seeing it before."\(^2\) This study and similar data reported by McGraw-Hill Research,\(^3\) suggest that the effect of repeated exposures of advertising to the same individuals is still unclear.

**Mathematical Models in Advertising.** As in psychology, advertising researchers have attempted to quantify the effects of repeated advertising. Strong concluded from his research that permanency of an advertising impression, measured by recall, increases as the cube root of the number of presentations. Benjamin recently reviewed five different mathematical models and concluded that a logarithmic response curve provided the best description of advertising effectiveness. David Learner\(^5\) describes the relationship between

\[^2\]Ibid.
\[^3\]Barton, op. cit.

advertising research and advertising awareness as highly non-linear, the basic mathematical function being a complex exponential equation. This function is incorporated in DEMON, a management planning and control system proposed for guiding effective decision-making in the introduction of new products.

To this date definitive research in advertising which permits proper evaluation of the variety of available mathematical models is lacking. The opportunity for marketing analysts to use mathematical techniques in measuring advertising effectiveness is promising. More research of this kind cannot help but be fruitful.

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CHAPTER II

DEFINITIONS AND HYPOTHESES

Independent Variables

The experimental variable most commonly manipulated by researchers in learning has been the number of trials, or exposures. An examination of the research literature since Ebbinghaus strongly supports this statement. The major independent variable in this study is termed frequency. This is defined as the total number of exposures for any specific advertisement.

The second independent variable is termed density, which is defined as the proportion of exposures for any given advertisement. The following relationship between frequency and density may be defined:

\[ D = \frac{n}{T} \]

where:  
\( D \) = density  
\( n \) = frequency  
\( T \) = total number of advertising exposures.
For example, suppose the total number of advertising exposures is fifty (i.e. \( T = 50 \)), and one particular advertisement appears ten times (i.e. \( n = 10 \)), then the density of this advertisement, in this condition, is equal to 0.20.

\[
D = \frac{n}{T} \\
D = \frac{10}{50} \\
D = 0.20
\]

Now, suppose that in another series, the same advertisement appears ten times again, but this time the total number of advertising exposures is seventy-five (i.e. \( T = 75 \)). The density for this ad, in this circumstance, would now be equal to 0.15.

\[
D = \frac{n}{T} \\
D = \frac{10}{75} \\
D = 0.15
\]

It can be seen, therefore, that density bears an inverse linear relationship to the total number of advertising exposures. If \( n \) is held constant, then as \( T \) increases, \( D \) decreases. If the total number of advertising exposures (\( T \)) is doubled, then the density (\( D \)) is halved.
The operational definition of density, for purposes of this study, was made in terms of \( T \), the total number of advertising exposures. Two levels of \( T \) were used: (1) low density -- \( T = 75 \); and (2) high density -- \( T = 50 \).

The variable called frequency (\( n \)) was manipulated by using six different levels for \( n \). These were (1) \( n = 1 \); (2) \( n = 2 \); (3) \( n = 4 \); (4) \( n = 8 \); (5) \( n = 12 \); and (6) \( n = 16 \). Thus, each advertisement occurred once, twice, etc. to sixteen exposures in any particular series.

The last independent variable in this design is the stimulus. This consisted of six "test" advertisements (two soup ads, two cigarette ads, and two beer ads).

In addition, a variety of "control" advertisements were used. These were added to the test slides to yield a total of seventy-five slides for the high density condition and fifty slides for low density. The exact procedure is described in the methodology chapter.
**Dependent Variables**

The first dependent variable is **awareness**. Awareness is an evaluation, by the subject, of whether or not they recognized individual slides presented in a test battery.

Three different measures of attitudes were employed in this study. The first is termed **saliency**. This is defined as those advertisements considered "conspicuous" by the subjects. Essentially, this variable is a combination of both awareness and attitudes. The methods of assessing saliency, and the other dependent variables, are described in the next chapter.

The second attitude variable is an **attitude rating**. The attitude rating is defined as whether or not the advertisements were "liked" by the subjects, and whether or not the ads would be read by the subjects.

Finally, a measure of **satiation** was obtained on five dimensions: believable-unbelievable, pleasant-unpleasant, meaningful-meaningless, interesting-uninteresting, attractive-unattractive. Satiation is defined as the neutral point on the Semantic Differential scale. The questionnaire
which was used in this study is included in the Appendix.

**Hypotheses**

One principle in psychology is that repetition can be expected to yield a progressive improvement in awareness of a message. The research in advertising seems to support this principle. The first hypothesis in this study relates awareness to repetition.

1. As frequency is increased awareness will also increase.

Psychologists who have attempted to quantify the learning function agree that the relationship between repetition and awareness is not linear. The model which was selected for this study is a modification of the Hullian model previously described.

\[ A_n = A_o + (A_{\text{max}} - A_o)(1 - e^{-n}) \]

where:
- \( A_n \) = level of awareness after \( n \) repetitions
- \( A_{\text{max}} \) = maximum expected level of awareness
- \( A_o \) = level of awareness before the first exposure
- \( e \) = base of the natural logarithm
- \( n \) = number of repetitions
The second hypothesis includes the above mathematical model.

\[ A_n = A_o + (A_{max} - A_o)(1 - e^{-n}) \]

is a good description of the learning curve associated with repeated advertising exposures.

The next hypotheses relate to saliency. An attempt is made to replicate the curvilinear relationship between density and attitudes predicted by Wells. The two next hypotheses concerning saliency are:

(3) As frequency increases the saliency of an ad will increase.

(4) The relationship between frequency and saliency will interact with density such that the slope in the low density condition will be greater than the slope in the high density condition.

Next, an hypothesis is suggested which follows from the research on attitudes toward repeated communications. The majority of the studies

---

indicate that repetition has a positive effect on attitudes. However, since the results are not consistent, more research is definitely required. For this reason the following hypotheses were tested.

(5) The relationship between frequency and attitude ratings toward an advertisement will be negative under high density.

(6) The relationship between frequency and attitude ratings toward an advertisement will be positive under low density.

Finally, an hypothesis was derived from the literature on semantic satiation. It is expected that excessive repetition will result in a loss of meaning for the advertisement. The following two hypothesis were proposed.

(7) Increased repetition will result in satiation, under high density.

(8) Increased repetition will not result in satiation, under low density.
CHAPTER III

METHODOLOGY

Research Approach

It was decided that proper evaluation of the several hypotheses previously described could be conducted through the use of a laboratory experiment. A laboratory experiment may be defined as "one in which the investigator creates a situation in which he controls some variables, and manipulates others."\(^1\) The researcher is able to evaluate the effect of his manipulations on one or more criterion variables. Furthermore, his controls are arranged so that possible contaminating factors are kept to a minimum.

Most laboratory experiments lack the degree of control implied by the above definition. Yet, they still remain a sound starting base for scientific

investigation. For these reasons, a laboratory research study was proposed and conducted in order to investigate the effect of repetition of advertising on awareness and attitudes.

**Research Design**

The independent variables in this design were: (1) frequency; (2) density; and (3) advertisements. These variables were defined in the previous chapter. The following levels of each independent variable were used:

1. **frequency** - six levels: one, two, four, eight, twelve, and sixteen exposures
2. **density** - two levels: T = 50, and T = 75 (where T is the total number of exposures)
3. **ads** - six levels: two beer, two soup, two cigarette

The design which was employed in this study is known as a **replicated Latin square design**. The Latin square design "permits the systematic removal of main effects due to the sequence in which the treatments are presented and due to the ordinal
position within the sequence. The advantage of this design over the "complete factorial" design is that it requires fewer subjects, and it removes the effects of between-subjects variability from the error term.

The Latin square design can be extended to permit the investigation of additional treatment variables. One such procedure is to extend the number of squares, and to assign a different level of the additional treatment variable to each of the squares. The effect due to the differences between the levels of this additional variable is confounded with the differences between the squares. If the squares are identical, then the effect may be attributed to variation between the levels ("between subjects" effect). With identical squares, the design is called a replicated square design.

The particular design which was employed in this study is diagrammed in Table 1. Frequency, density, and ads are considered "fixed" variables; and the group and subject factors are assumed to be

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TABLE 1
EXPERIMENTAL DESIGN

<table>
<thead>
<tr>
<th>Group</th>
<th>Series</th>
<th>Ads</th>
<th>Group</th>
<th>Series</th>
<th>Ads</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>a b c d e f</td>
<td></td>
<td></td>
<td>a b c d e f</td>
</tr>
<tr>
<td>I</td>
<td>1</td>
<td>16 a 1 12 2 8 4</td>
<td>VII</td>
<td>1</td>
<td>16 1 12 2 8 4</td>
</tr>
<tr>
<td>II</td>
<td>2</td>
<td>2 16 4 8 1 12</td>
<td>VIII</td>
<td>2</td>
<td>2 16 4 8 1 12</td>
</tr>
<tr>
<td>III</td>
<td>3</td>
<td>12 4 8 1 16 2</td>
<td>IX</td>
<td>3</td>
<td>12 4 8 1 16 2</td>
</tr>
<tr>
<td>IV</td>
<td>4</td>
<td>4 12 1 16 2 8</td>
<td>X</td>
<td>4</td>
<td>4 12 1 16 2 8</td>
</tr>
<tr>
<td>V</td>
<td>5</td>
<td>8 2 16 4 12 1</td>
<td>XI</td>
<td>5</td>
<td>8 2 16 4 12 1</td>
</tr>
<tr>
<td>VI</td>
<td>6</td>
<td>1 8 2 12 4 16</td>
<td>XII</td>
<td>6</td>
<td>1 8 2 12 4 16</td>
</tr>
</tbody>
</table>

\(^a\) denotes frequency
"random" variables. The analysis of this design is described in Winer.\(^3\)

**Sample**

The sample consisted of students enrolled in the Introductory Psychology course at Ohio State University. The subjects participated in this experiment as a partial fulfillment of the requirements of that course.

The ninety-six subjects were divided into twelve groups of eight. Each of the groups was randomly assigned to either the "high" or "low" density condition. Within each of the density conditions, each group was randomly assigned to one of the six series of advertisements. Thus, each of the twelve groups was assigned to a different treatment condition by a completely random process.

**Data Collection**

**Stimulus Materials.** Color slides (35mm.) of magazine advertisements were provided by Batten, Barton, Durstine & Osborn, a New York advertising...

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agency. These slides were arranged in a Kodak Carousel projector in such a way that the two independent variables, frequency and density, could be manipulated. The exact order of presentation of the advertisements was determined randomly. The only constraint was that an ad could not occur twice in succession.

In Series 1, for example, the respective ads occurred with the following frequency:

<table>
<thead>
<tr>
<th>Ad</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>16</td>
</tr>
<tr>
<td>b</td>
<td>1</td>
</tr>
<tr>
<td>c</td>
<td>12</td>
</tr>
<tr>
<td>d</td>
<td>2</td>
</tr>
<tr>
<td>e</td>
<td>8</td>
</tr>
<tr>
<td>f</td>
<td>4</td>
</tr>
</tbody>
</table>

This yields a total of forty-three exposures. For the high density condition seven additional "control" slides were added. This produced a total of fifty exposures ($T = 50$). For the low density condition twenty-five more control slides were added. They were randomized and then inserted at every third position in the series. This produced a total of seventy-five exposures ($T = 75$). A similar procedure was followed for each of the five remaining series of advertisements.

**Presentation of Stimuli.** Research findings in experimental social psychology indicate that the experimenter can unintentionally influence
these results. In order to minimize the occurrence of this bias, the procedures of administering the experiment were carefully standardized.

A person who did not help formulate the hypotheses actually conducted the experiment. This person adhered strictly to a procedure which permitted no improvisation. Following a carefully prepared introduction, the slides were presented. Each slide was exposed for eight seconds. This interval was controlled by an automatic timer.

Questionnaire. Following the exposure of the slides, a questionnaire was distributed. The subjects were instructed, "Of all the ads you just saw, pick one." Next, they were asked, "Of all the advertisements you just saw, pick another." The responses to these two questions were combined and used as the measure of saliency.

A slide was then presented. The subjects were asked, "Do you remember seeing this ad among those presented?" This was the measure of awareness.

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The next section of the questionnaire consisted of two rating scales. These were as follows:

1. This ad is --

<table>
<thead>
<tr>
<th>much below</th>
<th>somewhat</th>
<th>somewhat</th>
<th>much above</th>
</tr>
</thead>
<tbody>
<tr>
<td>average</td>
<td>below average</td>
<td>average</td>
<td>above average</td>
</tr>
</tbody>
</table>

2. How likely is it that someone would read this ad?

<table>
<thead>
<tr>
<th>very unlikely</th>
<th>moderately unlikely</th>
<th>undecided</th>
<th>moderately likely</th>
<th>very likely</th>
</tr>
</thead>
</table>

The ratings obtained from these two scales were combined to yield the attitude rating of the advertisement.

The final section consisted of five Semantic Differential scales. These were:

1. believable

2. unpleasant

3. meaningful

4. boring

5. attractive
The subjects were instructed to "Place a check mark on each scale to best indicate what this ad means to you." The combined ratings from these five scales provided the measure of satiation used in this study. The Questionnaire is included in the Appendix.

After evaluating the first advertisement, another ad was presented. The awareness, attitude rating, and satiation data were collected for this second advertisement. This procedure was repeated for each of ten more ads. Two of the twelve test ads had not occurred in the presentation sequence.

The order of the test slides was randomized. This order was rearranged every third session. The whole session lasted less than thirty minutes.
CHAPTER IV

DATA ANALYSIS

Awareness

(1) As frequency is increased awareness will also increase.

(2) The function

\[
A_n = A_0 + (A_{\max} - A_0)(1 - e^{-n})
\]

is a good description of the learning curve associated with repeated advertising exposures.

In order to estimate \(A_0\), the level of awareness before the first exposure, a "control group" was run. Each test ad was presented and the subjects in this group were asked to indicate whether or not they had seen this advertisement before. The sample size in the control group was equal to twenty-three. Across all of the twelve test slides, the average "claimed" awareness was 36.23 per cent. That is, on the average, a little more than one-third of the subjects said they could remember having seen a given test ad before.
Using this value, 36.23 per cent, as the expected proportion for $A_o$, it was possible to estimate $A_o$ for the experimental groups. Since each density condition consisted of forty-eight subjects, then $A_o$ for each of these conditions was set at $17.4$ ($0.3623 \times 48 = 17.4$).

Since there were forty-eight subjects in each density condition, the maximum possible number of people who could be aware of an ad is forty-eight. $A_{\text{max}}$, therefore, was set at forty-eight.

With these specified values for the various parameters, the mathematical model now becomes:

$$A_n = A_o + (A_{\text{max}} - A_o)(1 - e^{-n})$$

$$A_n = 17.4 + 30.6(1 - e^{-n})$$

Since this model describes a positive relationship between awareness ($A_n$) and frequency ($n$), the acceptance of this model automatically results in acceptance of the first hypothesis. For this reason, the adequacy of the model (Hypothesis 2) was tested before Hypothesis 1. It should be noted that if Hypothesis 2 is rejected, however, this does not necessarily suggest the rejection
of Hypothesis 1.

To test the model, actual levels of awareness were tabulated for each frequency level. In order to correct for biases of "over-recall" (false claiming), awareness data were obtained for two control advertisements. Since these ads did not appear in the presentation sequence, any "recognition" can be attributed to an "over-recall" bias. This is more likely to affect the awareness scores for ads occurring infrequently in the series. As a correction, therefore, the per cent of "over-recall" was subtracted from the awareness score for the lowest frequency level.

For the high density group, the per cent of false claiming was equal to 3.13 per cent. For the low density group there was 1.04 per cent false claiming. These two values were used to "correct" the observed awareness scores for the remaining advertisements. This result yielded an estimate of the "true" awareness for each frequency level. The mathematical model was used to generate "predicted" levels of awareness for each frequency. To evaluate the model, the predicted and true awareness scores were correlated. These scores are shown in Table 2.
## TABLE 2

**AWARENESS DATA**

<table>
<thead>
<tr>
<th>FREQUENCY</th>
<th>PREDICTED AWARENESS</th>
<th>TRUE AWARENESS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>HIGH DENSITY</td>
</tr>
<tr>
<td>0</td>
<td>17.40</td>
<td>--</td>
</tr>
<tr>
<td>1</td>
<td>36.74</td>
<td>42.5</td>
</tr>
<tr>
<td>2</td>
<td>43.87</td>
<td>46.0</td>
</tr>
<tr>
<td>4</td>
<td>47.44</td>
<td>48.0</td>
</tr>
<tr>
<td>8</td>
<td>47.45</td>
<td>48.0</td>
</tr>
<tr>
<td>12</td>
<td>48.00</td>
<td>48.0</td>
</tr>
<tr>
<td>16</td>
<td>48.00</td>
<td>48.0</td>
</tr>
</tbody>
</table>
The null hypothesis is:

\[ H_{02} : \text{There is no correlation between the true awareness scores and the awareness scores predicted by the mathematical model.} \]

The correlations (Pearson r) between the predicted and observed values in Table 2 are 0.998 for the high density group, 0.911 for the low density group, and 0.956 for the two groups. All of these correlations are significant beyond the 0.05 level. This level of significance is used for all of the statistical tests in this study.

These significant correlations permit the rejection of \( H_{02} \). It may be concluded that the proposed mathematical model is a good description of the change in awareness associated with repeated advertising exposures.

The null hypothesis associated with the first experimental hypothesis is:

\[ H_{01} : \text{There is no relationship between frequency and awareness, or the relationship is negative.} \]

The rejection of \( H_{02} \) automatically indicates that \( H_{01} \) ought to be rejected as well. We may conclude, at the 95 per cent confidence level, that there is
a significant positive relationship between frequency of advertising exposures and awareness. An additional test of the model is described in Appendix E.

Saliency

(3) As frequency increases the saliency of an ad will increase.

(4) The relationship between frequency and saliency will interact with density such that the slope in the low density condition will be greater than the slope in the high density condition.

The two items used to evaluate saliency were:

(1) "Of the ads you just saw, pick one;" and (2) "Of the ads you just saw pick another." The responses to both questions were combined to yield a saliency score for each advertisement at each level of frequency. The data for each frequency level were summed to yield a score for that level. These data are presented in Table 3.

The following null hypotheses were tested:

$H_03$: The relationship between frequency and saliency is negative or equal to zero.

$H_04$: The relationship between frequency and saliency for low density is equal to or less than the relationship for high density.
TABLE 3
SALIENCY DATA

<table>
<thead>
<tr>
<th>FREQUENCY</th>
<th>HIGH DENSITY</th>
<th>LOW DENSITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>11</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>13</td>
<td>7</td>
</tr>
<tr>
<td>8</td>
<td>9</td>
<td>14</td>
</tr>
<tr>
<td>12</td>
<td>23</td>
<td>18</td>
</tr>
<tr>
<td>16</td>
<td>19</td>
<td>28</td>
</tr>
</tbody>
</table>
To test the first of the above two null hypotheses, a correlation (Pearson r) coefficient between frequency and saliency was computed for the two combined groups. The correlation is equal to 0.865. This is statistically significant beyond the 0.05 level. The null hypothesis, $H_{03}$, may be rejected. It may be concluded that there is a positive correlation between frequency of advertising exposures and saliency.

To test whether or not there is any interaction between frequency and density in $H_{04}$, the two correlations corresponding to the density levels were computed. These are 0.765 for high density and 0.990 for low density. Only the latter correlation is statistically significant at the 0.05 level. The conclusion is that there is a positive relationship between frequency and saliency for low density, but there is no such relationship under high density. In other words, there seems to be a significant interaction between frequency and density in terms of the saliency of advertising. This permits partial rejection of $H_{04}$.

To test whether or not the slope under low density is greater than the slope under high density, the significance of the difference between the two
correlation coefficients was derived. The obtained value for "t" was equal to 0.933. This is significant at the 0.20 level (d.f. = 8, one-tailed). This level of significance is not sufficient to permit the rejection of this part of H₀₄. It must, therefore, be concluded that the slope under low density is not significantly greater than the slope under high density. These two slopes are depicted in Figure 1.

It may be useful to examine the regression equations associated with the two lines in Figure 1.

High Density: \( S = 8.69 + 0.74n \)
Low Density: \( S = -0.75 + 1.73n \)

where: \( S = \text{saliency} \)
\( n = \text{frequency} \)

Only the slope of the second line is significantly different from zero. Thus, we may conclude again that the positive relationship between frequency and saliency only holds for the low density condition. The slopes are not, of course, significantly different. This is to be expected given the previous t-test on the difference between the correlation coefficients.
FIGURE 1
LINEAR RELATIONSHIP BETWEEN FREQUENCY AND SALIENCY
Attitude Rating

(5) The relationship between frequency and attitude ratings toward an advertisement will be negative under high density.

(6) The relationship between frequency and attitude ratings will be positive under low density.

The attitude rating was obtained from two nine-point rating scales. The points on these two scales were assigned values from one (extremely negative attitude) through nine (extremely positive attitude). Each subject's rating of each ad was assessed by combining the scores on these two scales. The attitude ratings, therefore, had a possible range from two to eighteen. Scores for each subject on each advertisement were obtained in this manner.

An analysis of variance was performed on these data (see Table 4). According to Myers, the F-tests for ads and frequency "will be positively biased if the sequence of treatment presentations interacts with ads or frequency." The following

1Myers, op. cit.
TABLE 4
ANALYSIS OF VARIANCE SUMMARY
(ATTITUDE DATA)

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density (D)</td>
<td>1</td>
<td>8.0</td>
<td></td>
</tr>
<tr>
<td>Groups (G)</td>
<td>5</td>
<td>6.0</td>
<td></td>
</tr>
<tr>
<td>G x D</td>
<td>5</td>
<td>3.2</td>
<td></td>
</tr>
<tr>
<td>Subjects w. G</td>
<td>84</td>
<td>10.27</td>
<td></td>
</tr>
<tr>
<td>Ads (A)</td>
<td>5</td>
<td>239.6</td>
<td>27.44</td>
</tr>
<tr>
<td>Frequency (n)</td>
<td>5</td>
<td>9.0</td>
<td></td>
</tr>
<tr>
<td>A x n</td>
<td>5</td>
<td>2.2</td>
<td></td>
</tr>
<tr>
<td>n x D</td>
<td>5</td>
<td>27.0</td>
<td>3.09</td>
</tr>
<tr>
<td>An¹</td>
<td>20</td>
<td>6.25</td>
<td></td>
</tr>
<tr>
<td>AnD¹</td>
<td>20</td>
<td>6.20</td>
<td></td>
</tr>
<tr>
<td>error</td>
<td>420</td>
<td>8.73</td>
<td></td>
</tr>
</tbody>
</table>
preliminary tests are recommended by Myers as evaluations of these sequence effects:

\[ F = \frac{MS_G}{MS_{SwG}} \]

\[ F = \frac{MS_{GxD}}{MS_{SwG}} \]

\[ F = \frac{MS_{An1}}{MS_{error}} \]

\[ F = \frac{MS_{AnD1}}{MS_{error}} \]

An examination of Table 4 shows that none of the above F-ratios are significant. This suggests that the assumption of "no sequence effects" was not violated. The interpretations based on the remaining F-tests are, therefore, meaningful.

The null hypothesis to be tested is:

\[ H_{05,6} : \text{There is no interaction between frequency and density in terms of the attitude ratings for the advertisements.} \]

The only two significant F-ratios in Table 4 are "ads" and the frequency x density (n x D) interaction. The most significant factor accounting for differences in attitude ratings is the differences between ads. This null hypothesis,
therefore, may be rejected.

To help interpret this interaction effect, the profiles for the simple effects of factor n (frequency) at each level of factor D (density) are given in Figure 2. The data seem to suggest an apparent negative change in attitudes with repetition under the high density condition. The null hypotheses here are:

\[ H_{05}: \text{The relationship between frequency and attitude ratings under high density is equal to or greater than zero.} \]

\[ H_{06}: \text{The relationship between frequency and attitude ratings under low density is equal to or less than zero.} \]

An analysis of the simple effects of factor n for the levels of factor D permits statistical tests of the differences among the set of points within the same profile. This analysis is summarized in Tables 5 and 6.

In order to maintain a conservative level of significance it is advisable to increase the significance level for tests of simple effects and for pair-wise comparisons. For this reason, the tests which follow will be evaluated at the 0.01 level. The F-ratio for differences between the
FIGURE 2

FREQUENCY x DENSITY PROFILES FOR ATTITUDE RATINGS
TABLE 5
FREQUENCY x DENSITY SUMMARY
(ATITUDE DATA)

<table>
<thead>
<tr>
<th>DENSITY</th>
<th>FREQUENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 2 4 8 12 16</td>
</tr>
<tr>
<td>HIGH</td>
<td>600^a 549 513 530 488 541</td>
</tr>
<tr>
<td>LOW</td>
<td>524 539 539 551 565 569</td>
</tr>
</tbody>
</table>

^aIndicates sum of scores for forty-eight subjects.
TABLE 6

ANALYSIS OF SIMPLE EFFECTS FOR FREQUENCY
(ATTITUDE RATINGS)

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>n at high density</td>
<td>5</td>
<td>29.8</td>
<td>3.41</td>
</tr>
<tr>
<td>n at low density</td>
<td>5</td>
<td>6.14</td>
<td></td>
</tr>
<tr>
<td>error</td>
<td>420</td>
<td>8.73</td>
<td></td>
</tr>
</tbody>
</table>
points on the high density profile are statistically significant, $F = 3.41$ (df = 5, 420). A test on the difference between the points corresponding to $n = 1$ and $n = 2$ yields an $F = 3.10$. For $n = 1$ and $n = 4$, the F-ratio equals 9.03. Both of these F-ratios are significant (df = 1, 420).

The first of these hypotheses, $H_{05}$, is rejected. The second, $H_{06}$, is accepted. The conclusion is that there is a negative relationship between frequency and attitudes under high density, but there is no relationship between frequency and attitudes under low density.

**Satiation**

(7) Increased repetition will result in satiation, under high density.

(8) Increased repetition will not result in satiation, under low density.

Satiation was evaluated using five Semantic Differential scales. Each point on the scale was assigned a value from one (extremely negative) through seven (extremely positive). The scores on these five scales were summed to yield a single score with a possible range from five to thirty-five. By definition, the satiation point corresponds to
the mid-point on the scale (neutrality). In this case, therefore, the point of satiation is equal to twenty. The two null hypotheses to be tested are:

\[ H_{07}: \text{Increased repetition will not result in satiation under high density.} \]

\[ H_{08}: \text{Increased repetition will result in satiation under low density.} \]

An analysis of variance was computed for those data. The summary table is presented in Table 7. An examination of this table indicates that the only significant effect was due to differences between advertisements. The two null hypotheses, \( H_{07} \) and \( H_{08} \), must be accepted. It may be concluded that repetition failed to produce satiation under high or low density.
TABLE 7

ANALYSIS OF VARIANCE SUMMARY
(SATIATION DATA)

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density (D)</td>
<td>1</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Groups (G)</td>
<td>5</td>
<td>35.6</td>
<td></td>
</tr>
<tr>
<td>G x D</td>
<td>5</td>
<td>48.2</td>
<td></td>
</tr>
<tr>
<td>Subjects w. G</td>
<td>84</td>
<td>55.8</td>
<td></td>
</tr>
<tr>
<td>Ads (A)</td>
<td>5</td>
<td>815.6</td>
<td>22.1</td>
</tr>
<tr>
<td>Frequency (n)</td>
<td>5</td>
<td>23.0</td>
<td></td>
</tr>
<tr>
<td>A x n</td>
<td>5</td>
<td>11.6</td>
<td></td>
</tr>
<tr>
<td>n x D</td>
<td>5</td>
<td>71.4</td>
<td></td>
</tr>
<tr>
<td>An¹</td>
<td>20</td>
<td>33.2</td>
<td></td>
</tr>
<tr>
<td>AnD¹</td>
<td>20</td>
<td>45.9</td>
<td></td>
</tr>
<tr>
<td>error</td>
<td>420</td>
<td>36.9</td>
<td></td>
</tr>
</tbody>
</table>
CHAPTER V
DISCUSSION OF RESULTS

Awareness

The tests on the first two null hypotheses indicate that the positive relationship between repetition and awareness is non-linear. This curvilinear function is accurately described by the following model:

$$A_n = A_o + (A_{max} - A_o)(1 - e^{-n}).$$

Let $y = A_n$,

$a = A_o$,

and $b = A_{max}$.

Therefore, $y = a + (b - a)(1 - e^{-n})$

$$y = a + (b - a) - (b - a)e^{-n}$$

$$y = b - be^{-n} + ae^{-n} \quad (1)$$

This function is depicted graphically in Figure 3. Certain properties of this curve may be examined.
FIGURE 3

EXPONENTIAL LEARNING FUNCTION
Some research on repetition of advertising has centered on the "vertex" of the learning function. The vertex is the point at which the function begins to plateau. The conclusion of these researchers is that excessive repetition is desirable until the plateau begins (i.e., the vertex is reached), then a so-called "maintenance" schedule of advertising is recommended.\(^1\) Some authors have gone even further and have attempted to specify the actual number of repetitions needed to reach the vertex. Stewart,\(^2\) Starch,\(^3\) and others suggest that four repetitions are needed. "There is something important about the number four," says Dave Learner. "In broadcast, it begins to look like four a week, and in print four a month."\(^4\)

Since the model above fits the data very well, it is possible to evaluate this function for the


required number of repetitions. In order to "normalize" awareness data across situations, the criterion variable can be changed from the number of people aware of the ad to the per cent aware. The maximum per cent that can be aware of an advertisement is, of course, 100 per cent. Thus, $A_{\text{max}}$ equals 100 per cent. Imagine that the advertisement is for a new product. (This is common for nearly all of the reported research.) Then, $A_0$ equals zero per cent, since no one can be aware of this ad before it has been exposed.

From equation (1):

$$y = b - be^{-n} + ae^{-n}.$$  

Since $b = A_{\text{max}}$, and $a = A_0$,

then, $y = 100 - 100e^{-n}$.

Taking the derivative:

$$\frac{dy}{dn} = 100e^{-n}. \quad (2)$$

The vertex represents the point at which the slope of the curve changes from a value greater than one to a value less than one. The vertex is a point where the slope is exactly equal to 1.00.
Equation (2), therefore, may be set equal to 1.00.

\[100e^{-n} = 1\]

Taking the natural logarithm,

\[\log_{100} + (-n)\log_{e} = \log_{e}1.0\]

\[-n = \log_{e}1.0 - \log_{e}100\]
\[n = \log_{e}100 - \log_{e}1.0\]
\[n = \log_{e}100\]
\[n = 4.61\] exposures.

According to this solution, the vertex occurs at a point between four and five repetitions. It is not surprising, therefore, to discover that others conclude that at least four repetitions are needed in order to reach the plateau of awareness. This is an inherent property of the above learning curve.

It may be noticed that in the model, the vertex and the maximum level of awareness are intimately related. While this model may provide a good description of mean learning curves across many ads, it is inadequate in completely describing the curves for particular advertisements. Figure 4 shows two
FIGURE 4
HYPERBOLIC LEARNING FUNCTION
learning curves which approach the same horizontal asymptote. Note that one curve has a slower rate of initial acceleration than the other. Some ads may achieve the maximum level of awareness sooner than others. A complete learning model should incorporate a "rate of learning variable."

Hull suggested the following equation:

$$A_n = A_{\text{max}} - (A_{\text{max}} - A_0)^{(n-1)}b$$

where: $b$ represents the growth rate of the curve.

It is possible to set this equal to another Hullian model (previously described):

$$A_n = A_{\text{max}}(1 - e^{-in})$$

where: $i = \text{rate of learning}$.

Solving for the value of $i$ (see the Appendix),

$$i = \frac{1}{n}\log_e\left[\frac{A_{\text{max}}}{(A_{\text{max}} - A_n)}\right]$$

This equation can be used to evaluate the rate of learning after $n$ exposures, given the values for $A_{\text{max}}$ and $A_n$. Since both of these parameters can

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5C. L. Hull, *Essentials of Behavior* (New Haven, Conn.: Yale University, 1951).
be determined, this function is useful for scaling advertisements in terms of their "learnability." The greater the value of \( i \) the faster the rate of learning. This index is not very meaningful, however, and is difficult to interpret.

Another approach to evaluating differential learning rates has been suggested by Wiley and Wiley. They recommend fitting a hyperbola to learning data. This idea was initially developed by Thurstone. Using this hyperbolic function, the suggested model is:

\[
A_n = a + \frac{bn}{c + n}.
\]

where: \( a \), \( b \), and \( c \) are constants,

\( A_n \) is awareness after \( n \) exposures,

and \( n \) is the number of exposures.

Solving for \( a \), \( b \), and \( c \) (see Appendix), the values for the parameters are as follows:

\[
a = 17.4
\]

\[
b = 33.24
\]

\[
c = 0.324
\]

---


Using the hyperbolic model, predicted values for $A_n$ may be generated. These predicted values are shown in Table 8. It is immediately apparent that the predicted data fit the observed data very closely. More significant, however, is that the predicted values were generated by using only the first three observed points. It is unnecessary to determine $A_{\text{max}}$, the maximum level of awareness. As a matter of fact, $A_{\text{max}}$ may be predicted by this model. The predicted value of $A_{\text{max}}$ is equal to $a + b$.

$$a + b = 33.24 + 17.4$$
$$a + b = 50.64$$

This represents the horizontal asymptote of the hyperbolic model. In addition to predicting the horizontal asymptote ($A_{\text{max}}$), the vertex may also be predicted.

$$n_V = \sqrt{bc} - c$$

where: $n_V =$ number of repetitions needed to reach the vertex.

$$n_V = \sqrt{33.24 \times 0.324} - 0.324$$
$$n_V = 2.957$$

Thus, for the data in this study three repetitions are needed to reach the vertex of the best fitting
<table>
<thead>
<tr>
<th>Number of Exposures</th>
<th>Predicted Awareness (17.4)</th>
<th>Actual Awareness (42.5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>(17.4)</td>
<td>17.4</td>
</tr>
<tr>
<td>1</td>
<td>(42.5)</td>
<td>42.5</td>
</tr>
<tr>
<td>2</td>
<td>(46.0)</td>
<td>46.0</td>
</tr>
<tr>
<td>4</td>
<td>48.1</td>
<td>48.0</td>
</tr>
<tr>
<td>8</td>
<td>49.3</td>
<td>48.0</td>
</tr>
<tr>
<td>12</td>
<td>49.8</td>
<td>48.0</td>
</tr>
<tr>
<td>16</td>
<td>50.0</td>
<td>48.0</td>
</tr>
</tbody>
</table>

Chi Square = 1.796 (df = 3)
curve satisfying the above hyperbolic model.

This model is very useful for analysis of the effects of repetition in advertising. On the basis of a few initial points it is possible to predict the maximum level of awareness and the number of repetitions necessary to reach the vertex. It is also possible to derive the expected awareness level at the vertex.

\[ A_y = (a + b - c) - n_y \]

where: \( A_y = \) awareness level at vertex.

\[ A_y = 17.4 + 33.24 - 0.324 - 2.957 \]

\[ A_y = 47.36 \]

The two variables, \( A_{\text{max}} \) and \( A_y \), are useful in evaluating the results of repeating particular advertisements. Ads may be scaled either in terms of the expected maximum level of awareness, or in terms of the expected level of awareness at the vertex. Two ads may have the same values for \( A_{\text{max}} \) and yet have very different values for \( A_y \). The ad with the lower value of \( A_y \) may be considered as having lower "learnability," (i.e., it takes more repetitions to generate a given level of awareness).
Since this model employs very few data points to generate the necessary parameters, it would be quite practical to apply test market data to this function. Further validation is certainly required before this model can be recommended for practical applications. The implications are sufficiently enticing, however, that such validation is strongly recommended.

Saliency

Saliency was measured by asking the subjects to select two ads. The analysis of the saliency data produced the following two regression lines:

High Density: \( S = 8.69 + 0.74n \)

Low Density: \( S = -0.75 + 1.73n \)

Only the slope for low density is significantly different from zero. This indicates that as an advertisement is repeated the ad does tend to become more salient. This is true only under low density. For high density, this relationship does not exist. While the slopes are not significantly different, they are different at the 0.20 level. In addition, the difference is in the predicted direction (slope for low density is greater than slope for high density).
Saliency was defined in terms of "conspicuousness." Conspicuousness, however, is a function of both awareness and attitudes. If repetition leads to increased awareness, the probability that a repeated ad will be salient would also increase.

However, an ad may be salient because it is conspicuously good or conspicuously bad. It is hypothesized that excessive repetition leads to negative attitude change under high density. If this is true then it would be expected that for low density a repeated ad would have a higher probability of being selected. For high density, repetition which leads to negative attitudes would counteract the effect of heightened awareness on the probability of selection. This interpretation provides a satisfactory explanation of the two regression lines. To see what the effect of repetition is on attitudes it is necessary to examine the remaining data.

**Attitude Ratings**

Neither frequency nor density alone produced a significant effect on attitudes. However, the interaction between these two variables was significant. Examination of the simple effects showed that
repetition did result in negative attitude change under high density. While the effect for low density was not significant, the data do indicate a positive trend between attitudes and repetition. This analysis confirms the explanation of saliency in the previous section. It may be concluded that repetition does lead to increased awareness, but excessive repetition under high density conditions results in a negative attitude. This confirms a similar finding by Wells. It may be concluded at this point that in evaluating the effects of repetition on attitudes both frequency and density must be considered as relevant variables.

**Satiation**

The results of this research failed to produce satiation of advertising with repetition. This is consistent with others, such as Messer, who have similarly failed in their efforts to satiate non-verbal stimuli. This consistency is

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discouraging. It is reasonable to expect that excessive repetition would eventually neutralize the meaningfulness of a communication. This does not seem to be the case, however. Possibly the negative attitudes produced by excessive repetition counteract this loss of meaning.

"Meaningfulness" may be defined as deviations from the neutral point on the Semantic Differential scale. As a message is repeated it loses its uniqueness and thus the size of the deviations supposedly decrease. However, if repetition leads to negative attitude change, the repeated ad may become uniquely bad. The ad still has "meaning," but the meaning is now negative. At this point, one can only say that excessive repetition does not lead to satiation of meaning. Whether this is good or bad information for the advertising strategist is still unclear.
Conclusions

The results in this study strongly indicate that repetition leads to increased awareness of advertising. This increase, however, is not necessarily paralleled by a positive change in attitudes. To properly evaluate the effect of repetition on attitudes the interaction between frequency and density must be considered. Excessive repetition in a high density situation may lead to negative attitude change.

It seems that those studies showing a positive relationship between frequency and attitudes probably involved a low density condition. On the other hand, the several studies which indicated a negative change in attitudes with repetition might have been conducted in a high density context. This is a reasonable explanation of the apparently contradictory findings on this
topic which were cited in the first chapter.

The exponential model which was evaluated in this study provides a good description of the "learning function" in advertising. The results of this study suggest two significant improvements which may be made. First, a parameter corresponding to differential learning rates for various advertisements ought to be included. A hyperbolic function was discussed. This model does include an index corresponding to the "learnability" of the stimulus. Such an index would account for the qualitative differences between advertisements. The data indicated that the difference between advertisements is the most important factor in determining attitudes. The analyses of variance demonstrated that qualitative differences between advertisements are more important than frequency or density in terms of both attitude ratings and satiation.

Second, an adequate model should include density as well as frequency. The attitude data suggest that frequency and density interact significantly. Advertising planners, accustomed to considering only frequency, should begin to add
density as an important element in media scheduling decisions. The failure to combine both frequency and density may result in a less desirable schedule from an awareness and attitude point of view. These considerations played an important role in a recent decision by a major coffee manufacturer to move their advertising completely from broadcast to print media.\footnote{"Chase and Sanborn Goes All Print," \textit{Printer's Ink}, August 11, 1967, \textit{295}, 3.} They hoped that they might be able to achieve "greater visibility" and "more memorability" by being in a medium where the brand would stand alone.

A difficulty with the proposed exponential model is that a value is needed for the parameter corresponding to the expected maximum level of awareness. An estimation of this parameter may involve extensive test marketing. The hyperbolic function provides a seemingly accurate prediction of this maximum level even though it employs only a few initial data points. Validation of the effectiveness of this function is, therefore, highly recommended.

Finally, one limitation of the experimental design should be discussed. All of the stimuli
were presented in a completely random sequence. This resulted in essentially equal spacing of the occurrence of the ads throughout the whole presentation sequence. Research in learning suggests that the spacing of trials is an important variable. What would be the effect of a "cluster" of exposures? Are the data from industrial psychology on massed trials applicable here? This information would be very useful in planning an advertising campaign.

Further Research

Because of the important nature of the topic of repetition, continued research in this area will have significant benefits. The following are recommended as being particularly worthy of further research:

(1) A field validation of the exponential function described and tested in this study.

(2) An experimental study on the usefulness of the hyperbolic function in predicting the maximum level of awareness.

(3) Development of an index which would account for differential learning rates of various ads.

(4) An investigation of the effects of clustering advertising exposures.

The findings obtained from the above research would be extremely enlightening both to the psychologist
interested in the effects of mass communications and to the strategist planning media schedules.
APPENDIXES
APPENDIX A

QUESTIONNAIRE

A. Do you remember seeing this ad among those presented? _____yes _____no.

B. Place an "X" in the one space that best describes your opinion of this ad. There are no right or wrong answers. Only your opinion counts.

1. This ad is ---

<table>
<thead>
<tr>
<th>much below average</th>
<th>somewhat below average</th>
<th>somewhat above average</th>
<th>much above average</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. How likely is it that someone would read this ad?

<table>
<thead>
<tr>
<th>very unlikely</th>
<th>moderately unlikely</th>
<th>undecided</th>
<th>likely</th>
<th>very likely</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

C. Place a check mark on each scale below to best indicate what this ad means to you.

1. believable______ ______ ______ ______ ______unbelievable
2. unpleasant______ ______ ______ ______ ______pleasant
3. meaningful______ ______ ______ ______ ______meaningless
4. boring ______ ______ ______ ______ ______interesting
5. attractive______ ______ ______ ______ ______unattractive
APPENDIX B
STIMULUS PRESENTATION SEQUENCE

The following represents the order of presentation of the advertisements. A, B, C, D, E, F represent the six "test" ads; X represents "control" advertisements; and Y represents additional "control" advertisements inserted for the low density condition. The test ads appeared with the following frequencies:

- A = 16
- B = 12
- C = 8
- D = 4
- E = 2
- F = 1

Order of Presentation

A X Y B C Y A B Y D X Y A B Y A E Y B A
Y C X Y A B Y A D Y B C Y X A Y B C Y A
C Y A B Y A F Y X A Y B C Y A D Y B C Y
A B Y A D Y C X Y E X Y B A Y
APPENDIX C

SOLUTION FOR HULL'S LEARNING RATE PARAMETER

According to Hull,\(^1\)

\[ H_n = M - (M - H_o) b^{n-1} \]  \hspace{1cm} (1)

where: \( H_n \) = habit strength after \( n \) trials,
\( M \) = maximum habit strength,
\( H_o \) = growth rate of learning function,
\( n \) = number of trials.

But, Hull\(^2\) also states that

\[ H_n = M(1 - e^{-in}) \]  \hspace{1cm} (2)

where: \( i \) = learning rate parameter.

In order to make (1) and (2) comparable, set \( H_o \) to zero in (1).

\[ H_n = M - M b^{n-1} \]  \hspace{1cm} (1a)

\[ H_n = M(1 - b^{n-1}) \]  \hspace{1cm} (1b)


\(^2\)Ibid.
If we let (2) equal (1b),

\[ M(1 - e^{-in}) = M(1 - b^{n-1}) \]

\[ e^{-in} = b^{n-1} \]  \hspace{1cm} (3)

Take the natural logarithm of (3)

\[ -in \log_e e = (n - 1) \log_e b \]

\[ -in = (n - 1) \log_e b \]

\[ \log_e b = -in/(n - 1) \]

\[ b = \text{antilog}_e \left[ -in/(n - 1) \right] \]

\[ b = \text{antilog}_e \left[ \ln/(1 - n) \right] \]  \hspace{1cm} (4)

Let \( \ln/(1 - n) = V \),

\[ b = \text{antilog}_e V \]  \hspace{1cm} (4a)

Substituting in (1b)

\[ H_n = M \left[ 1 - (\text{antilog}_e V)^{n-1} \right] \]

\[ M - H_n = M(\text{antilog}_e V)^{n-1} \]

Take the natural logarithm,

\[ \log_e (M - H_n) = \log_e M + (n-1)V \]  \hspace{1cm} (5)
But, $V = \ln/(1 - n)$.

$$\log_e(M - H_n) = \log_e M - \ln$$

$$\ln = \log_e M - \log_e(M - H_n)$$

$$\ln = \log_e[M/(M - H_n)]$$

$$i = (1/n)\log_e[M/(M - H_n)]$$ \hspace{1cm} (6)

Substituting in (6) as follows:

$$M = A_{\text{max}}$$

$$H_n = A_n$$

$$i = (1/n)\log_e[A_{\text{max}}/(A_{\text{max}} - A_n)]$$

This may be used as an equation for Hull's learning rate parameter.
The hyperbolic learning function used in this study is:

\[ A_n = a + \frac{bn}{c + n} \]

where: \( a, b, c \) are constants,
\( A_n \) is awareness after \( n \) trials,
and, \( n \) is the number of trials.

Wiley and Wiley\(^3\) provide the following equation:

\[ A_1 - A_j = x - y \left[ \frac{(A_1 - A_j)}{(n_1 - n_j)} \right] \]

(1)

where: \( x \) and \( y \) are constants.

Choosing points on the curve corresponding to \( n_1 \), \( A_1 \) and \( n_j \), \( A_j \), we may solve for \( b \) and \( a \). Using the data in Table 9, the constants may now be simply determined.

TABLE 9
SOLUTION OF LEARNING CONSTANTS
(HYPERBOLIC FUNCTION)

<table>
<thead>
<tr>
<th>A</th>
<th>n</th>
<th>A₁ - Aₖ</th>
<th>n₁ - nₖ</th>
<th>(A₁ - Aₖ)/(n₁ - nₖ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>17.4</td>
<td>0</td>
<td>28.6</td>
<td>2</td>
<td>14.3</td>
</tr>
<tr>
<td>42.5</td>
<td>1</td>
<td>3.5</td>
<td>1</td>
<td>3.5</td>
</tr>
<tr>
<td>46.0</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
From Table 9, substitute in (1)

\[ 28.6 = x - y(14.3) \]  \hspace{1cm} (1a)
\[ 3.5 = x - y(3.5) \]  \hspace{1cm} (1b)

Solving these simultaneous equations for \( x \) and \( y \)

\[ x = -2.324 \]
\[ y = -4.634 \]

Writing (1) explicitly for \( A_j \),

\[ A_j = \frac{-y(n_1 - n_j)}{x + (n_1 - n_j)} + A_i \]  \hspace{1cm} (2)

Substituting the values for \( x \), \( y \) and \( n_1 \)

\[ A_j = \frac{4.634(2 - n_j)}{-2.324 + (2 - n_j)} + 46.0 \]  \hspace{1cm} (3)

Rearranging terms,

\[ A_j = -28.604 + \frac{33.238n_j}{0.324 + n_j} + 46.0 \]

Simplifying,

\[ A_j = 17.396 + \frac{33.238n_j}{0.324 + n_j} \]  \hspace{1cm} (4)
Comparing (4) and the general model, the value of the learning constants are:

\begin{align*}
    a &= 17.4 \\
    b &= 33.24 \\
    c &= 0.324
\end{align*}

Wiley and Wiley\(^4\) provide the following additional functions:

(a) the horizontal asymptote:

\[ A_{\text{max}} = a + b \]
\[ A_{\text{max}} = 17.4 + 33.24 \]
\[ A_{\text{max}} = 50.64 \]

(b) the number of repetitions at the vertex:

\[ n_V = \sqrt{bc} - c \]
\[ n_V = \sqrt{33.24 \times 0.324} - 0.324 \]
\[ n_V = 2.957 \]

(c) awareness at the vertex:

\[ A_V = (a + b) - p/\sqrt{2} \]  \hspace{1cm} (5)
where: \( p = \sqrt{2bc} \).

\(^4\)Ibid.
Therefore, \( A_Y = (a + b) - \sqrt{5c} \)

but, \( n_Y = \sqrt{5c} - c \).

Therefore, \( \sqrt{5c} = n_Y + c \).

Substituting in (5):

\[
A_Y = a + b - (n_Y + c) \\
A_Y = (a + b - c) - n_Y \\
A_Y = 17.4 + 33.24 - 0.324 - 2.957 \\
A_Y = 47.36
\]
APPENDIX E

ADDITIONAL TEST OF THE LEARNING MODEL

The test of the theoretical learning curve described in Chapter IV might be considered to be somewhat inadequate. A high correlation between the "predicted" and the "true" values (see Table 2) is possible, even if there is a significant difference in the elevations of the two curves.

Grant⁵ suggests a test which evaluates the correspondence between the theoretical and the observed values. He recommends calculating the following two mean squares:

1. \[
    M S \text{ correspondence } = \frac{n(\Sigma t_1 \bar{Y}_i)^2 / \Sigma t_1^2}{n_T}
\]

   where: \( n \) = number of observations in each group \( i \);

   \( \bar{Y}_i \) = mean of group \( i \);

   \( t_1 \) = difference between the predicted value of group \( i \) and the grand mean;

   \( n_T \) = number of linearly independent fitting constants in the mathematical model.

---

(2) M S error = \[ \Sigma(Y_{ij} - \bar{Y}_i)^2 / [k(n - 1)] \]
where: \(Y_{ij}\) = jth observation in group i;
\(k\) = number of groups

The following F ratio may be computed:
\[ F = \text{MS correspondence}/\text{MS error} \]

The analysis is summarized in Table 10. The obtained F ratio clearly indicates that the null hypothesis ought to be rejected. The null hypothesis is:

The correlation between the predicted values and the observed values is zero, after all the correlation due to the curve-fitting process has been removed.

Rejection of the above null hypothesis means that the covariation between the predicted and the observed values of the criterion variable is greater than chance, i.e. the "fit" is statistically significant. It may be concluded that there is a significant correspondence between the theoretical values and the empirical values obtained in this study.
### TABLE 10

**ANALYSIS OF VARIANCE SUMMARY**

*(TEST OF LEARNING MODEL)*

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>M S</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correspondence</td>
<td>2</td>
<td>29.54</td>
<td>263.75</td>
</tr>
<tr>
<td>error</td>
<td>66</td>
<td>0.112</td>
<td></td>
</tr>
</tbody>
</table>


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