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The relationships between 24 print ad characteristics and recall, readership, and inquiry-generation measures of effectiveness are examined for 1160 industrial ads. Both recall and readership are strongly related to format and content characteristics of industrial ads. The relationship between inquiry-generation and ad characteristics is significant but weaker. Some characteristics, such as ad size and position in the magazine, are consistently related to effectiveness across product categories and effectiveness measures. The effects of other characteristics, such as the use of four colors and attention-getting techniques, are specific to the product category and effectiveness measure. In addition to these substantive findings, methodological issues in model development and testing are presented.

The Effectiveness of Industrial Print Advertisements Across Product Categories

Advertising is becoming an increasingly important part of industrial marketing programs. With the cost of a sales call rising dramatically, industrial marketing managers are investigating the use of more economical communication vehicles to perform tasks now assigned to salespeople. This trend is illustrated by the following quotation.

> A new breed of industrial marketers is winning ball games by using advertising to relieve the salesman of as much of his communication job as it can. . . . The secret of efficient and profitable communication is to use cheap multiple communications to do as much of the job as they can do, and to use expensive individual communication only to the extent you must. The result is lower communication cost per sales or higher sales per dollar of communication costs (Tyson 1976).

Despite advertising's increasing importance in the industrial marketing mix, it has received limited research attention. Recent research on industrial advertising has been concerned with setting industrial advertising objectives and budgets (Lilien et al. 1976). The content and format of advertising campaigns have not been examined.

The purpose of this investigation is to identify the specific characteristics of industrial print advertisements that are related to effectiveness in performing advertising functions. The study focuses on print advertising because that medium accounts for approximately 75% of the industrial advertising expenditures (*Industrial Marketing* 1974). In addition to isolating the characteristics of effective industrial advertisements, the authors offer methodological contributions in the areas of model development and validation.

ANALYSIS OF PRIOR RESEARCH ON PRINT ADVERTISEMENTS

For more than 60 years, researchers have investigated the effect of print advertising characteristics (Hendon 1973). A wide range of mechanical and content characteristics of the ads have been considered. The mechanical aspects examined range from ad size, number of colors, proportion of illustration to copy, and the absence of borders (bleed) to the point size of the largest type. The content factors include objective measures such as the number of words in the ad and subjective measures such as the "readability" of the ad, the number of product facts mentioned, and the number of product benefits mentioned.

These mechanical and content characteristics have

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accounted for a substantial amount of the variance in the ad effectiveness measures used. Twedt (1952) developed a model based on three mechanical characteristics—ad size, number of colors, and square inches of illustration. When the model was used to predict ad readership for five different magazines, it explained between 34 and 64% of the variance in readership. Diamond (1968), using a larger set of ad characteristics, was able to explain between 10 and 55% of the variance in three different measures of ad effectiveness. These strong relationships between ad characteristics and effectiveness may be due, in part, to the type of ads examined and the measures of effectiveness used. Most previous studies have examined the effectiveness of *consumer product* ads, using *recall methods* for assessing effectiveness.

Effectiveness of Consumer and Industrial Advertisements

Many studies have investigated the relationship between effectiveness and characteristics of ads appearing in *consumer* publications (Buchanan 1964; Carter 1968; Crane 1964; Diamond 1968; Frankel and Solov 1963; Morrison and Dainoff 1972; Troldahl and Jones 1975; Yamanaka 1962). Only two studies have considered industrial ads appearing in trade magazines (Assael, Korfon, and Burgi 1967; Twedt 1952). Though these industrial ad studies have uncovered some significant relationships between industrial ad characteristics and effectiveness, the relative importance of various ad characteristics has not been examined.

The results from studying consumer product ads are not likely to be generalizable to industrial product ads, because advertising performs different functions in the marketing of consumer and industrial products. The greater complexity of industrial purchase decisions usually necessitates personal contacts to consummate an industrial sale. Thus industrial advertising has a more informational and supportive role. Some of its specific functions are (1) identifying potential customers, (2) indicating to customers that a company is a potential supplier for a product, (3) disseminating technical information to customers, and (4) supporting the personal selling effort by "opening the door" for the salesperson (Swinyard and Ray 1977), creating a favorable image of the company, and reaching otherwise inaccessible customers. Differences in the functions of consumer and industrial advertising are expected to lead to differences in the impact of various ad characteristics.

Measures of Effectiveness

Prior research has considered only effectiveness measures based on *reader recall,*[1] primarily the Starch (1966) or Starch-like effectiveness measures "noted," "seen/associated," and "read most." Though these measures provide some indication of ad effectiveness, they do not indicate the degree to which an important function of industrial advertising, the identification of potential customers, is performed. Therefore, an additional effectiveness measure, the number of inquiries generated by an advertisement, is used in this study. To make inquiries, readers must see the ad and have enough interest in the information presented to circle the ad number on a card. Thus the number of inquiries is an unobtrusive behavioral measure indicating the ad was noted and some interest was generated.

To the authors' knowledge, no published studies of advertisement effectiveness have used this measure, even though it is a common criterion used by industrial marketers in assessing effectiveness. Traditional effectiveness measures based on reader recall are also examined. This research thus provides an opportunity to compare the effectiveness of ad characteristics across a variety of measures.

Product Type and Ad Effectiveness

Just as the relationship between ad characteristics and effectiveness probably differs for consumer and industrial products, one might also expect differences in these relationships across types of industrial products. For example, the principal function of ads for products in the early stages of their life cycles and for complex products could be to provide information. The function of ads for simpler, more familiar products could be to provide a "reminder." Thus one would expect ads with high information content to be more effective for new, complex products and ads with attention-getting characteristics to be more effective for simple, familiar products.

Several studies have indicated that the relationship between ad characteristics and effectiveness does indeed depend on the product, but no study has examined this issue in detail (Crane 1964, Diamond 1968, Troldahl and Jones 1975). In terms of methodology, the problem is one of heterogeneity in response functions, which has been addressed in marketing by Bass and Wittink (1975) and Wittink (1977). The authors apply the analysis of covariance framework (e.g. Johnston 1972) to determine whether or not the advertisement effectiveness models differ across product categories.

Summary of Issues

This research has three objectives: (1) to investigate the relationship between effectiveness and characteristics for industrial print advertising, (2) to examine

[1] In a strict sense, these measures are of recognition, not recall, because the stimulus, the ad, is shown to the reader. However, the measures are commonly referred to as recall in the advertising literature.

this relationship across three measures of industrial ad effectiveness—inquiry generation and "seen" and "read most" scores, and (3) to compare this relationship across different types of industrial products.

RESEARCH METHOD

In this section, the data (the sample of industrial ads) used to study the issues are described. After exploring some specific methodological issues associated with modeling the relationship, the authors present the entire method and its implementation.

Sample of Industrial Ads

All advertisements[2] in 10 issues of *Electronic Design* were used in the study. The issues, published between January 5 and September 13, 1976, contained an average of 224 pages with 116 ads/issue. *Electronic Design* is a controlled circulation, bimonthly magazine published by Hayden Publications. It is the largest U.S. magazine, in terms of ad revenues, directed toward design engineers in the electronics industry. Circulation in 1976 was 84,355 (Media Comparability Council 1976). Eighty-five percent of the circulation was in the United States and the rest was in Europe and Japan.

Measures of Ad Effectiveness

The publisher provided data on the number of inquiries generated by each ad from the domestic circulation and from the foreign circulation. Additional effectiveness measures were available because each of the issues was part of a regular readership survey conducted by the publisher (*Electronic Design Reader Recall Report* 1976). Three weeks after distribution of each issue, 300 additional copies with special instructions were mailed to a stratified sample of the publication's circulation. Readers were asked to indicate ads and editorial material they remembered having *seen* and having *read most of*. The average response rate for the readership studies was 32%. The "seen" and "read most" effectiveness measures are the percentages of respondents who reported having *seen* the ad and having *read most of* the ad.

Measures of Ad Characteristics

The set of content and mechanical characteristics included in the study was developed from the following sources.

1. A review of significant research findings on ad effectiveness reported in academic journals and by magazine publishers.
2. A focus group conducted with advertising managers from one of the largest industrial advertisers in the western United States.
3. Interviews with industrial media buyers and publisher representatives.

A description of the variables and their anticipated relationships with effectiveness is shown in Table 1. The variables are grouped in seven categories. Logically, the first group includes the cost factors. Of these factors, only ad size is coded as an interval-scaled variable. Color is coded with dummy variables because prior research indicates substantial nonlinearities in the effectiveness of black and white (one color), two-color, and four-color ads (*Laboratory for Advertising Performance* 1971).

The second category of ad characteristics is position in the magazine, which practitioners perceive as very important. It includes the page number, right vs. left page, and the position of the ad *vis-à-vis* other ads and editorial matter. These position characteristics have not been thoroughly considered in prior research.

The next three categories, layout, content, and headline characteristics, include various ad-specific attributes that can be manipulated by advertisers. These variables are anticipated to have effects which vary across product categories.

Studies by magazine publishers indicate that the use of attention-getting design techniques increases ad readership (*Maximizing Advertising Effectiveness: How to Capture More Readers' Attention,* 1972). Therefore, a sixth category called "attention-getting techniques" includes the display of women, the height of largest copy size, and the use of pointers and free offers.

Finally, several studies have shown a relationship between interest in the product category or brand and ad readership (Buchanan 1964; Frankel and Solov 1963; Silk and Geiger 1972). The 1976 *Electronic Design Brand Recognition Study* was used to develop interest measures for each brand. This study measures brand interest by the number of times the manufacturer of the advertised product was listed as a potential supplier for the product category by a random sample of readers.

Methodological Issues—Data Analysis

The analysis of the data involves a number of steps. This section begins with a discussion of three methodological issues: (1) the examination of data base homogeneity, (2) specification of the model form, and (3) the investigation of model validity. After an overview of each of these issues, the authors' approach to addressing them is presented. Then the steps taken to examine the substantive industrial advertising issues are described.

Homogeneity of the data base. One of the objectives of this study is to examine the relationship of industrial ad characteristics and effectiveness across product categories. To study this issue, one must determine whether the data (the ads) can be pooled across product categories.

[2] Inserts and ads appearing on the cover pages are not included in the study.

Table 1
AD CHARACTERISTICS AND EFFECTIVENESS MEASURES

Ad characteristics	*Measure*	*Expected sign*	*Mean*	*Standard deviation*
Effectiveness measures				
Noted (%)	NOTED		.15	.13
Read most (%)	READ		.04	.05
Domestic inquiries	DINQ		172	169
Foreign inquiries	FINQ		33	32
Cost factors				
Size of ad (in pages)	ADSIZE	+	.79	.51
Two color (1) or not (0)	2COLOR	+	.16	.37
Four color (1) or not (0)	4COLOR	+	.24	.43
Bleed (1) or not (0)	BLEED	+	.27	.45
Position in magazine				
Page number	PAGENO	–	112	62
Number of ad pages before ad	BEFORE	–	1.16	2.27
Number of ad pages after ad	AFTER	–	1.16	2.36
Ad next to editorial (1) or not (0)	EDIT	+	.68	.47
Ad on right page (1) or not (0)	RIGHT	+	.61	.49
Layout				
Space for text in ad (mm^2 per ad page)	TEXT	[a]	134	175
Photo of product (1) or not (0)	PHOTO	[a]	.88	.33
Illustration of product (1) or not (0)	ILLUS	[a]	.19	.39
Product shown in action (1) or not (0)	ACTION	[a]	.10	.30
Environment surrounding product (1) or not (0)	SURROUND	[a]	.14	.34
Multiple products shown (1) or not (0)	MULTIPLE	[a]	.29	.46
Content				
Product specifications in copy (1) or not (0)	SPECS	[a]	.79	.41
Headline characteristics				
Number of words in headline	WORDS	[a]	8.58	5.02
Product named in headline (1) or not (0)	PRODUCT	[a]	.85	.36
Product or benefit feature in headline (1) or not (0)	HBENEFIT	[a]	.25	.44
Attention-getting techniques				
Women in ad (1) or not (0)	WOMEN	+	.04	.20
Pointer in ad (1) or not (0)	POINTER	+	.04	.29
Free offer in ad (1) or not (0)	FREE	+	.02	.14
Height of largest copy size (in mm.)	COPYSIZE	+	11.25	7.03
Interest in brand (index)	BRAND	+	11.37	18.83

[a] Sign varies across effectiveness measures and product categories.

Though pooling issues have been explored in the marketing literature (e.g. Bass and Wittink 1975, Wittink 1977), those studies focused on testing models when homogeneous groups are predetermined by some objective characteristic. For example, Bass and Wittink (1975) tested the validity of a model for predicting furniture sales in the United States versus predictions based on 50 separate models, one for each state. In the present research, however, the criterion for categorizing products into homogeneous groups is not readily apparent. Therefore, the first task in the study is to develop product categories so that the responses to ad characteristics for all products in a category are homogeneous but the responses across categories are heterogeneous. The description of the purchasing behavior associated with the products is used as a basis for establishing these categories. Presumably, homogeneous relationships between ad characteristics and effectiveness will arise when the products described in the ads are purchased under similar circumstances. In these situations, the advertisements would be designed to accomplish similar marketing objectives.

Model form specification. To estimate the relationship between ad characteristics and effectiveness, a specific form of the relationship must be determined. In the literature reviewed, only linear response functions are found. The linear model

$$(1) \qquad y_i = a + \sum_{j=1}^{p} b_j x_{ij} + u_i \, (i = 1, N),$$

where:

y_i = the effectiveness of the i^{th} ad and
x_{ij} = the value of the j^{th} characteristics in the i^{th} ad

is very appealing in this context because it is simple, robust, and easy to interpret. However, its assumption of additivity needs further examination. Assael, Korfon, and Burgi (1967) found significant interactions between ad characteristics, specifically between ad size and number of colors. Their findings were supported by the authors' discussions with practitioners, who indicated that several factors are needed to make an ad effective by portraying a quality image.

These interdependencies among ad characteristics can be modeled in various ways. The most obvious method would be to include specific interaction terms in the response function, but these terms would consume degrees of freedom and cause estimation problems due to multicollinearity. To allow for interactions in a implicit way, a multiplicative model is specified and a logarithmic transformation is used to estimate the parameters of the model.

$$y_i = e^a \prod_{j=1}^{p} x_{ij}^{b_j} e^{u_i}, \tag{2}$$

or, in estimation form:

$$ln\, y_i = a + \sum_{j=1}^{p} b_j\, ln\, x_{ij} + u_i.$$

One special problem in using this multiplicative response function is the appearance of zeros in the data matrix. This problem is particularly acute in this research because dummy variables are used extensively. To overcome this problem, ad characteristics that logically can assume a value of zero are rescaled so that the variable is equal to one if the characteristic is not present. Factors that cannot logically assume a zero value (page number and size in this study) are not rescaled.

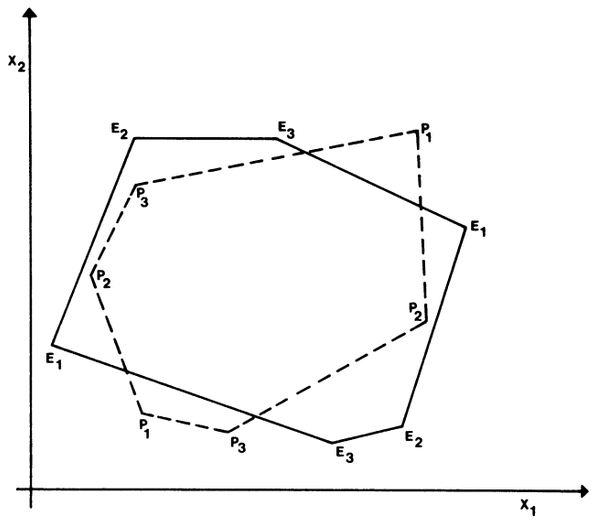
The final version of model 2 is:

$$y_i = e^a \prod_{j=1}^{p_1} x_{ij}^{b_j} \prod_{j=p_1+1}^{p} (1 + x'_{ij})^{b_j} e^{u_i} \tag{3}$$

where x_{ij} are the unaltered and x'_{ij} the rescaled variables.

Model validation. Validation of models in nonexperimental research is a very important issue which is often neglected in applied studies. Both the descriptive and predictive performance of models specifying the relationship between ad characteristics and effectiveness should be validated. Typically, this is done by dividing the sample into two sets. Models are validated with respect to their descriptive performance by comparing the signs and magnitudes of the parameters estimated for each set. Predictive performance is assessed by the goodness-of-fit achieved when parameters derived in one set are used to estimate the dependent variables in the other set.

Figure 1
EXAMPLE OF DUPLEX DATA SPLIT



E_i: point assigned to estimation set in i^{th} round.
P_j: point assigned to prediction set in j^{th} round.

In cross-sectional studies the strategy for data splitting is not obvious; in fact, most often splits are done at random, at the risk of building estimation and prediction sets that are not really comparable. Recent methodological literature has focused on the development of algorithms for data splitting in nonexperimental research. Specifically, Snee (1977) proposed an algorithm called DUPLEX, which computes Euclidian distances among the orthonormalized explanatory variables of a model. The two most distant points are assigned to the estimation set, the next two join the prediction set, etc., until all data points have been assigned. Using two sets formed by this procedure provides very powerful model validation in the sense that the entire range of observations on the independent variables is represented in both sets. Figure 1 shows a DUPLEX data split in a hypothetical case with observations on two explanatory variables, x_1 and x_2. This two-variable example indicates visually the similarity in the range of observations between the two data sets. This study is the first in which the DUPLEX algorithm is used to split a sample for validation in a marketing context.

Overview of Analysis

Figure 2 is an overview of the entire method used in the study. The first task in the study, to develop

Figure 2
OVERVIEW OF RESEARCH METHOD

Objective	*Research activity*	*Method*
1. Develop homogeneous product groups	Expert opinion on product purchasing characteristics	Survey questionnaire
a. Find underlying structure describing purchasing decision	Reduce the number of dimensions describing purchasing decision	Factor analysis
b. Define product groups with homogeneous purchase decisions	Cluster products in the factor space	Cluster analysis
2. Model specification and parameterization	Estimate models for each product group and the pooled group	Multiple regression
a. Examine pooling issue	Test for differences in the ad characteristics/effectiveness relationships across product groups	Chow test
3. Model validation	Split samples into two sets	DUPLEX
a. Descriptive validity	Estimate and compare models and parameters using each set	Multiple regression and Chow test
b. Predictive validity	Cross-validation	Correlation of Y and $\hat{Y}$

homogeneous product categories, was done by analyzing responses from magazine readers describing the purchasing characteristics for various product types. The responses were factor analyzed to find the underlying dimensions which describe purchasing behavior across product categories. Then the factor scores for each product type were used to cluster product types on the basis of similar purchasing patterns. This sequence of steps is described hereafter.

Once the relevant product categories were formed, models describing the relationship between ad characteristics and effectiveness were estimated by using observations in each product category and then pooling the observations across product categories. A Chow test was performed to determine whether the response functions are heterogeneous between product categories.

After the response functions were shown to be different between categories, the set of ads in each category was divided into an estimation and a prediction sample by the DUPLEX algorithm. The DUPLEX sets were used for model validation by three methods: (1) Chow tests to assess the homogeneity in response functions within each category, (2) parameter comparison to assess descriptive validity, and (3) predictive validity testing by using the estimation set parameters to predict advertisement effectiveness in the prediction set. The results of these analyses are described hereafter.

RESULTS

Formation of Homogeneous Product Categories

In reporting the results of the readership surveys, the publisher of *Electronic Design* grouped the ads into 15 product categories, apparently on the basis of similarity of product technology and customer application. The sample of ads was not large enough to estimate and validate models for each product category. Also, it is not apparent that a grouping based on similar technology and application would provide homogeneous response functions for advertisement characteristics. Rather, it is anticipated that homogeneous response functions arise when the goals for the advertisements are similar. Because the nature of the purchase process and decision should be closely related to advertisement goals, these factors were used to group the products in the present study.

The nature of the purchasing process for products in the 15 categories was assessed by sending questionnaires to 500 randomly selected recipients of *Electronic Design*. Each reader was asked to rate each product category on the following dimensions.

1. Technical influence—the relative influence of technical compared to purchasing personnel in the vendor choice decision.
2. Number of potential vendors.
3. Order size—the relative size of the average purchase order for products in the category.
4. Complexity—the technical complexity of typical products.
5. Personal information sources—the relative importance of personal selling versus advertising as a source of information about products.
6. Importance—the importance of the product to the success of the reader's company.
7. New products—the relative frequency of new product introductions for the category.
8. Growth rate—rate of increase in sales for products in the category.
9. Price instability—the degree to which price increases or decreases are occurring.
10. Information needs—the amount of information needed to make purchase decisions for products in the category.

Fifty-five usable questionnaires were returned, representing an 11% response rate. The low response rate is probably due to the length of the questionnaire.

Table 2
ANALYSIS OF DIMENSIONS USED TO DESCRIBE PURCHASING BEHAVIOR

Dimension[a]	*Importance (factor 1)*	*Life cycle stage (factor 2)*	*Uniqueness (factor 3)*	*Mean*	*Standard deviation*
Primary influence, purchasing/technical	−.011[b]	.252	.672	5.23	1.73
Number of vendors, few/many	−.120	.188	−.773	4.23	1.78
Order size, small/large	.800	−.129	−.304	3.50	1.81
Complexity, low/high	.711	.181	.330	3.83	1.79
Information source, impersonal/personal	.528	.257	.131	2.95	1.88
Importance, low/high	.740	.196	.025	4.48	1.90
New products, few/many	.533	.629	.123	3.70	1.93
Growth rate, low/high	.543	.566	.097	4.05	1.65
Price instability,[c] falling/increasing	.052	.808	−.027	1.12	1.06
Information needs, little/a lot	.588	.443	.372	4.34	1.74
Eigenvalue	3.88	1.29	0.99		

[a] 7-point scales.
[b] Factor loadings.
[c] Midpoint labeled "stable." The scale was coded −3 to +4 and the absolute value was used in the analysis.

Each respondent was asked to evaluate 150 scale items (10 dimensions for each of 15 product categories). Because of the large amount of data collected from each individual, the sample size is adequate for the next stage of the analysis.

An initial factor analysis was performed to uncover the underlying structure used to describe purchasing behavior. For this analysis, the potential number of observations on each of the 10 dimensions is 825 (ratings by 55 respondents for 15 product categories); however, missing data reduced the number of observations to 746. These observations were submitted to a principal component factor analysis with varimax rotation. The matrix of factor loadings for three significant factors is shown in Table 2.

The three factors account for 62% of the variance and are very interpretable. The first factor indicates the *importance of purchasing decisions* for products in the category. This factor is strongly related to the size of the typical order, the complexity of the product, the amount of information needed to make a purchase decision, and the use of personal sources (salespeople) of information about the product. The number of new product introductions, the degree of price instability, and the growth rate of product sales have high loadings on the second scale. Thus, this factor indicates *growth in product sales or stage in the product life cycle.* The third factor seems to be related to the *uniqueness of the purchase decision.* Because the influence of technical people in the purchase decision loads positively and number of vendors loads negatively, the factor represents a "new task" purchase decision in which primary efforts are made at developing specifications and finding a vendor to provide a product which meets the specifications.

Thus, the factor analysis reduces the original 10

Table 3
DESCRIPTION OF PRODUCT CATEGORIES

	Routine (group 1)	*Unique (group 2)*	*Important (group 3)*
Product categories	connectors control devices hardware tools potentiometers	relays display devices rotating components power equipment	microelectronics semiconductors measuring/test equipment computers-peripheral
Mean factor scores for decision characteristics			
Importance	−.231	−.328	.730
Product life cycle stage	−.401	−.284	.933
Uniqueness	−.300	.130	.289
Mean interpoint distance between and within groups			
Group 1	.129	.368	3.207
Group 2		.264	2.835
Group 3			.270

Table 4
POOLING TEST

Sample on which model developed	Residual sum of squares (RSS) for models based on following effectiveness measures: Seen	Read most	Domestic inquiries	Foreign inquiries	Number of observations	Degrees of freedom (DF)
All ads	727	1959	656	684	916	891
Ads in product category 1	233	579	131	153	326	301
Ads in product category 2	154	363	131	163	221	196
Ads in product category 3	266	505	339	272	369	344
F-test for homogeneity[c]	1.906[b]	1.698[b]	1.539[a]	2.746[b]		

[a] $p < .05$.
[b] $p < .01$.
[c] $$F = \frac{RSS_{ALL} - \sum_{i=1}^{3} RSS_i}{\sum_{i=1}^{3} RSS_i} \times \frac{\sum_{i=1}^{3} DF_i}{DF_{ALL} - \sum_{i=1}^{3} DF_i}.$$

dimensions used to describe product purchase decisions to three more global dimensions. The mean factor scores for these dimensions were computed for each of the original 15 product categories. These three scores were then used to calculate the interpoint distance matrix for these product categories. Johnson's Hierarchical Clustering Routine (1967) was used to cluster the 15 product categories into three groups. The decision on the number of clusters was based primarily on the size of the data set, the interpretability of the clusters, and the within versus between cluster distances. The cluster analysis results are summarized in Table 3.

The first group consists of mature products that are relatively unimportant and purchased in a *routine* manner. The products in the second group are more *unique* but represent less important purchasing decisions. The products in the third group are very different from the products in the first two groups. These products represent the most *important* purchases with the highest growth. On the basis of these descriptions, the product categories are labeled *routine, unique, and important*. After the deletion of missing values and a few outliers in the data set, there are 393 ads for products in the first group, 251 in the second, and 440 in the third group.

Little research has been directed toward identifying products with homogeneous advertising effectiveness relationships. In most prior research, the ad characteristic/effectiveness relationship is assumed to be independent of the product's characteristics. The method for forming product categories in the authors' research is exploratory. However, the results indicate that product groups formed in this manner have interpretable differences in their ad characteristics response function. Further research is needed to investigate systematic differences in advertising effectiveness across product categories.

Testing for Group Differences

Even though the product users indicate the groups are different, one must demonstrate that these differences are relevant for the industrial advertisement response functions. To examine the differences in response functions, the multiplicative models are estimated for the pooled groups and for each group separately. Then a Chow F-test on the residual sums of squares is performed for each response variable. The results, summarized in Table 4, indicate that the hypothesis of homogeneity is rejected for all equations at the 5% level.

Having rejected the hypothesis of overall homogeneity, one could proceed to test for partial homogeneity, for example, common slope regression. However, as various coefficients in the models have widely different magnitudes and even conflicting signs, further analysis is based on developing different response functions for each category.

The significant coefficients of models estimated for each product group and each effectiveness measure are shown in Table 5.[3] These results demonstrate that different ad characteristics are significant for the different product categories and effectiveness mea-

[3] The relationships between effectiveness and ad characteristics were also estimated by using linear models. The results were similar to those obtained by using multiplicative models in terms of explanatory power, estimated signs of the coefficients, predictive validity, and descriptive validity. Only the results of the multiplicative models are reported because this model is robust and incorporates the hypothesized interactions among the variables.

Table 5
RELATIONSHIP BETWEEN AD CHARACTERISTICS AND EFFECTIVENESS: COEFFICIENTS

	Routine products (Group 1)				*Unique products (Group 2)*				*Important products (Group 3)*			
Ad characteristics	*Seen*	*Read most*	*Dom. inq.*	*For. inq.*	*Seen*	*Read most*	*Dom. inq.*	*For. inq.*	*Seen*	*Read most*	*Dom. inq.*	*For. inq.*
Cost factors												
Ad size	.64	.43	.21	.29	.87	.65			.82	1.04		.29
2 color				.34						.58	.50	
4 color	.48				.48		.70		1.26	1.48	.85	.95
Bleed								.58		−.40	−.33	−.36
Position in magazine												
Page number	−.17	−.22		−.23	−.12	−.20			−.12	−.17		
Before ad				−.31				−.28				
After ad		.27		−.20	−.26							
Editorial								−.47				
Right side												
Layout												
Text					.31							
Photo	.77	.99							.41		−.53	
Illustration	.54	.73									.53	.53
Action												
Surround		−.72			.58				−.46			
Multiple products			.46	.32			.42		−.49	−.58		
Content												
Specs	.31		−.35		.48							
Headline												
Words												
Product					−.63	−.79	−.48					
Benefit	−.32							−.44				
Attention-getting												
Women	1.69	2.43			1.12							
Pointer			.45		.79							
Free offer							1.08	.87				
Copy size		.48					.30	.28		−.28		
Brand interest												
Brand recognition	.08	.14	.07		.13							
Sample size	326	326	326	326	221	221	221	221	369	369	369	369
R^2	.51	.34	.22	.19	.49	.33	.36	.21	.47	.39	.20	.20
Adjusted R^2	.47	.28	.16	.12	.43	.25	.28	.12	.43	.35	.14	.15

sures. A complete discussion of these results is given in the next section.

Model Validation

The first step in validating the models describing the relationship between ad characteristics and effectiveness is to split the sample for each product category, using the DUPLEX algorithm.[4] First, the homogeneity within each category is tested by performing a Chow test for the estimation and prediction set response functions. The null hypothesis of homogeneity could not be rejected at $\alpha = 0.05$ in all 12 cases. In addition, comparisons of the estimation and prediction set correlation matrices of the independent variables indicated that the two sets represent the data range adequately.[5]

The next step is the assessment of the predictive performance of the models. Table 6 lists the correlations between actual and predicted dependent variables for the various regressions. These correlations are to be compared with the correlations on the estimation

[4]In the application of DUPLEX to the industrial advertisement models, the large number of dummy or pseudo-dummy explanatory variables in the equations causes a problem. These dichotomous variables have relatively small interpoint distances and too many of them would be lost because DUPLEX removes identical or near-identical points from the data set prior to splitting. This problem is circumvented by including only the interval-scaled explanatory variables in the run, i.e., size of the ad, number of colors, page number, number of words, and number of products advertised. This approach moderates the computational expense of the run and reduces the number of points lost to about a dozen in each group.

[5]The volumes of the regions covered by the data points are related to the determinants of these correlation matrices. Also, a Bartlett test for equality of matrices, described by Morrison (1967), can be used to compare the DUPLEX sets. The results in this application were satisfactory.

Table 6
PREDICTIVE VALIDITY OF MODELS

Effectiveness measure	*Product category 1 (routine)*	*Product category 2 (unique)*	*Product category 3 (important)*
SEEN	.494[a] (.734)[b]	.711 (.759)	.640 (.715)
READ MOST	.345 (.648)	.468 (.664)	.579 (.672)
DOMESTIC INQUIRIES	.190 (.589)	.459 (.648)	.247 (.512)
FOREIGN INQUIRIES	.125 (.553)	.280 (.542)	.327 (.479)
Number of observations			
Estimation set	163	110	185
Prediction set	163	111	184

[a]Adjusted R for model using validation.
[b]Adjusted R for model using estimation set.

sets shown in parentheses. The results are encouraging in most cases. Overall, advertising recall and readership are much more predictable than product inquiries.

Finally, the stability of regression coefficients across the DUPLEX sets is examined. Because of space limitations only the results for one randomly selected case, the *seen* effectiveness measure in Group 3, are reported. The same patterns emerged for the other cases which satisfied the predictive criterion. Table 7 shows these regression coefficients for the two postulated models. The strong factors such as ad size and colors are consistently significant and there is close agreement between the estimates. The less important factors are occasionally significant and occasionally not, but there are no conflicting signs between a model's coefficients in the estimation and the prediction sets. The relatively large incidence of insignificant parameters is not surprising; as sample size is cut, standard errors of estimates increase. For example, Snee (1977) reports that, assuming estimation and prediction sets with the same correlation structure, a 50/50 data split results in a 41 to 45% increase in standard errors. For this reason the complete samples in each category are used for discussing the results.

DISCUSSION OF RESULTS

The substantive results of this study are summarized in Table 5. The strength of the relationships between ad characteristics and the various effectiveness measures is considered first, then the contribution of individual characteristics to effectiveness is examined. An attempt is made to arrive at some empirical generalizations about the importance of specific ad characteristics across product categories and across measures of effectiveness.

Strength of Relationship

The results on the strength of the relationship between ad characteristics and recall measures of effectiveness in this study are similar to findings in previous studies (Diamond 1968; Twedt 1952). Ad characteristics account for more than 45% of the variance in the *seen* effectiveness measure and more than 30% of the *read most* effectiveness measure.

Table 7
EXAMPLE OF DESCRIPTIVE VALIDITY—SEEN EFFECTIVENESS MEASURE FOR CATEGORY 3

Ad characteristics	*Estimated coefficients for*	
Cost factors	*Set 1*	*Set 2*
ADSIZE	0.87[a]	0.77[a]
2COLOR	0.27	0.42
4COLOR	0.33[a]	1.19[a]
BLEED	0.00	0.00
Position in magazine		
PAGENO	−0.07	−0.16[a]
BEFORE	−0.15	−0.05
AFTER	−0.02	0.12
EDIT	−0.27	0.05
RIGHT	0.08	0.11
Layout		
TEXT	−0.29[a]	0.06
PHOTO	0.59[a]	0.21
ILLUS	0.15	−0.05
ACTION	0.53	0.19
SURROUND	−0.57[a]	−0.36
MULTIPLE	−0.34	−0.58[a]
Content		
SPECS	0.17	0.07
Headline		
WORDS	0.12	0.00
PRODUCT	0.09	0.21
BENEFIT	−0.20	0.24
Attention-getting		
WOMEN	0.29	0.92
POINTER	−0.30	0.38
COPYSIZE	0.08	−0.26[a]
Brand interest		
BRAND	0.04	0.05
Sample size	185	184
R^2	.51	.50
Adjusted R^2	.44	.43

[a]Significant at alpha = 0.10.

The variance explained for the *seen* measure is significantly greater than the variance explained for the *read most* measure. These results are consistent across the three product categories and consistent with results obtained in previous studies.

Ad characteristics account for a small but significant percentage of the variance in the number of inquiries generated. Between 19 and 36% of the variance in inquiry generation is accounted for by ad characteristics.

The strength of the relationships between ad characteristics and the three effectiveness measures (seen, read most, and inquiry generation) is consistent with a hierarchy of effects model. Communication variables typically have a greater effect on lower order responses (awareness) than higher order responses (behavior) (McGuire 1978). Thus, one would expect ad characteristics to be related more strongly to *seen*, a measure of awareness or recognition, than to inquiry generation, a behavioral measure.

Effectiveness of Industrial Ad Characteristics

The numbers reported in Table 5 are estimates of the response coefficients for each ad characteristic. Only the significant ($\alpha < .10$) coefficients are reported.

The following discussion is organized by type of ad characteristics. Specific attention is directed toward the degree to which the ad characteristic effects can be generalized across effectiveness measures and product categories. To facilitate the discussion, average coefficients are reported in parentheses where appropriate.

Cost factors. The cost factors have, in general, a medium to high positive effect on ad performance. Ad size is strongly related to recall (seen) (.78) and readership (read most) (.71). However, these relationships exhibit diminishing returns to scale. In contrast to the effect on recall and readership, ad size has a much weaker effect on inquiry generation (.13). The effect of ad size appears to be consistent across the three product categories.

The effects of color are particularly pronounced in ads for important products. The use of color has only limited effects for routine and unique products. Though there is little difference between two-color and black and white ads, the use of four colors has a substantial impact on all measures of effectiveness for important products and a significant but weaker impact in ads for unique products. Four colors have a greater impact on recall and readership measures than on inquiry generation.

The effect of bleed (absence of borders) is equivocal. For routine and unique products, the use of bleeds typically is not related to effectiveness. For important products, the relationship is significant but negative. This finding suggests that the additional cost of bleeds cannot be justified in terms of the effectiveness measures examined in this study.

Position in magazine. The effects of characteristics related to the position of the ad in the magazine are either low or not significant. The page number of the ad is systematically related to recall and readership measures across product categories (− .17) but not related to inquiry generation.

Contrary to the opinions expressed by practitioners, the placement of an ad with respect to editorial material and other ads has little or no effect on the impact of the ad. Right pages are not more effective than left pages. The one consistent exception to this finding is in foreign inquiries for routine products. Ad clutter, the number of ads before and after the ad, seems to have a negative impact (− .20) on foreign inquiry generation. This finding may be due to the fact that international audiences are less accustomed to extensive advertising than American readers and thus are more affected by clutter.

Layout. In general, the effects of layout depend on the specific product category and performance measure considered. Photographs and illustrations are helpful in improving recall and readership for routine products (.76). The use of illustrations for important products improves inquiry generation (.53).

The amount of an ad devoted to text has little impact on effectiveness. This unexpected finding supports Diamond's (1968) results for consumer product ads. It was anticipated that information content would be an important determinant in industrial ads. The weak relationship between text and effectiveness may occur because information is conveyed through photographs and illustrations.

A common question is whether to advertise multiple products in an ad. The results of this study suggest that the use of multiple products in an ad will increase inquiry generation for routine and unique products but reduce recall and readership for important products. This finding suggests that multiple product ads are not as noticeable as single product ads, but give readers more opportunity to find a product of interest if they consider the ad thoroughly.

The importance of text material versus pictures and illustrations is low for industrial products. Likewise, showing a product in use does not improve the effectiveness of the ad.

Content. The one content factor examined, product specifications in an ad, has a medium positive effect on recall for routine and unique products (.40). In contrast, the richness of information given about a product through technical specifications may lead to fewer inquiries, although this relationship was observed only for routine products (−.35).

Headline. The characteristics of the ad headline do not contribute positively to the performance of the ad. The number of words in the headline is unrelated to the effectiveness measures. The mention of the product name in the headline of ads for unique products has a negative impact on effectiveness, possibly be-

cause unique products appeal to a narrow segment of customers. Indicating the product name in the headline might immediately dissuade customers outside the interested segment from further considering the information in the ad.

Attention-getting techniques. Attention-getting techniques have a strong but selective impact on ad effectiveness. None of the four attention-getting techniques considered has a positive impact in ads for important products. However, the use of women in ads for both routine and unique products has a dramatic effect on recall scores (1.40), but no effect on readership for unique products and no effect on inquiry generation for either product category.

The advertisement of free offers has just the opposite effect. Free offers are very effective for generating inquiries for unique products, but do not affect recall or readership in any of the categories. Finally, the use of a pointer or larger copy size in the ad is occasionally significant.

Brand interest. Interest in or familiarity with the advertised brand is only weakly related to the three measures of effectiveness for routine products (.10) and the recall of unique products (.13). Because of the correlational nature of this study, the causality of these relationships cannot be specified. As the recall and readership measures are retrospective, readers may be biased toward overreporting the recall or readership of ads for familar products.

Summary by Product Category

The results indicate that the use of photographs, illustrations, and women is strongly related to the recall and readership of ads for routinely purchased products. Ad size and the use of multiple products and pointers have the strongest impact on inquiry generation for these products.

Ad size and the use of women and pointers have the largest impact on the readership and recall of unique products. Mentioning the name of a unique product in the headline has a negative impact on effectiveness. Inquiry generation is strongly related to the use of four colors and free offers.

All effectiveness measures of ads for important products are related to cost characteristics such as ad size and color. Multiple products in important product ads decrease readership and recall.

CONCLUSION

The study demonstrates that the recall and readership of industrial ads are strongly related to mechanical and format characteristics of the ad, as has been shown previously for consumer product ads. Inquiry generation is also related to ad characteristics, but the relationship is not as strong. Because inquiry generation is an important function of industrial advertising, further research is needed to uncover advertising mechanisms related to effectiveness measures. Objective mechanical variables do not account for a high percentage of the variance in inquiry generation. More subtle measures of information content, organization, and readibility should be explored.

There are a few limitations to this study. The industrial ads examined are from a single trade publication during a six-month time period. Thus, some specific findings may not be generalizable to other industrial publications or audiences. The method used to classify products into homogeneous groups is exploratory. A small number of readers provided perceptual information about the product categories and purchasing decisions related to the product categories. The specific information collected was not based on a conceptual model of industrial purchasing behavior, but rather on an *ad hoc* notion of variables related to purchasing behavior.

Despite these qualifications, the study demonstrates that the relationship between the characteristics of an industrial advertisement and its effectiveness is moderated by characteristics of the advertised product. This finding confirms the conventional wisdom that the specific product and the desired effect must be considered in designing an industrial ad. One ad execution style does not work well for all products. The design elements will be effective when used with a particular product and ineffective when used with other products. The study also indicates that categorizing products on the basis of characteristics associated with the purchasing decision may be a useful starting point for exploring the relationship among product types, ad characteristics, and ad effectiveness. Further research is needed to identify the specific product characteristics that have a strong moderating effect on industrial advertising.

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