

PIE: AN AID TO ADVERTISING RESEARCH

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This article uses information theory to develop and empirically validate a new construct labeled perceived informational entropy (PIE). PIE is proposed to be a core construct, central to understanding communication effectiveness. It is correlated with message and audience-centered variables, which are known to influence message effectiveness. Results of the study suggest that PIE is positively correlated with novelty and complexity of an advertisement, and negatively correlated with audience familiarity. In addition, PIE is also negatively correlated with various measures of advertising effectiveness indicating that informational entropy might be an important factor to consider when developing an advertising strategy.

INTRODUCTION

The goal of much marketing communication is to inform and persuade others to develop particular attitudes toward objects such as organizations, products, and people. Within an advertising context, typical goals are to positively influence outcome variables such as attitude toward the advertisement, attitude toward the brand, and behavioral intentions. Thus, from a strategic perspective, it is critical to understand how marketers can manage variables that influence advertising communication and ensure that effectiveness is maximized.

Marketing scholars have studied advertising effectiveness for over three decades contributing significantly to the discipline (Appel 1966; Grass and Wallace 1969; Greenberg and Suttoni 1973; Calder and Sternthal 1980; Rethans, Swasy and Marks 1986; Hughes 1992; Singh and Cole 1993; Haugtvedt et al. 1994; Kover, Goldberg and James 1995; Scott and Solomon 1998; Blair and Rabuck 1998; Blair 2000). A key concept within the advertising effectiveness literature has dealt with "advertising wearout", the notion that the effectiveness of an advertisement declines over time and exposures. A review of the literature dealing with advertising effectiveness reveals the following: 1) researchers have

studied both message-centered and audience-centered variables as they relate to advertising effectiveness, however, they have often studied these variables in isolation to each other; 2) theoretical explanations of the same phenomenon have differed depending upon the theoretical background chosen by the researcher; 3) due to the diversity in theories from which the variables were chosen, the results of studies are sometimes contradictory and irreconcilable; and 4) relevant audience-centered and message-centered variables have often not been integrated when studying communication effectiveness, thus rendering the results somewhat incomplete. Interestingly, while the term "wearout" appeared almost three decades ago and remains central to the effectiveness debate, questions are still being raised about what comprises "wearout" (Scott and Solomon 1998).

This study attempts to address issues relating to the advertising wearout phenomenon by developing and validating a new construct, which is proposed to be central to understanding the characteristics of effective marketing communications. Using an interdisciplinary approach to evaluating message effectiveness, a new construct labeled *Perceived Informational Entropy* (PIE) is offered as an improved and potentially parsimonious tool to study advertising effectiveness.

THEORETICAL BACKGROUND

While several theories have been used to explain advertising effectiveness (Scholten 1996), a prominent approach is the information processing view and its many variates espoused by Cacioppo and Petty (1979, 1980) and Calder and Sternthal (1980). Researchers subscribing to this approach suggest that exposure to advertising messages produces two types of thoughts: message-related and those that reflect previous experiences or self-generated thoughts. During initial exposures to a message, thoughts are primarily message-related. However, message effectiveness declines as self-generated thoughts begin to predominate and take the form of counter-arguments as an advertisement is viewed repeatedly (Calder and Sternthal 1980).

Alternative explanations for the persuasive power of a message include the weak-effect hypothesis, the strong-effect hypothesis, and the two-factor theory. The weak-effect hypothesis (Greenberg and Suttoni 1973) suggests that the effectiveness of a message is a function of the level of exposure that the message attains; multiple exposures ensure that the message is better ingrained in the audience's mind. Contrary to this approach, the strong-effect hypothesis (Leavitt 1974) suggests that effectiveness may not be a function of the number of times a message is viewed since information contained in the message is learned during the first few viewings only. Finally, the two-factor theory, which borrows from Berlyne (1970), suggests that a decline in message effectiveness occurs after the initial uncertainty associated with a novel stimulus has been resolved and there is nothing more to learn about the stimulus.

Despite their different theoretical orientations, there appears to be a common thread in these explanations of message effectiveness. According to these theories, message effectiveness should be directly related with the information contained in the message—to the extent that this information can be learned, the message would be effective. Thus, factors that tend to facilitate or inhibit this learning would also enhance or diminish the effectiveness of the message. This argument is further extended in this paper to suggest that the impact of the factors that enhance or diminish message effectiveness can be ascertained by measuring the audience response

to these factors. This response is labeled *informational entropy* in this study, borrowing the notion of entropy from communication engineering. A detailed description of the construct follows in the following section.

Information Theory and Entropy

Developed by Shannon and Weaver (1949), information theory and its pivotal constituent *entropy* were initially used to design technical communication systems, which ensured a higher level of communication integrity than had been previously possible. This was achieved by minimizing information loss during the transmission process by controlling for variables such as message complexity, system capacity, redundancy, and audience familiarity and knowledge. Subsequently, information theory was used in several disciplines, ranging from biology (e.g., Gatlin 1972) to marketing (e.g., Herniter 1973), to study mechanical as well as human communications demonstrating the universal applicability of entropic processes.

The gist of information theory is that the amount of information conveyed in an event depends upon the probability of the event. If a person is being told something that he/she already knows, there is no transmission of "information" in the process. In probabilistic terms, in such an event, the outcome probabilities are completely known. Conversely, messages with which an audience is completely unfamiliar have higher entropy because outcome probabilities are completely unknown; the audience has no knowledge about the intended message. Of course, during message transmission itself, the outcome probability distribution changes as the audience "learns" the message and in many instances, may be able to predict the outcome even before complete message transmission has taken place. For most people, a cognitive reaction to a situation where message outcome is unpredictable is informational entropy. Informational entropy creates discomfort, which could be likened to cognitive chaos, and it can be resolved by importing energy (information) from the environment (Young 1987). This information simplifies the outcome probability distribution as some outcomes become more likely while others are ruled out.

Within marketing, often the task of a communication is not to remove the entropy to zero but rather to a level that the audience considers "optimal" as long as message effectiveness is not impacted negatively (Bruner 1984; Jacoby et al. 1994; Myers-Levy, Louie and Curren 1994). Messages with zero entropy will offer no challenge to the audience and may be ignored and messages that fall into an "optimal" entropy range will be more effective than messages that do not. Marketing communications such as advertisements may generate information entropy for several reasons. For example, if the stimulus is perceived to be very complex, novel and/or unfamiliar, the initial informational entropy could be too high. Stimuli generating very high levels of entropy would require that the audience engage in extensive information search in the external environment, or, in information theoretic terms, import information from the external environment. Furthermore, different people may experience differing levels of entropy on being exposed to the same incoming stimulus, depending upon their inherent tolerance for uncertainty and their willingness to explore the environment to reduce cognitive discomfort (e.g., Raju 1981; Steenkamp and Baumgartner 1992).

The preceding discussion suggests that informational entropy could be an important construct in the context of marketing communications since message effectiveness would be closely related to the levels of entropy generated in the audience. While some researchers have indirectly addressed the processes that may give rise to informational entropy (e.g., Berlyne 1970), a construct similar to the one proposed in this study has not been used as an explanatory variable in a human communication context. The construct is labeled *perceived* informational entropy (PIE) since it should be a function of the individual and the context. In the present context, PIE is defined as a mental state associated with cognitive discomfort or cognitive chaos concerning a stimulus to which an audience is exposed. Stimuli that are perceived to be novel, complex, and/or unfamiliar would generate high entropy. In addition, audience characteristics, such as the tolerance for cognitive discomfort, will determine the level of entropy experienced. In general, the larger the entropy generated from an incoming stimulus, the longer it would take the message to be transmitted and learned. Once all relevant

information has been learned, but the audience continues to be exposed to the message, processes such as counter-argumentation may replace message processing since there would be no additional "value" in the message.

STUDY PURPOSE

The focus of the research reported here is to test the relative impact of the factors governing message processing from marketing communications and explore the role of informational entropy in assessing message effectiveness. It is posited that a theoretical foundation which integrates the multiple factors governing message processing would not only assist researchers in reconciling diverse findings but might also provide an alternative framework for future research. It is hoped that by looking at the impact of various factors on message processing, results of this study should enable advertisers to understand characteristics of "better" communications, particularly advertisements, and develop appropriate communication strategies. Finally, given the inter-disciplinary nature of the approach used in this study, the construct may well prove to be useful in another communication context, thus making this interdisciplinary approach quite useful.

Consistent with the information-processing framework, it is posited that message processing from marketing communications such as advertisements can be explained in an integrative manner utilizing information theory (Shannon and Weaver 1949) and its central constituent *entropy*. In addition to developing the new construct PIE, this study investigates the relationships between several variables, with PIE. Preliminary findings relating PIE with advertising effectiveness are also reported.

HYPOTHESES

Message Novelty

Attneave (1959) referred to novelty of an event as being a simple function of the probability of the event relative to the probability of other events. In other words, since novel events are less probable than common, anticipated events, they are likely to generate more informational

entropy than simple expected events. Higher "surprisal" will result when the expected probabilities of certain outcome events are smaller (e.g., a picture in an advertisement is not logically related to the message that follows it). Therefore, the initial uncertainty (e.g., why does this picture appear with these messages?) will be high, resulting in a high PIE. In this study, this construct was labeled *perceived novelty* (PNOVL) indicating that it is dependent upon the audience's perception. High levels of novelty will be associated with high informational entropy and will require considerable information importation from the environment. In general, audiences of marketing communications may not be motivated to exert high levels of cognitive effort to marketing stimuli under normal circumstances. Based upon the preceding discussion the following is proposed:

H₁: There is a positive relationship between the perceived novelty of an advertisement and the PIE it evokes.

Message Complexity

Information theory suggests that high levels of entropy accompany complex communications. Marketing researchers have operationalized complexity along many dimensions such as visual intricacy, number of characters, number of bits, and number of words in an advertisement (Cox and Cox 1988; Chamblee et al. 1993). Furthermore, complexity, like novelty, is in the eye of the beholder and is likely to vary between viewers. Therefore, in this study the construct is labeled *perceived complexity* (PCOMPL), and it is proposed that complex advertisements will create more informational entropy than simpler advertisements. In addition, complexity and novelty are treated as related constructs in terms of the resulting PIE because complex messages may be considered novel and vice versa and both would generate PIE. Previous operationalizations of stimulus complexity have included measures of novelty as well. However, novelty does not necessarily imply stimulus complexity and complex stimuli are not necessarily novel. Therefore, a conceptual and operational distinction between the two is made in the study albeit the two are surely correlated. It is believed however, that highly

complex and novel stimuli will generate high levels of informational entropy. Accordingly, it is proposed that:

H₂: There is a positive relationship between perceived complexity of an advertisement and the PIE it evokes.

H_{2a}: Perceived novelty and perceived complexity are positively correlated.

Familiarity

Clearly, the nature of information processing as well as the effort exerted in the process are different for novices and experts (low versus high familiarity). At least three categories of familiarity could exist in an advertising context: advertisement familiarity, brand familiarity, and product class familiarity. From an information theoretic perspective, higher familiarity with the categories noted above would mean that the informational entropy as well as the overall effort to reduce entropy would be lower and consequently, PIE will be lower. Thus, a negative relationship between familiarity and PIE is expected:

H₃: The relationships between advertisement familiarity, product class familiarity, and brand familiarity, and PIE are negative.

Optimum Stimulation Level (OSL)

Research suggests that the extent to which people seek variety in their environments and show tolerance toward uncertainty and ambiguity is a function of their optimum stimulation level (OSL) (e.g., Raju 1980). Empirical evidence also shows that high values of OSL are accompanied by more tolerance of uncertainty and a tendency to complicate decision tasks to avoid boredom (Raju 1980, 1981; Steenkamp and Baumgartner 1992). From an information theoretic viewpoint, people with a high OSL should experience less informational entropy from a stimulus due to their ability to tolerate uncertainty and a preference for extensive exploratory behavior. This would enable them to allocate sufficient cognitive energy to import information from the environment and reduce the corresponding entropy generated from an incoming

stimulus. Thus, cognitive discomfort would be resolved more easily by reducing PIE. On the other hand, message effectiveness will decline faster for these individuals since entropy reduction will be quicker, making them prone to boredom, counter-argumentation, and irritation. Therefore, it is posited that:

H₄: There is a negative relationship between OSL and PIE.

Advertising Effectiveness

Advertising researchers use a wide array of theories to address issues surrounding advertising effectiveness. The most common theories include the Hierarchy-of-Effects models, the Information Processing Approach, and variations of the Elaboration Likelihood Model (see Scholten 1996 for a review). The theories chosen to measure effectiveness reflect the researcher's definition of what constitutes effectiveness. Thus, measures of effectiveness run the gamut from attitude toward the advertisement to the correlation between advertising expenditure and brand sales.

This study uses the information processing model of advertising effectiveness and four measures of advertising effectiveness which have been used in prior research to address issues pertaining to advertising effectiveness. The four measures which have typically been used to measure audience response to an advertising communication are: 1) the evaluative component of attitude toward the advertisement (EVAL); 2) the affective component of attitude toward the advertisement (AFCT); 3) attitude toward the act of purchase (ACT); and 4) behavioral intention (BI). Based upon the information-processing model, it is proposed that the audiences actively process information contained in an advertisement. This information may generate informational entropy in the audience due to message-related factors such as complexity and/or audience-related factors such as OSL. If informational entropy is higher than what the audience is willing to tolerate, it will affect message effectiveness negatively. This, in turn, should be reflected in measures of effectiveness such as attitude toward the advertisement, attitude toward the act of purchase, and behavioral intention. Thus, a negative correlation between PIE and

all measures of advertising effectiveness was expected. Additionally, qualitative information was also collected on brand name recall.

Subjects were asked to recall the name of the advertised brand. A recall was coded as complete or partial depending upon whether the subject was able to recall the name of the brand completely or only partially. Partial recall coding took into account the "gist" of the name instead of the complete name itself (Keller, Heckler and Houston 1998). For example, if a subject reported the name of the jeans as "French Fashion" (instead of the correct name "French Connection"), it was coded as recall under the partial recall category. It is pertinent to mention that recall measures were used primarily as qualitative measures and thus, no specific hypotheses regarding brand name recall were constructed. However, it was expected that advertisements that generate lower cognitive entropy would also generate high recall. The following hypotheses are offered regarding the relationship between advertising effectiveness and PIE:

H₅: The relationships between PIE and evaluative and affective components of attitude towards the advertisement are negative.

H₆: The relationships between PIE and attitude toward the act of purchase and behavioral intentions are negative.

METHOD

Four print advertisements, three color and one black and white, were chosen from foreign magazines. The advertisements were selected by the researchers from a large pool of advertisements after discussion with peers and other researchers specializing in advertising and communications research. Selection criteria were relative novelty and complexity of the advertisements. The advertisements chosen were such that both the advertisements and the brand names were expected to be unfamiliar to the audience. Manipulation checks suggested that this assumption was indeed valid and that, in general, the target audience had neither heard the brand names nor seen the advertisements before. The advertisements used in the experiment were for the

following products: jeans (Advertisement 1), a relatively expensive wristwatch (Advertisement 2), moderately priced crystal (Advertisement 3), and toothpaste (Advertisement 4). A high quality (four-color) reproduction of the advertisements ensured that the pictures appeared as they would in a magazine.

Two hundred-fifteen undergraduate and graduate students were recruited from consumer behavior and international business courses at a large mid-western university. One hundred ninety-four usable responses were obtained from a sample that was sixty-two percent male. The majority of respondents (eighty-one percent) were between 19-25 years of age. The sample was primarily undergraduate (eighty-six percent), American (seventy-four percent), and majoring in business (sixty-two percent). Sixty-four percent of the respondents were white, twenty-seven percent were Asian-Americans, and nine percent were African-Americans. Testing revealed no relevant differences between the various ethnic groups, majors, genders, and educational levels.

All scales used to measure the many constructs reported in the study were adapted from studies published earlier (except the scale used to measure PIE, which was developed within this study). The scales were reanalyzed to ensure that they were face-valid and had acceptable reliabilities. Reliabilities reported in the study pertain to LISREL model assessment (Jöreskog and Sörbom 1988). Measure development for the construct PIE followed the guidelines suggested by Gerbing and Anderson (1988). An initial sample of twenty-five items was generated after a review of the psychology literature on entropy. The set was reduced to sixteen items after three expert judges assessed their content validity and was further reduced to eight items through exploratory factor analysis.

For the assessment of convergent validity, two procedures were employed. As noted earlier, PIE was expected to be influenced by complexity of the incoming stimuli, among other variables. Therefore, complexity and PIE were expected to be correlated. A correlation of .30 and above was used as evidence of convergent validity. Items loading on the same factor in confirmatory factor analysis and a significant model were also used to infer convergent validity. An

important aspect of discriminant validity was measured by correlating scale items for all constructs with an abridged version of the Marlowe-Crowne social desirability scale (Crowne and Marlowe 1960; Strahan and Gerbasi 1972; King, Bruner and Hensel 1991). The ten-item, nine-point scale was used to assess subjects' tendency to respond in a socially desirable manner. Low and non-significant correlations (below .30) were interpreted as partial evidence of discriminant validity.

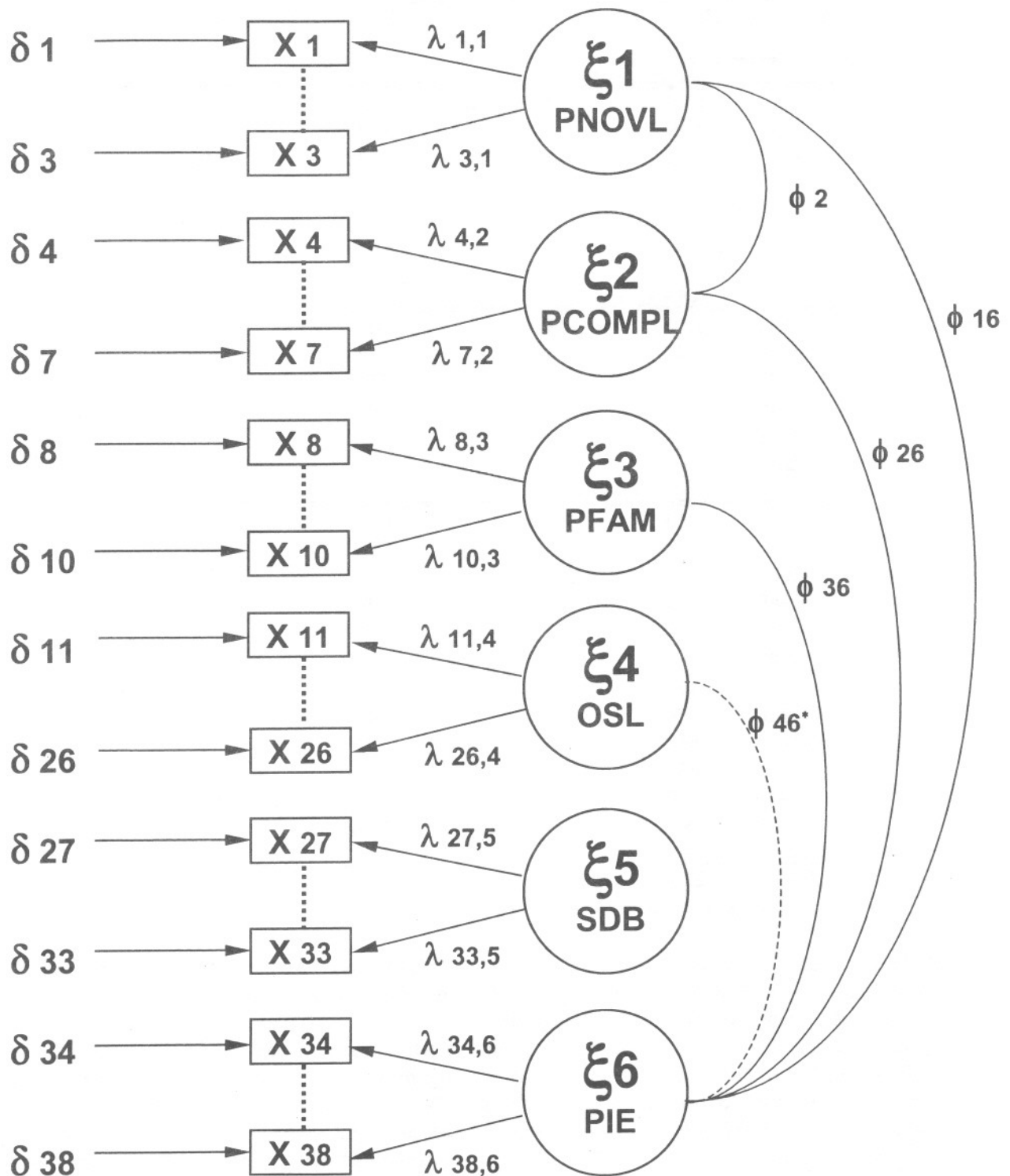
RESULTS

Model Fit

After elimination of items that did not meet the criteria for acceptable fit, the final measurement model (shown in Figure 1) contained 38 X-variables (exogenous indicators) loading on 6 ξ (exogenous) constructs. Most researchers agree that the assessment of a model fit needs to be explored within the context of the study and should be theoretically justified (Tanaka 1993). Thus, we posit that the relative improvement in model fit justifies item elimination since there was a distinct improvement in the model fit without any loss of information (Byrne 1989). A coefficient of determination of 1.00 indicated a reliable model and Q-plot of standardized residuals suggested a good fit.

Table 1 presents the null and alternative measurement model results. In accordance with the standard nomenclature, in this study null model refers to a model with no correlations whereas the alternative (measurement) model is the proposed correlated model. In keeping with accepted practice, multiple indices for determining the quality of the model fit were used (Byrne 1989; Bollen and Long 1993). The Chi-square/df was significant for all advertisements. Furthermore, as shown in Table 1, other statistics also supported the observation that the model fit for the alternative measurement model was adequate. The near identical results for all four stimuli suggest that the fit was not a mere artifact of one stimulus. Thus, the correlated measurement shown in Figure 1 indicates a parsimonious and acceptable fit between the hypothesized and actual models, and the model appears to have been validated.

Figure 1: Final Measurement Model



Note: X1--X3 indicators X1 through X3, etc.

* This Path not supported

TABLE 1
Goodness-of-fit Indices for Null and Alternative Measurement Models

Original Model	Final Modified Model			
Advertisement 1				
	Null	Alternative	Null	Alternative
χ^2/df	1.78	1.70	1.73	1.55
GFI	.663	.675	.767	.792
AGFI	.639	.649	.741	.772
RMS	.101	.075	.113	.067
$\Delta \chi^2$	155.3		144.01	
Δdf	15		15	
Advertisement 2				
χ^2/df	1.69	1.64	1.62	1.52
GFI	.671	.679	.776	.790
AGFI	.648	.653	.751	.761
RMS	.091	.077	.094	.069
$\Delta \chi^2$	98.97		87.7	
Δdf	15		15	
Advertisement 3				
χ^2/df	1.70	1.68	1.80	1.57
GFI	.665	.671	.770	.781
AGFI	.642	.645	.744	.750
RMS	.095	.078	.094	.071
$\Delta \chi^2$	95.29		76.85	
Δdf	15		15	
Advertisement 4				
χ^2/df	1.79	1.68	1.80	1.57
GFI	.658	.674	.753	.787
AGFI	.633	.648	.723	.757
RMS	.108	.074	.128	.065
$\Delta \chi^2$	181.56		173.27	
Δdf	15		15	
CV (/ /)	24.996			
CV = Critical Value for χ^2				

All factor loadings for all advertisements were significant at the .05 level, and ranged from .460 to .96. In addition, all T-values were higher than the suggested 2.00 level (Byrne 1989). All item loadings on PIE were significant and higher than .70. Therefore, it can be inferred that all retained items are adequate descriptors of the constructs. Correlations (ϕ) among the constructs for the four stimuli are reported in Table 2. Correlation between PNOVL and PIE was significant and positive for all stimuli except for advertisement 3. The significance and strength of the correlations suggest that

PNOVL and PIE are positively correlated. Thus, hypotheses H_1 is supported

Correlations between PCOMPL and PIE were significant and positive for all the advertisements. Therefore, hypothesis H_2 is supported although for advertisement 3 the correlation is low. Furthermore, as hypothesized, PNOVL and PCOMPL were positively correlated and all correlations were significant. Thus, hypothesis H_{2a} is also supported. Correlations between PFAM and PIE were significant and negative for all

TABLE 2
Correlations Between the Constructs (T-values in Parentheses)

Advertisement 1						
	PNOVL	PCOMPL	PFAM	OSL	SDB	PIE
PNOVL	1.00					
PCOMPL	.70 (4.9)	1.00				
PFAM	-.05 (-.65)	-.08 (-.94)	1.00			
OSL	.16 (1.76)	-.09 (-1.06)	-.16 (-1.9)	1.00		
SDB	.28 (2.79)	-.33 (-3.07)	.12 (1.38)	.075 (.84)	1.00	
PIE	.31 (3.28)	.469 (4.328)	-.34 (-4.15)	.093 (1.15)	.25 (2.8)	1.00
Advertisement 2						
PNOVL	1.00					
PCOMPL	.58 (3.90)	1.00				
PFAM	-.13 (-1.4)	-.05 (.56)	1.00			
OSL	-.05 (-.6)	-.06 (-.70)	-.00 (.04)	1.00		
SDB	-.03 (-.32)	-.05 (-.48)	.19 (2.21)	.07 (.83)	1.00	
PIE	.45 (4.33)	.39 (3.36)	-.21 (-2.59)	.07 (.86)	.04 (.51)	1.00
Advertisement 3						
PNOVL	1.00					
PCOMPL	.64 (4.31)	1.00				
PFAM	-.14 (-1.7)	-.12 (-1.3)	1.00			
OSL	-2.3 (-2.4)	.08 (.87)	-.17 (-2.8)	1.00		
SDB	-.01 (-.15)	.00 (.01)	.12 (1.5)	.07 (.79)	1.00	
PIE	.14 (1.53)	.19 (1.9)	-.28 (-3.3)	-.16 (-1.8)	.1 (1.27)	1.00
Advertisement 4						
PNOVL	1.00					
PCOMPL	.533 (4.950)	1.00				
PFAM	-.46 (-5.1)	-.35 (-3.8)	1.00			
OSL	.04 (.50)	-.20 (-2.2)	.09 (1.2)	1.00		
SDB	.07 (.84)	-.07 (-.82)	-.00 (-.05)	.07 (.79)	1.00	
PIE	.55 (5.8)	.50 (4.94)	-.42 (-4.8)	-.03 (-.32)	.09 (1.0)	1.00

advertisements. Therefore, hypothesis H_3 is supported. The correlations between OSL and PIE were not significant for any stimulus except for Advertisement 3, where it was low. Therefore, hypothesis H_4 is not supported.

Correlations reported in Table 2 also indicate that there were no systematic associations between the various

constructs used in the study and the Social Desirability Bias (SDB) scale. This suggests a lack of social desirability bias in the study and confirms one aspect of discriminant validity (King, Bruner and Hensel 1991). In addition, as seen in Table 2, no systematic associations other than the ones hypothesized by the study were found among other constructs, indicating a clean factor structure.

Measure Quality

Construct reliability and variance extracted were determined using structural equation modeling (Hair, Anderson, Tatham and Black 1998). Average LISREL Reliability estimates for the scales measuring PNOVL, PCOMPL, PFAM, OSL, and SDB were .77, .72, .95, .86 and .76 respectively. Reliability for the scale measuring PIE was .90. Average variances extracted for PNOVL, PCOMPL, PFAM, and OSL were .51, .36, .83, and .29. The low variance extracted by OSL and failure to find support for hypothesis H₄ suggest that OSL does not contribute much to the explained variance in the model, and did not perform as hypothesized.

A significant positive correlation between PNOVL and PCOMPL for all stimuli provides some evidence of convergent validity between these two constructs since they were expected to be theoretically related (Table 2). Other indicators of convergent validity were the loadings on individual constructs as detailed earlier. The one aspect of discriminant validity was confirmed as reported earlier.

Evidence of nomological validity comes from validation of theory (Peter 1981). In our case, the significance of the overall model in which four constructs (PNOVL, PCOMPL, PFAM, and OSL) had been hypothesized to be correlated with the construct PIE, provides evidence of the model's validity. The manner in which the constructs borrowed from previous studies behaved within the context of our study also provides additional support for a claim of nomological validity. Furthermore, the relationships and correlations, which support the theoretical model, also strengthen our argument for nomological validity.

PIE and Advertising Effectiveness

The scales used to measure effectiveness have reported high reliability coefficients in previous studies. LISREL reliability estimates for these measures in the present study ranged from .83 (for the scale measuring the evaluative component of attitude toward the ad labeled EVAL) to .95 (for the scale measuring attitude toward the act of purchase labeled ACT). These results suggest that the measures had adequate psychometric qualities.

To test hypotheses H₅ and H₆ measures of advertising effectiveness were correlated with PIE and the correlations are reported in Table 3.

The correlations between PIE and three measures of advertising effectiveness (EVAL, ACT, and BI) were significant and negative. Only for one measure of effectiveness, affective component of attitude toward the advertisement, there was no correlation between PIE and AFCT. This indicates, that in general, informational entropy is negatively correlated with advertising effectiveness. Thus, hypothesis H₅ is supported for the evaluative component of advertising effectiveness but not for the affective component. Hypothesis H₆ dealing with attitude toward the act of purchase (ACT) and behavioral intentions (BI) is also supported.

In order to assess whether advertisements with intermediate levels of entropy were viewed as more effective than advertisements with either very high or very low levels of entropy, several pair-wise correlations were performed. Mean PIE values for advertisements 2 and 4 were found to be in the intermediate range whereas advertisement 1 had the highest mean value for PIE and advertisement 3 had the lowest. The effectiveness measures were generally higher for advertisements 2 and 4 as compared to advertisements 1 and 3. For example, the mean EVAL values for advertisements 2 and 4 were 5.27 and 5.25 as compared to 4.36 and 3.82 for advertisements 1 and 3, respectively (all pair-wise correlations had a 2-tail significance of at least .005). Similarly, mean BI values were 4.19 and 3.84 for advertisements 2 and 4 as compared to 3.10 and 3.71 for advertisements 1 and 3, respectively (all pair-wise correlations had a 2-tail significance of at least .002). Mean ACT values for advertisements 2 and 4 were 5.25 and 4.71 as compared to 3.92 and 4.45, respectively for advertisements 1 and 3 (all pair-wise correlations had a 2-tail significance of at least .002). Finally, mean AFCT values for advertisements 2 and 4 were 3.53 and 3.81 versus 3.77 and 3.24, respectively. However, not all differences were significant for AFCT. Thus, preliminary results based upon this study seem to confirm the notion that advertisements which generate moderate levels of informational entropy are more effective than either very low or very high information entropy generating advertisements.

TABLE 3
Correlations Between Pie and Advertising Effectiveness Measures (P-values in Parentheses)

Effectiveness Measures	PIE1	PIE2	PIE3	PIE4
EVAL1	-.27(.00)	.1067 (.14)	-.16 (.03)	.02 (.77)
EVAL2	.05 (.50)	-.21 (.004)	-.04 (.52)	.00 (.99)
EVAL3	.08 (.24)	.06 (.36)	-.18 (.009)	.07 (.36)
EVAL4	.06 (.40)	-.11 (.13)	-.12 (.80)	-.29 (.00)
AFCT1	-.0344 (.63)	.19 (.005)	.06 (.44)	.08 (.29)
AFCT2	.16 (.03)	.13 (.07)	.22 (.002)	.12 (.092)
AFCT3	.14 (.06)	.11 (.13)	.02 (.82)	.11 (.13)
AFCT4	.10 (.16)	.10 (.14)	.07 (.33)	-.01 (.93)
ACT1	-.37 (.00)	.08 (.28)	-.09 (.19)	-.12 (.11)
ACT2	-.07 (.36)	-.31 (.00)	-.14 (.05)	-.16 (.03)
ACT3	.04 (.54)	.02 (.87)	-.18 (.012)	.07 (.33)
ACT4	-.06 (.39)	-.06 (.38)	-.06 (.41)	-.42 (.00)
BI1	-.37 (.00)	.07 (.37)	-.08 (.25)	-.11 (.10)
BI2	-.09 (.19)	-.26 (.00)	.03 (.66)	-.17 (.02)
BI3	.03 (.64)	-.05 (.51)	-.13 (.08)	.04 (.61)
BI4	-.08 (.26)	-.01 (.83)	.05 (.51)	-.35 (.00)

Note: The numbers 1, 2, 3, and 4 refer to advertisements, i.e., EVAL1 is the evaluative measure for advertisement 1, and so on.

Complete brand name recall was highest for the jeans (*French Connection*) followed by the wristwatch. Twenty-two percent of the subjects were able to recall the complete name of jeans as opposed to eighteen percent for the wristwatch. Interestingly, only ten percent were able to recall the name of the toothpaste and about the same were able to recall the brand name for the crystal. For partial recall, results were similar with the advertisement for jeans ranking number one (thirty-five percent in recall) followed by the wristwatch (twenty-two percent). However, more subjects recalled the name of the toothpaste (nineteen percent) than the crystal (twelve percent). These results are interesting in that they present a somewhat contradictory picture because while the results for the wristwatch are in keeping with what was expected of mid-range complexity, the results for jeans are somewhat unexpected. While the four effectiveness measures indicate that, in general, advertisements that generate moderate levels of complexity are more effective, the recall measures are different. The advertisement for the jeans was deemed the most complex and yet it had the highest recall. It is plausible that the relevance of the product to the target market may have moderated the results in this case. It is pertinent to mention that these

recall measures were not as detailed or as sophisticated as the others; they simply asked the respondents to report on the brand names not the details contained in the message. Nevertheless, it is interesting to note the differences in the recall measures and other measures of effectiveness.

DISCUSSION

The results suggest that, in general, stimuli that are perceived to be novel and/or complex will produce higher levels of informational entropy in the audience than advertisements that are deemed simple and/or ordinary. Thus, for an advertiser, the objective would be to arrive at a manageable level of informational entropy that does not interfere with message effectiveness. Similarly, communications perceived as too novel might also create cognitive discomfort until the novelty is resolved by actively examining the communication. The positive correlation between perceived novelty and complexity suggests that novel advertisements may be viewed as being complex and vice-versa.

While all novel advertisements are not necessarily complex, some might be perceived as such because the audience does not know with any certainty what the communication means. Creative advertising (Kover, Goldberg and James 1995) might be especially prone to this effect where ad novelty might give rise to informational entropy and impact message effectiveness negatively. On the other hand, informational entropy is negatively correlated with audience familiarity with the product class. Prior knowledge of any kind about the object of communication will help alleviate informational entropy since people can draw inferences about it by using their existing knowledge structure even when they are not familiar with the communication.

Despite a strong theoretical support for a relationship between optimum stimulation level and informational entropy, the two showed no association in the present study. In the Steenkamp and Baumgartner (1992) study, measures for perceived novelty, complexity, and familiarity were not included. It could be that optimum stimulation level was substituting for these measures to produce a significant correlation. In addition, some items had to be deleted since they did not meet the model fit criterion for the measurement model. This could also have influenced the usefulness of the measure.

Results of the study also show that, in general, informational entropy is negatively correlated with advertising effectiveness confirming our hypothesis that very high entropy affects communication effectiveness, negatively. This suggests that marketing communications, which attempt to make the communications cognitively very challenging might not perform as well as those that keep this challenge manageable. Since the audience for marketing communications is constantly bombarded with a plethora of messages, it deals with this informational overload by ignoring, filtering, or otherwise minimizing the effort required to process these messages. Most consumers prefer an intermediary level of cognitive challenge indicating that messages generating intermediary levels of informational entropy may have a better chance of being processed than either very high or very low levels of informational entropy. It is thus the task of the advertiser to ensure that marketing communications fall within this "optimal" entropy range.

Contrary to expectations, no association was found between the affective measures of advertising effectiveness and informational entropy. Intuitively, it would appear that if informational entropy is high, it would manifest itself into affective discomfort along with a cognitive discomfort thus impacting message effectiveness negatively. One explanation for this result could be that informational entropy is a cognitively-oriented measure and does not capture the affect dimension. Another reason could be that the advertisements themselves or the setting (e.g., low level of audience involvement) might have been incapable of evoking strong emotional response in the audience. Furthermore, results reported in the study are based upon a single exposure assessment of effectiveness, which may have been inadequate to generate affective response in the subjects. Overall, the study found that the most effective advertisements were those for which the mean PIE values were in the intermediate range. This suggests that if the audience views informational entropy as "acceptable", message effectiveness should not be impaired.

As noted earlier, for one of the advertisements, which was the only black and white ad, the strength and correlations between various measures were consistently lower than those for color advertisements. Industry practice subscribes to the view that black and white advertisements are less effective than color advertisements (Gronhaug, Kvitastein and Gronmo 1991). Future studies may need to address whether black and white advertisements are processed differently than color advertisements.

As with any study conducted in an artificial environment, an important limitation of this study can be the environment where subjects were "forced" to process information that they might not otherwise do. Additionally, the study used print advertisements and, as such, the findings reported here are limited to such stimuli only. Another limitation of the study is that it used advertisements and brands with which the audiences were not familiar. The use of a student sample and the corresponding issue of external validity (Lynch 1982, 1983) could also limit the generalizability of the results. A logical extension of this study would be to test the model on other populations as well as settings.

Similarly, the model could also be tested for other forms of advertising media such as television and radio.

SUMMARY AND CONCLUSION

Overall, results of this study suggest that PIE is an important construct in understanding how marketing communications are processed and could provide the backdrop against which advertising and other forms of marketing communications could be studied. In addition, PIE also seems to resolve the seeming contradictions in the extant research to explain the decline in message effectiveness by providing an alternative explanation for marketing communication processes. PIE should also enable researchers to investigate message effectiveness in an alternative yet parsimonious manner since the study tested the applicability of PIE alongside other constructs known to impact message effectiveness.

A holistic assessment of processes governing marketing communications needs to address both the communicator and the recipient. Results of this study suggest that advertisers need to examine characteristics of the advertisements such as novelty and complexity along with the characteristics of the intended audience. While this appears intuitive, it is important to remember that a message strategy which does not address the audience's subjective perceptions may be fraught with problems. Using the informational entropy paradigm as a tool to understand how the same message may be understood by different audience should enable marketers to develop communications that are more effective.

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