

## A KNOWLEDGE-BASED SYSTEM FOR ADVERTISING DESIGN

RAYMOND R. BURKE, ARVIND RANGASWAMY, JERRY WIND  
AND JEHOOSHUA ELIASHBERG

*University of Pennsylvania*

In recent years, artificial intelligence research has provided new tools and techniques for marketing model builders. These tools, when combined with problem-solving knowledge from a specific domain, can be used to create expert systems. This methodology is most applicable in semistructured problem domains where the key relationships are logical rather than numerical and problem-solving knowledge is incomplete. One such problem in marketing is advertising design.

In this paper, we describe the application of expert system techniques to the development of ADCAD, a system designed to assist advertisers of consumer products with the formulation of advertising objectives, copy strategy, and the selection of communication approaches. The paper highlights the assembly of ADCAD's knowledge base of ad design heuristics from multiple sources of published research and practitioner expertise and describes its structure and content. We discuss the procedures and obstacles associated with building, implementing, and validating such an expert system. Our experiences with ADCAD suggest that knowledge-based systems have significant potential for the consolidation and integration of marketing knowledge as interactive input for decision makers. We conclude by noting several avenues for the future development of advertising expert systems.

(Artificial Intelligence; Expert Systems; Advertising; Creativity)

Advertising design is an inherently complex and error-prone decision because of the tremendous variety of creative options and the large number of consumer and environmental factors determining advertising effectiveness. A considerable amount of research has been conducted to uncover the relationships between advertising communication variables and consumer decision making, and to identify the conditions under which specific communication approaches (e.g., ad formats, appeals, layouts, emotions, presenter characteristics) will have an impact on consumer behavior. Bauer (1968, p. 5) notes, "... we have known for a precious long time that communication effects are contingent on a variety of circumstances. What I am advancing is a statement of faith that we are advancing from a stage in which we had to shrug our shoulders and say 'it depends,' to the stage where we can be quite specific as to what 'it depends' on, that we are developing a set of interlocking propositions that are moving us to a coherent and complex model."

Despite the volume of empirical and theoretical work, advertising design remains a subjective and intuitive process. Practitioners make decisions largely on the basis of experience with past campaigns, creative insight, and intuition rather than published research. This may be due to several factors. The relevant research is diverse, coming

from marketing and advertising practitioners as well as from the academic disciplines of marketing, the behavioral sciences, and the humanities. Research results are typically unavailable to advertisers at the time of the ad design decision. A second factor is agency skepticism regarding the value of research and rules based on the belief that their use reduces creativity and leads to homogeneous advertising (Kingman 1981; Williams 1986). Advertisers are also concerned that research may not measure some important aspects of consumer response to advertising (Morgan 1984).

Historically, the advertising creative decision has been outside the realm of marketing science. The objective of this paper is to demonstrate that, through the application of expert system techniques, marketing science can assist advertisers with ad design by helping them to consider and apply the large number of insights from published research and practitioner experience. Expert system methodology is well suited for bringing together diverse forms of knowledge into a coherent decision support system. This methodology is particularly appropriate for the advertising domain because variables are often categorical rather than continuous, many of the reported relationships are logical rather than arithmetical, and knowledge in the domain is incomplete (Rangaswamy et al. 1987). Advertising design requires the application of a large number of problem-solving heuristics to new situations. These heuristics can be incorporated into an advertising expert system.

The paper describes ADCAD, a knowledge-based system for *ADvertising Communication Approach Design*.<sup>1</sup> The ADCAD system uses expert system methodology to codify and synthesize prior research, theory, and expertise in a decision aid for selecting advertising objectives, creative strategy, and communication approaches. ADCAD was designed to serve several purposes. First, it should improve the quality of advertising decisions. By asking a series of questions about the brand, competition, consumers, and the environment, the system should stimulate the user's creative process by identifying information that is potentially relevant to the decision. The system should then provide interactive input to the decision process by presenting several advertising suggestions and lines of reasoning in response to a variety of user-generated scenarios. Through this process, the system can stimulate the consideration of new alternatives and provide a better understanding of the communication problem. Second, the expert system should facilitate the accumulation of advertising knowledge by allowing the addition, deletion, and modification of rules in the knowledge base in response to the experience of users, copytesting results, and other published theories and findings. Third, the system should enhance the communication between the ad agency and client by allowing the two parties to explicitly state their assumptions and test the consequences. Finally, it should assist with the training of individuals who are unfamiliar with the problem domain.

In the following sections, we will describe the assembly of ADCAD's knowledge base of ad design heuristics from multiple sources of published research and practitioner expertise and describe its structure and content. We illustrate ADCAD's features and the interaction of the knowledge elements with an example consultation. We then discuss issues associated with the implementation and validation of such an expert system, and identify several avenues for the future development of advertising expert systems.

### **Knowledge Acquisition and Representation in System Development**

Expert systems are interactive computer programs that apply a variety of knowledge elements, such as facts, rules, and models, in a manner that supports and enhances problem-solving in specific domains. The main components of an expert system are the

<sup>1</sup> The system is, strictly speaking, a knowledge-based system rather than an expert system because it incorporates several sources of knowledge rather than the experience of a single expert. As is common in the literature, the two terms will be used interchangeably in the following discussion.

*knowledge base* and the *inference engine*. The knowledge base consists of the definitions of objects and variables in the chosen domain, the relationships between objects and variables, and the problem-solving rules relevant to that domain. The inference engine is the set of general control processes that manipulate the rules and facts in the knowledge base, along with information supplied by the user, in a manner which solves the problem. (For a detailed discussion of expert system components, see Harmon and King 1985, and Hayes-Roth, Waterman, and Lenat 1983.) In this section, we provide an overview of ADCAD's development and discuss the acquisition and representation of advertising knowledge. In the following two sections, we describe the content of ADCAD's knowledge base and the operation of its inference engine.

### *Domain Specification*

The major challenge in building an expert system for advertising design is the construction and refinement of the knowledge base. The first step in this process is the specification of the problem domain. This requires an analysis of the information that is available to the advertiser, the specific decision areas of interest, and the set of possible actionable recommendations. Advertisers may have access to information on consumer, product, brand, and competitor characteristics. They seek information on ad creative strategies and communication approaches. The main stages in advertising design are: (1) market assessment, (2) marketing strategy development, (3) segment selection, (4) selection of communication objectives for the targeted segment, (5) positioning, (6) deciding on how this positioning can best be communicated, and (7) checking if the execution is preempted by a competitor (Young & Rubicam). In the development of ADCAD, we focused on all stages except segment selection and competitive advertising, which will be addressed in future research.

Based on an analysis of the problem domain, ADCAD's task was defined as the selection of a product benefit, the format, presenter, executional techniques, and the emotional tone of the advertisement. The specification of benefits, format, and emotional tone was necessarily limited to the selection between a few common types (see Burke et al. 1988).

### *Identification of Key Variables*

The next step in system development is the identification of key variables. The system must include a relatively complete set of categories and values to reason accurately about the problem. An examination of published materials uncovered a large number of potentially relevant variables. This list required considerable editing and revision. Terms were often redundant or were used inconsistently (for example, "involvement" described both the mental activity associated with a brand decision and the attention typically associated with a particular medium). In many cases, the values given were neither mutually exclusive nor collectively exhaustive. Variable names and values were standardized for computer use. These included the advertisement variables mentioned above, as well as characteristics of the brand of product to be marketed, competitors' brands, and the consumer. (See Burke et al. 1988, Table 1, for a complete list of variables and values.)

### *Identification of Key Relationships*

In this section, we identify the key relationships between market characteristics and communication approaches to be represented as rules in the knowledge base.

*Published Materials.* A set of copy design rules was derived from existing theories of ad effectiveness, including the "hierarchy of effects" model (Colley 1961; Lavidge and Steiner 1961), the "low involvement" model (Krugman 1965; Ray 1973), the "elaboration-likelihood" model (Petty and Cacioppo 1983), the Rossiter-Percy communication

model (Rossiter and Percy 1987), and the "resource-matching" model (Anand and Sternthal 1986). The rules modeled the relationships between advertising copy factors and environmental characteristics, consumer behavior, and the psychological processes driving that behavior.

These theories do not make recommendations covering the entire problem domain. Therefore, other sources of published knowledge on copy effectiveness were explored. A number of empirical studies have investigated how various ad characteristics affect consumer response (e.g., Diamond 1968; Holbrook and Lehmann 1980; Rossiter 1981; Stewart and Furse 1986). A variety of mechanical and content factors have been studied, including the size/length of the ad, the use of color and illustrations, the message source, appeal, and the nature of claims mentioned. This research has typically regressed one or more consumer response variables (e.g., ad readership, recall) onto a number of dummy-coded ad characteristics. The results of these regression analyses were used to develop rules relating ad characteristics to consumer reactions.<sup>2</sup>

Finally, a large number of heuristics concerning copy strategy have appeared in advertising textbooks and trade magazines (e.g., Burton 1981; Runyon 1984). These are often presented as checklists of "do's and don'ts" (see, e.g., Jewler 1985; Ogilvy 1983; Roman and Maas 1976). These rules required substantial modification and refinement before they could be used contingently in the knowledge base. Many rules were universally stated, leaving the specification of contingencies up to the reader. The authors of the texts typically assumed that the reader would have relevant world knowledge to "fill in the blanks" where assumptions were not explicitly stated. In addition, because the writers tend to have experience with particular product categories, their books often promote a single view of how advertising works. Therefore, conditions were added to many of the rules to take into account the impact of other variables such as advertising objectives, market situations, and consumer characteristics.

*Practitioner Knowledge.* The creative personnel of a major advertising agency (Young & Rubicam, New York) also provided input to the system's development. It was thought that many of the practitioners' rules for copy strategy would be implicit in the decision making process. In order to explicate these rules, these "experts" were asked to show examples of their past advertising and to discuss the background information and reasoning underlying their choice of copy strategies. Other creative personnel were then asked to comment on the advertising and supportive arguments. These protocols were tape recorded, and then transcribed and converted to rules at a later point in time. Agency personnel were also helpful in defining key variables and their levels. The new rules, variables, and values derived from this interaction were input to the rule database and the updated materials were returned to the agency for comment. The rule database was revised in response to this feedback.

### The Knowledge Base

This section describes the current structure and content of the advertising knowledge base. Figure 1 presents an overview of the stages in the advertising design process and the operation of the ADCAD system. This review necessarily covers only a subset of the rules in ADCAD's knowledge base.<sup>3</sup> ADCAD is not meant to be a new theory of consumer

<sup>2</sup> A limitation of this research is that "copy effectiveness" is often defined in terms of just one or two measures, and the analyses only estimate the main effects of the ad characteristics, neglecting their interactions with consumer characteristics and situational factors. An additional problem is that these studies typically use ads that are already at the final stages in testing, and are therefore likely to evoke favorable responses. Consequently, there may be relatively little variation in some important ad characteristics. A notable exception is the recent study by Stewart and Furse (1986).

<sup>3</sup> To conserve space, the paper presents the knowledge for only part of the advertising design process: selecting marketing and advertising objectives. A complete discussion of ADCAD's rules and supporting citations is available from the authors.

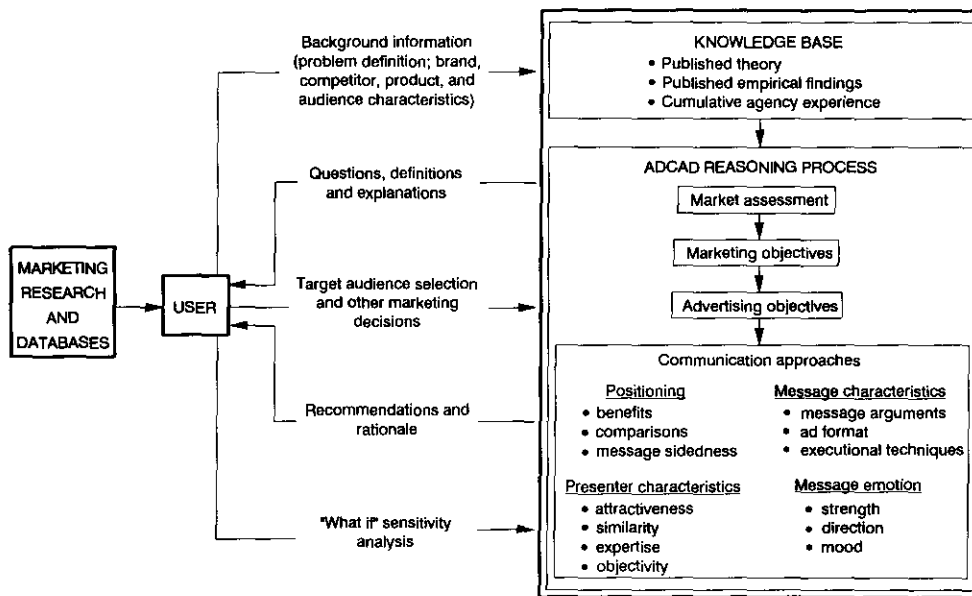


FIGURE 1. Overview of the Major Steps in Advertising Design and User Interaction with ADCAD.

response to advertising. Rather, it is an attempt to develop a decision aid which uses existing theory and empirical research to assist marketers with advertising design.

A simple model of consumer behavior underlies the present framework. Before purchasing a brand, it is assumed that consumers must: (1) have a salient need to move from their current state to some desired end state, (2) be aware of a brand that can produce this change, (3) be able to identify the brand or discriminate between brands in the product class at the time of the purchase decision, and (4) have no situational barriers to behavior.<sup>4</sup> If one or more of these elements inhibits purchase, then it must be addressed through advertising or other elements of the marketing program. Advertising can stimulate category need, create brand awareness and attitude, facilitate brand recognition and recall, and reduce or remove purchase obstacles.

#### *Marketing and Advertising Objectives*

ADCAD first asks the user to segment consumers into various target audiences. These groups typically differ in terms of purchase motivations, brand loyalty, and levels of product usage. An advertising communication strategy is developed for each target audience.<sup>5</sup> In this section, we review ADCAD's heuristics for selecting one or more marketing and advertising objectives. To illustrate how this information is encoded in the knowledge base, Table 1 presents a selection of rules for setting objectives. The total rule counts for each topic are listed parenthetically.

For new product categories (especially discontinuous innovations) and for new users of existing product categories, it is necessary to stimulate primary demand by communicating the benefits that tie the product category to consumers' needs and wants (Howard 1977). Likewise, if the product is at the maturity or decline stage of the product life cycle and the brand has a large market share, it may be desirable to increase primary demand, as the brand will reap a large share of the increased category sales (Benn 1978; Young & Rubicam). For products that are infrequently purchased (e.g., carpet cleaner) or pur-

<sup>4</sup> ADCAD can be used to develop advertising for both products and services. For brevity, the term "brand" is used throughout.

<sup>5</sup> ADCAD develops recommendations independently for each segment. It does not consider segment overlap.

TABLE 1  
*Example Rules for Selecting Marketing and Advertising Objectives*

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*Marketing Objectives (11 rules)*

- \* IF product life cycle stage = introduction AND innovation type = discontinuous THEN marketing objective = stimulate primary demand
- \* IF brand usage = none THEN marketing objective = stimulate brand trial
- \* IF current brand usage = some AND (brand switching = high OR product usage rate = fixed) THEN marketing objective = stimulate repeat purchase/loyalty
- \* IF current brand usage = some AND brand switching = low AND product usage rate = variable THEN marketing objective = increase rate of brand usage

*Advertising Objectives (18 rules)*

- \* IF marketing objective = stimulate primary demand AND product purchase motivation direction = negative THEN ad objective = convey product category information
  - \* IF marketing objective = stimulate brand trial AND brand purchase motivation direction = positive THEN ad objective = convey brand image
  - \* IF time of brand decision = at point of purchase AND package visibility = high AND package recognition = low THEN ad objective = increase brand recognition
  - \* IF marketing objective = increase rate of brand usage AND new brand uses = yes THEN ad objective = convey new brand uses
- 

chased once and used infrequently, the advertiser should remind the target audience of its need for the product (Rossiter and Percy 1987).

For both new and existing products, if the target audience has not used the brand in the past, then the advertiser should attempt to stimulate brand trial. If consumers have used the brand, then advertising should be designed to stimulate repeat purchase or loyalty, or to increase the rate of brand usage. When the rate of product usage is positively related to the quantity purchased (as with snack foods or ingredients), it may be desirable to increase usage by communicating new brand uses and/or directly stimulating purchase through promotions (Young & Rubicam). However, when consumers' consumption rate is not influenced by the amount purchased, it is generally less beneficial to have consumers stock up (unless, e.g., the advertiser anticipates heavy competitive activity and is attempting to maintain continuity of purchase). The advertiser should consider alternative objectives, such as increasing brand loyalty by creating or reinforcing positive brand beliefs or by projecting a favorable brand image or lifestyle.

Consumer motivation is a key consideration in setting communication objectives (Young & Rubicam). The two basic motivations for product and brand purchase are the need to restore equilibrium from an aversive to a neutral state (negative reinforcement), and the need to increase the level of desirable stimulation (positive reinforcement). The large number of specific purchase motives can be grouped into eight categories (Fennell 1978; Rossiter and Percy 1987). The negative motivations include removing or avoiding a problem, incomplete brand satisfaction, and normal product depletion. Positive motivations include sensory gratification, intellectual stimulation, self-esteem, and social approval.

When the motivation is negative, the consumer seeks to overcome or avoid a problem. Advertising can explain how a brand helps to remove the problem and/or offers better performance than the consumer's current brand. This type of advertising has been called "informational" (Puto and Wells 1984; Wells 1981), "thinking" (Foot Cone & Belding 1978), or "rational/reason why" (Young & Rubicam) advertising. When the motivation is positive, the consumer is interested in purchasing the brand primarily to feel good or enhance his/her image. In this case, advertising can communicate a brand image, mood, or the sensory qualities associated with the brand; known as "transformational" (Puto and Wells 1984; Wells 1981), "feeling" (Foot Cone & Belding 1978), or "emotional" (Young & Rubicam) advertising.

Communication objectives are also a function of the task faced by the consumer at the time of the purchase decision. If the brand decision is made at the point of purchase, then the consumer must be able to recognize the brand (i.e., discriminate between this brand and competing brands; Bettman 1979). However, if the brand decision is made prior to purchase, then the consumer must be able to recall the brand's name given the product class name or desired benefit as a memory cue (top-of-mind brand awareness). If brand awareness is already high, then it is only necessary to remind consumers of the association between the brand and purchase motivation.

Decision involvement is an important consideration for determining the amount of information to present in ads and the evaluation certainty necessary for choice. Consumer decision involvement is a function of the economic, psychosocial, and physical risk associated with purchasing and/or using the advertised brand. In low involvement situations, consumers may choose a brand based on brand recognition and/or the recall of a few brand benefits (Krugman 1965). On the other hand, high involvement decisions require higher levels of evaluation certainty and reduced decision risk. In the latter case, ads should be designed to communicate sufficient information to support the benefit claims.

#### *Advertising Communication Approaches*

ADCAD then selects various advertising communication approaches to achieve the marketing and advertising objectives based on a consideration of consumer, product, and environmental characteristics. These approaches, which include brand positioning, message and presenter characteristics, and the emotional tone of the ad, are briefly described below. Table 2 lists a selection of rules for each of these topics.

*Positioning.* The system picks benefits to be featured in the advertisement based on their importance, the degree to which the brand delivers the benefit, and the distinctiveness of the benefit relative to other brands (see Aaker 1982; Martilla and James 1977). The system also suggests whether the ad should directly or indirectly compare the brand to one or more competitors, and determines whether a one-sided or two-sided message should be considered.

*Message Characteristics.* An extensive set of rules in the knowledge base selects various message characteristics, including ad format, message arguments, executional techniques, and layout. The system recommends techniques for enhancing brand identification (recognition and top-of-mind awareness), communicating brand information, and increasing brand evaluation. ADCAD attempts to match the cognitive resources required for ad processing with the cognitive resources available. This ensures that consumers will understand and react to the key brand message (Anand and Sternthal 1986; Petty and Cacioppo 1983).

*Presenter Characteristics.* The target audience's response to an ad depends on the characteristics of the presenter as well as the message he or she delivers. ADCAD determines the expertise, objectivity, attractiveness, and similarity of the presenter by considering the brand's advertising objectives and relative performance, and consumers' purchase motivations, message processing ability, decision involvement, and brand attitude. The system also makes suggestions concerning the age, sex, and identity of the presenter.

*Message Emotion.* The last major dimension on which ADCAD makes recommendations is the emotional tone of the advertisement. The brand's characteristics, consumer purchase motivations, and ad format dictate the specific tone of the message. When an informational creative strategy is used, ADCAD selects a message emotion to support the main selling proposition. If message processing motivation is low, the system advises the advertiser to arouse a strong emotional response (positive or negative) in order to stimulate message processing (cf. Silk and Vavra 1974). When the creative strategy calls for transformational advertising, ADCAD recommends conveying the brand's image,

TABLE 2

*Example Rules for Selecting Advertising Communication Approaches**Positioning (24 rules)*

- \* IF ad objective = convey brand image or reinforce brand image AND brand purchase motivation = social approval AND brand usage visibility = high THEN possible benefit = "status" (cf. Holbrook and Lehmann 1980)
- \* IF ad objective = convey brand information or change brand beliefs AND perceived differences between brands = small or medium AND perceived relative performance = inferior or parity AND relative performance = superior AND current brand loyalty = competitor loyal THEN message comparison = direct comparison against competition (Gorn and Weinberg 1983)
- \* IF ad objective = convey brand information or reinforce brand beliefs AND conflicting information = likely AND education = college or graduate AND product knowledge = high AND involvement = high THEN message sidedness = two-sided (McGuire and Papageorgis 1961)

*Message Characteristics (80 rules)*

- \* IF ad objective = increase top-of-mind awareness THEN technique = jingle, rhyme, or slogan (MacLachlan 1984)
- \* IF ad objective = convey brand information or reinforce brand beliefs AND market share > 18.5 AND brand switching = high AND product type = existing THEN technique = sign off (Stewart and Furse 1986)
- \* IF ad objective = convey brand information or change brand beliefs AND message processing motivation = low AND message processing ability = low THEN ad format = problem solution (Schwerin and Newell 1981)

*Presenter Characteristics (20 rules)*

- \* IF ad objective = convey brand information or change brand beliefs AND message processing ability = low THEN presenter expertise = high (Rhine and Severance 1970)
- \* IF presenter expertise = high THEN time of identification in message = early (Sternthal, Dholakia, and Leavitt 1978)
- \* IF ad objective = convey brand information or change brand beliefs AND involvement = high THEN presenter objectivity = high (Choo 1964)

*Message Emotion (35 rules)*

- \* IF ad objective = convey brand image or reinforce brand image or change brand image THEN emotional direction = positive (Young & Rubicam)
- \* IF ad objective = convey brand image or reinforce brand image AND brand purchase motivation = sensory stimulation AND message processing motivation = high THEN emotional tone = elation (Rossiter & Percy 1987)
- \* IF ad objective = change brand beliefs AND message processing motivation = low AND purchase anxiety = low AND brand use avoids fearful consequences = yes THEN emotional tone = high fear (Ray and Wilkie 1970)

mood, or sensory qualities in an appealing way, portraying what the consumer might feel when using the brand (Young & Rubicam).

### The Inference Engine

The set of rules were input to an expert system shell (M1) as described in Rangaswamy et al. (1987). The shell processes the rules in a manner that focuses the knowledge base on the particular situation presented by the user during a consultation. The "procedural rules" discussed in the last section specify the appropriate actions to take or subgoals to establish when a certain objective and set of conditions exist. In addition, a large number of "declarative rules" were included in the database. These imposed semantics on the knowledge elements and helped to maintain consistency in the computer's database by specifying the relationships between facts. Rules were also added to enhance the user's interaction with the system.

In this section, we briefly describe the reasoning process used in ADCAD, provide an example application, and outline the methods employed for reasoning under uncertainty.



### *The Reasoning Process*

The ADCAD system requests information on the name and product class of the brand to be advertised, and the number and names of the market segments. It then uses the set of rules in a primarily goal-driven (i.e., backward chaining) fashion to search from alternative communication approaches and copy strategies back through the rules to conditions to be asked of the user (see, e.g., Harmon and King 1985). ADCAD only asks for information that is necessary to evaluate the current set of possible alternatives and that cannot be inferred from past responses. In the case of variables that can have multiple values (such as marketing and advertising objectives, consumer purchase motivations, and ad formats), the program evaluates the acceptability of each alternative. For single-valued variables, the system stops searching for a value when the accumulated evidence supports a single hypothesis with a confidence of 100 percent.

To illustrate the manner in which ADCAD selects rules from the knowledge base to make recommendations in specific situations, we describe a sample consultation based on the Suave shampoo case (Albion 1984). Table 3 summarizes the user input and ADCAD's recommendations for the first part of the consultation.<sup>6</sup> Figure 2 displays how the system links user input with rules in the knowledge base to reach a subset of the conclusions.

The Suave case describes the shampoo market as mature, competitive, and highly fragmented. Eighteen to 34 year old women are traditionally the heaviest shampoo users. Suave management segments this market into three groups: a loyal group of Suave users (22 percent), consumers who have tried Suave but now use other brands (28 percent), and consumers who have never tried Suave (50 percent). The third group is targeted and the user enters this information.

ADCAD first asks a series of questions to identify a set of marketing objectives. When requesting information, the system provides a "What" facility to give the user a detailed definition of terminology used in the system's questions, and a "Why" facility to tell the user why a certain piece of information is being used in the particular decision. In the Suave example, ADCAD infers that, because shampoo is a mature product and most consumers use it relatively often, it is not necessary to increase primary demand. The target audience has not used Suave, so ADCAD suggests stimulating brand trial.

Next, ADCAD attempts to determine appropriate advertising objectives. The user assumes that the audience's brand purchase motivation is to enhance self esteem and achieve social approval, so ADCAD proposes that advertising should communicate a brand image, mood, or lifestyle (Rossiter and Percy 1987; Wells 1981). The case suggests that brand decisions are made at the point of purchase, so the system recommends that advertising should enhance brand recognition (Bettman 1979).

Finally, ADCAD attempts to select a benefit to be featured in the advertisement and determine effective communication approaches. Suave sells at a much lower price than competitors but offers similar performance. The price attribute is important to the target audience, so ADCAD recommends positioning on value. However, the user anticipates the introduction of a number of low priced competitors, and he/she overrides this suggestion and chooses to enhance the quality image of Suave. The image-oriented creative strategy dictates a one-sided message.

At the end of the consultation, ADCAD presents its conclusions (and the associated confidence levels) for each market segment to the user. Because shampoos are relatively inexpensive, perceived brand differences are small, and there are minimal health risks, ADCAD infers that the purchase decision is low involvement. ADCAD suggests that the endorsement of an attractive, recognizable, female celebrity be used to attract the audience's attention and communicate the quality image (Petty, Cacioppo, and Schumann 1983; Young & Rubicam). The ad should be appealing, capturing what the consumer

<sup>6</sup> The full text of the consultation is presented in Burke et al. (1988), Appendix 1.

TABLE 3  
*Input and Output Values for Sample Consultation*

INPUT: *Market Assessment*

Audience Characteristics:

Sex = female	Past brand usage = none
Product category usage = frequent	Product purchase interval = short
Perceived brand differences = small	Benefit "value" important = yes
Current loyalty = unfavorable brand switcher	Time of brand decision = at point of purchase
Brand purchase motivation = self esteem, social approval	Package recognition = low

Product-Class Characteristics:

Life cycle stage = maturity	Complexity = low
Possible to demo. "quality" = yes	Competition = heavy

Brand/Competitor Characteristics:

Brand market share = 2.0	Relative performance = parity
Brand price = \$1.40	Competitor price = \$3.60
Package visibility at purchase = high	Brand usage visible = low
"Quality" visibility in ad = high	"Quality" visibility in use = low
Benefit "value" unique = yes	Benefit "value" deliverable = yes
Physical/health risks = low	

OUTPUT: *Marketing and Advertising Objectives*

Marketing objective = stimulate brand trial	Advertising objectives = create/increase brand recognition, communicate brand image/mood/lifestyle
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OUTPUT: *Communication Approaches*

Positioning:

Featured benefit = quality (user replaced rmnd. of "value")	Message comparison = none
Benefit claim = extremely positive	Message sidedness = one-sided
	Number of benefits = few

Message Characteristics:

Format = demonstration of product in use, endorsement by celebrity, vignette	Technique = closeup, color illustration, long package display, music, visual stimuli/imagery, surrogate indicators of performance, capture consumer emotions
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Presenter/Principal Character:

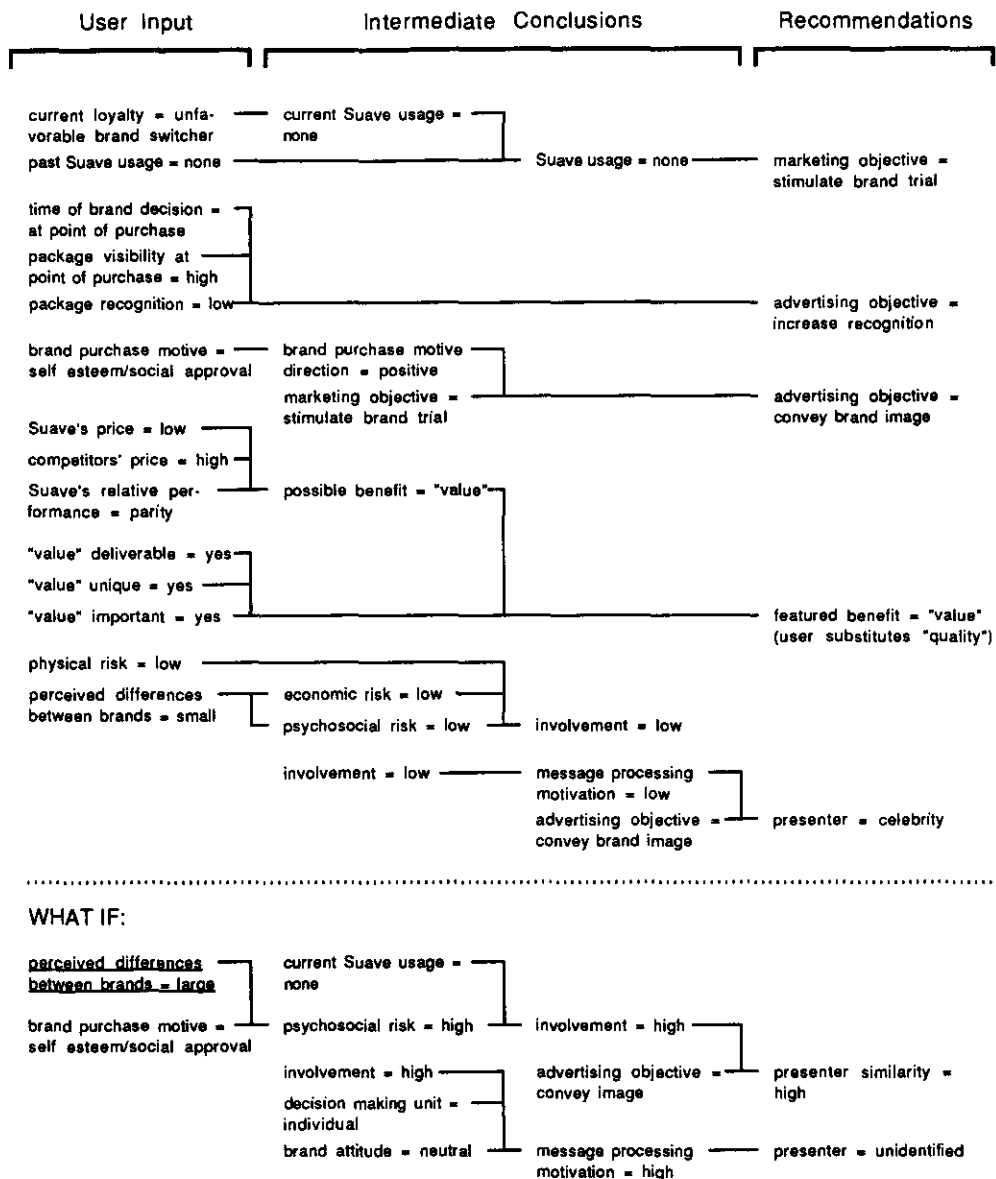
Identity = celebrity	Sex = female
Likability = high	Attraction = high
Identification in message = early	Recognizability = high

Message Emotion:

Strength = high	Direction = positive
Tone = apprehension/flattery	Authenticity of portrayal = high

feels, and use visual stimuli, imagery, and music to enhance the emotional response (Mehrabian 1982; Rossiter 1982; Young & Rubicam). To make salient the audience's brand purchase motivations, ADCAD proposes an emotional tone of apprehension followed by flattery (Rossiter and Percy 1987). Since the audience's evaluation of brand performance is subjective (benefit visibility in use is low) and its message processing motivation is likely to be low, ADCAD recommends making extreme brand performance claims (Maloney 1962) and showing surrogate indicators of performance (e.g., thick suds, rich colors; Runyon 1984). To increase brand recognition, ADCAD suggests using large color photographs or extended closeups of the brand's package (Diamond 1968; Holbrook and Lehmann 1980; Starch 1966). The user can ask "How" a conclusion was reached, and ADCAD will report the underlying rationale for the recommendation.

The user can then review and revise the input information and examine its impact on system recommendations. In the Suave example, the user considers an alternative scenario where consumers perceive significant differences between brands. Because the purchase motivation is tied to social approval and self esteem, ADCAD infers that the psychosocial



\*Rules are represented as line segments linking a conjunction of premises on the left with a conclusion on the right.

FIGURE 2. Illustration of ADCAD Reasoning Process.

risk and involvement for the shampoo decision are now high and revises a number of its recommendations (see Figure 2). The audience may be somewhat more critical of message claims, so ADCAD suggests using strong claims with supporting information (Petty, Cacioppo, and Schumann 1983). The audience is more likely to be interested in the brand message, so ADCAD proposes using the testimonial of an attractive presenter with which the audience can identify (Brock 1965; Young & Rubicam). ADCAD no longer recommends portraying apprehension in the ad because it assumes that the purchase motivation is already salient (Rossiter and Percy 1987).

#### *Uncertainty Representation and Propagation*

Most of the rules in the knowledge base have been stated such that the conclusion of the rule follows inevitably when the premises of the rule are satisfied. However, ADCAD

permits the user to respond to the queries posed by the system by associating a confidence factor (between -100 and 100) with the response value.<sup>7</sup> ADCAD uses several mechanisms for the propagation of these uncertainties across knowledge elements. These mechanisms are similar to the ones used in MYCIN (Shortliffe 1976) and are provided as built-in features of the M1 shell (M1 Manual 1986). The heuristics are summarized below:

1. *Uncertain premise*: If  $A \Rightarrow B$  with confidence CF2, and if the confidence factor of  $A$  during a consultation is equal to CF1, then the confidence factor of the conclusion is computed as  $(CF2 \times CF1)/100$ . Thus, the uncertainty in a premise is directly transferred to the conclusion.

2. *Combining multiple sources of evidence*: If  $A \Rightarrow B$  with  $CF1 > 0$  and  $C \Rightarrow B$  with  $CF2 > 0$ , then the confidence factor of  $B$  (equal to CF3) is given by:

$$CF3 = CF1 + ((100 - CF1)/100) \times CF2 \quad (1)$$

If both CF1 and CF2 are  $< 0$ , their signs are ignored and CF3 is computed with the above formula and then the negative value of CF3 is taken to be the result. If on the other hand, either one of CF1 or CF2 is positive and the other negative, CF3 is given by:

$$CF3 = (CF1 + CF2) \times (100/(100 - A)) \quad \text{where} \\ A = \text{Min}(|CF1|, |CF2|) \quad (2)$$

Formulae (1) and (2) suggest that incremental consistent evidence (sign of CF2 is the same as that of CF1) has proportionately lesser impact on increasing the confidence of a conclusion, while contradictory evidence (CF2 has a sign opposite of CF1) has a proportionately greater impact on the resulting confidence factor.

3. *Conjunction of premises*: If  $A$  and  $B \Rightarrow C$ , and if the confidence in  $A$  is CF1 and the confidence in  $B$  is CF2, then the confidence factor of  $C$  is equal to  $\text{Min}(CF1, CF2)$ . Thus, a conclusion is only as strong as the weakest link in the chain of premises that lead to the conclusion.

4. *Disjunction of premises*: If  $A$  or  $B \Rightarrow C$ , the confidence in  $C$  is computed as follows. The system first determines the confidence factors of  $A$  (CF1) and  $B$  (CF2) from the knowledge base (or user queries) and then uses formula (1) or (2) to compute the confidence factor of  $C$  (CF3). It is possible that  $A$  is unknown ( $CF1 = 0$ ), in which case  $CF3 = CF2$ .

5. Finally, we note that when a conclusion is known with certainty, no further evidence will be sought regarding this conclusion.

To facilitate the interpretation of ADCAD's recommendations, ad agency personnel suggested that we associate confidence categories rather than numeric estimates of confidence with the final conclusions. We followed this suggestion. ADCAD reports the confidence as "low" if the CF is between 20 and 40, "moderate" if the CF is between 40 and 70, and "high" if the CF is greater than 70. Conclusions with a CF less than 20 are not reported.

Although ADCAD's heuristics for propagating uncertainties seem generally intuitive, these and similar heuristics have been criticized as being ad-hoc in comparison to the more formal Bayesian method of updating. For example, the heuristics ignore the numerous dependencies between the knowledge elements and consequently, the confidence factor of a conclusion is the same whether it results from independent or correlated sources of evidence. On the other hand, Bayesian methods impose enormous computational burdens even in moderately sized expert systems such as ADCAD. For example,

<sup>7</sup> In future extensions of the system, we plan to associate confidence factors with rules to control the influence of individual rules on the reasoning process and system recommendations.

if the rule  $A \Rightarrow B$  with probability  $P$  is interpreted as the conditional probability  $P(B|A)$ , then at each stage of the reasoning process, this has to be continuously updated as new conclusions are derived. That is, one has to compute  $P(B|A, C)$ ,  $P(B|A, C, D)$ , and so on.

Currently, no update mechanism exists that is both procedurally simple and as widely accepted as the Bayesian mechanism. This is an important area of current research and Pearl (1988) summarizes some of the major approaches and issues related to uncertainty updating. As Pearl points out, the heuristics used in MYCIN type updating will be valid from a probabilistic interpretation if and only if the set of rules in the knowledge base form a directed tree. This requirement is satisfied when any set of premises in the knowledge base does not lead to more than one conclusion. If such rules exist, they create interdependencies between the conclusions. This requirement is often restrictive and difficult to accomplish in practice, especially in marketing domains where the variables exhibit complex patterns of interrelationships.

In ADCAD, we have attempted to satisfy this restriction to the extent possible. In particular, the knowledge base is organized hierarchically (e.g., market assessment  $\Rightarrow$  marketing objectives  $\Rightarrow$  advertising objectives  $\Rightarrow$  benefit communicated  $\Rightarrow$  communication approaches) and most of the rules have been coded such that the conclusions of a rule will hold regardless of how the premises of the rule are derived and irrespective of what other conclusions are made by the system during a consultation. This makes the rules in the system modular and lends credibility and coherence to ADCAD's updating mechanisms.

### Implementation

The implementation of an expert system is an iterative process of system use, feedback, and updating. The ADCAD system was refined through a series of meetings with ad agency personnel. At each meeting, the advertising recommendations of the computer program were compared with the judgments of the agency's creative personnel for a set of new brands. In the case of conflicts, the user interactively traced back through the computer's reasoning and identified rules requiring revision. The structure of the rule database was modified by deleting rules, changing existing rules, or adding new rules in order to resolve discrepancies.

The agency also made a number of general suggestions for improving the system (see Burke et al. 1988, for a more detailed discussion). Many of these suggestions have been implemented, including the addition of the "How," "What," and "What If" features described earlier, reasoning separately about each segment, and allowing the user to override ADCAD's recommended objectives and positioning. Some of the agency's recommendations for expanding the set of input variables were not followed because there were insufficient rules to relate these variables to ad recommendations.

ADCAD was designed so that users can understand the process by which the program arrives at its recommendations (by using the "How" command) and have the facility and knowledge to modify its behavior. For example, creative people are able to change the set of rules in the knowledge base in response to copytesting results, brand sales performance, and published research. These changes often occur in reaction to new situations which were not anticipated at the time the system was designed (for example, to extend the system beyond advertising for consumer goods and services). The updating process should lead to continual improvements in system performance. If performance does not improve with the modification of the rules, this may indicate a problem with the user's understanding of the system, or a more basic problem with the original choice of concepts, knowledge representation, or inference strategy. In the latter case, the system variables or values may need to be revised, additional stages added to the reasoning process, or the system reprogrammed with a different expert system shell.

### Validation

Validation of the ADCAD system requires the use of at least three criteria (Rangaswamy et al. 1987). The first criterion is the validation of the substantive contents of the knowledge base. The relationships specified in the rule set should be empirically supported and properly qualified in light of the range of situations to which the system will be applied. The rules in the ADCAD system are based largely on empirical research. However, many of the studies are laboratory experiments using non-commercial persuasive messages, the results of which may not generalize to advertising in field situations. Furthermore, some of the rules are based on theoretical propositions that have not yet been tested. Additional research should be conducted to empirically evaluate the relationships specified in the rule set.

The second criterion is validation against expert judgment. For a variety of problems, the system's recommendations can be compared with those of an expert in the problem domain. The ADCAD software was evaluated over a two-week period by a Young & Rubicam creative group. The group used ADCAD to generate advertising communication approaches for a variety of products and services. It concluded that the system made appropriate recommendations in most cases and found that the series of questions helped to identify relevant information and insured that the group adhered to the proper disciplines of advertising.

The group's major criticism was that the program could not make a recommendation based on the competitive environment. "The recommended executional technique, in other words, would be perfectly fine as long as no other toothpaste was on the market advertising." The group suggested that the computer program should start from a knowledge base of the advertising activities of competitors. Until such a database of content-analyzed competitive advertising is available, the user must screen alternatives in light of his/her knowledge of competitive activities. If a communication approach is preempted, the user can consider other options from ADCAD's list of recommendations and/or vary assumptions to generate additional suggestions. Additional research is necessary to determine the influence of competitive advertising on the effectiveness of specific communication approaches (see Burke and Srull 1988).

A third consideration is whether the use of the system results in better advertising decisions. ADCAD will be validated-in-use by providing the system to only one of two groups of agency personnel and assessing the quality of the two groups' advertising recommendations for a diverse set of consumer products. Ad performance will be evaluated using both the subjective judgment of a group of experts and objective laboratory copy-testing procedures. In order to properly qualify the rules, the copytesting must be tailored to the specific communication objectives identified in the rules (Morgan 1984).

The original objectives for building ADCAD provide additional criteria for evaluating the system. We do not yet have feedback on whether ADCAD facilitates the accumulation of knowledge in the ad agency. However, informal observation suggests that ADCAD is useful for improving the communication between the ad agency and the client. In one case, the two parties had conflicting opinions about the appropriate creative strategy and communication approaches to be used for the client's advertising. During a consultation with the ADCAD system, the two parties occasionally disagreed on system input (e.g., consumer purchase motivation and the identity of the decision maker) which helped to explain these differences. The authors have used ADCAD in several MBA advertising courses as well as various Executive Education programs and have found it to be an effective teaching and training tool.

### Discussion and Future Directions

Expert systems have been built in many areas such as medical diagnosis, mineral prospecting, and credit authorization. Unlike these expert systems, which have tended

to focus primarily on practitioners' expertise, ADCAD incorporates a diverse body of knowledge that includes both academic and practitioner insights and heuristics. In contrast to other marketing decision models, ADCAD has attempted to represent the largely symbolic knowledge that associates consumer, market, and advertising characteristics with consumer behavior. Recent advances in AI programming tools permit expert systems to be linked with conventional analysis tools and databases. This will enable marketing model builders to go beyond ADCAD and develop decision models combining qualitative and quantitative reasoning.

Currently, ADCAD has a number of limitations which suggest possible extensions. First, ADCAD reasons about ads in only one way. It builds up an overall ad recommendation from judgments about the individual components. In contrast, the human advertising expert can reason in a variety of ways. Advertisers tend to reason configurally, considering the special character of the combination of parts. An agency creative notes, "Formats and techniques evolve as the conceptual idea evolves. The idea dictates formats and techniques." Creatives can also reason by analogy, with new situations reminding them of past decisions because of some basic similarity in consumer motivations, competitive situation, etc. (cf. Schank 1982). This suggests the future addition of system options for example-based and analogical reasoning (see, e.g., Burke 1990, Kolodner 1988).

Advertising creatives must also understand the culture in order to select stimuli that evoke desired responses in the target audience; to portray the selling proposition in a compelling and engaging way. It would be very difficult to build this type of general knowledge into the computer system. A related issue is that much of the knowledge represented in ADCAD is U.S. based. These rules may need to be modified for use in other cultures.

Second, ADCAD has no mechanisms for "creative thinking." Amabile (1983) states, "A response will be judged as creative to the extent that (a) it is both novel and appropriate, useful, correct, or valuable to the task at hand and (b) the task is heuristic rather than algorithmic." While ADCAD's reasoning is heuristic and its output is useful, the system does not generate new responses. Instead, it makes recommendations based on what has been found in the past to be effective in situations with the same set of characteristics. Yet, because of its unfailing application of relevant knowledge to each new situation, we find that ADCAD will often recommend options that are new to the user or that were overlooked. The system sometimes makes surprising recommendations for a brand's advertising because it applies rules derived from products and situations with different physical characteristics, but sharing other critical features (e.g., consumer purchase motivation, decision complexity) that cause the generalization. As Perkins (1981, p. 71) notes, "Far from being contrary to insight, reasoning is an important means to insight, and often a neglected one."

Creativity could be added to the ADCAD system in a number of ways. For example, one could include a search mechanism to identify a combination of ad elements for which there may be high uncertainty about performance (perhaps due to a lack of prior experience, insufficient consumer information, etc.), but a potentially high payoff in terms of generating consumer interest and attitude because of the combination's relative distinctiveness. Copytesting could then be used to evaluate the recommendation. Another approach is to build a gaming component into the reasoning process that evaluates advertising alternatives in light of both current competitive advertising and possible competitive reactions. Baker (1979), Gordon (1961), and Osborn (1963) discuss other approaches to generating new ideas.

Third, ADCAD would benefit from direct links to databases of consumer and market information. At the present time, the user manually enters background information on the brand, competitor, product, and audience characteristics. If ADCAD could extract this information directly from databases, it would reduce the number of questions in the

consultation, unambiguously define the required input, insure data currency, and allow individual- rather than segment-level analysis of consumer data. With data on competitive ad executions, ADCAD could select more distinctive and creative communication approaches.

A final consideration is that the advertising rules may eventually become outdated. It is our belief that while specific ad appeals and formats may vary in effectiveness over time due to changes in their popularity, distinctiveness, current events, and consumer lifestyles, the basic principles of communication and consumer decision making will endure. George Gallup reports, "The kind of copy that has always worked still works. The problem is not so much one of finding out what new appeals work better today as it is of educating the new creative people . . . in the basic principles of advertising" (quoted in Burton 1981, p. 7). Yet, it is likely that some of ADCAD's relationships will interact with unmodeled situational factors that may change over time. Further research should explore adding a mechanism for machine learning to automatically adjust associative weights and modify rules in response to ad performance data to maintain the validity of the knowledge base (see, e.g., Michalski, Carbonell, and Mitchell 1986).

### Conclusion

In summary, this paper has demonstrated the applicability of expert system methodology to a new problem domain for which little formal modeling has been attempted in marketing. The major challenge in the development of the ADCAD system is the specification of a valid knowledge base to represent the key variables and relationships that embody the theoretical and empirical findings as well as practitioner expertise relevant to advertising design. This process of knowledge consolidation is akin to a "meta-analysis" (Farley and Lehmann 1986) and is useful in its own right independent of whether the knowledge is actually used in an expert system. The development of the knowledge base helps to identify gaps in our understanding of the advertising communication process and highlights directions for future research.

The incorporation of diverse sources of knowledge into an expert system makes the knowledge available at the point of decision making. Thus, ADCAD helps disseminate research findings and expertise to those who need it most. The ability of ADCAD to provide explanations for its recommendations stimulates advertisers to logically examine copy strategy issues and provides training to individuals who are unfamiliar with the problem domain. As one advertising executive put it, "It helps us to think a little deeper about the issues we have to consider in developing ads that are both strategically and executionally sound." However, ADCAD's lack of "creative thinking" and its inability to represent and use world knowledge suggest that such systems are supplements and not substitutes for the creative process in ad design.

Our experiences in developing ADCAD indicate that the emerging techniques of AI can be usefully employed by marketing scientists to model many new problem domains. The development of marketing expert systems may help to alleviate the shortage of marketing expertise by incorporating knowledge in a medium that allows it to be distributed easily and inexpensively. Their use may encourage managers to consider the large number of insights from published research and practitioner experience. Moreover, expert systems may help managers to better address the many complex problems in marketing, such as advertising design, which require heuristic reasoning.<sup>8</sup>

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