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Energy-Efficient Clothing, Interior Architecture and Furnishing Designs: Consumer Attitudes, Acceptability Levels and Preferences

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ENERGY-EFFICIENT CLOTHING, INTERIOR ARCHITECTURE, AND FURNISHING DESIGNS: CONSUMER ATTITUDES, ACCEPTABILITY LEVELS, AND PREFERENCES

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Master of Science

by

Barbara C. Parks

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ENERGY-EFFICIENT CLOTHING, INTERIOR ARCHITECTURE, AND FURNISHING DESIGNS: CONSUMER ATTITUDES, ACCEPTABILITY LEVELS, AND PREFERENCES

Barbara C. Parks August 1982 62 pages

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Energy-efficient designs in clothing, interior architecture, and furnishings were evaluated (a) to assess consumers' attitudes toward the designs, (b) to compare acceptability levels of participants who were knowledgeable in the home energy field with those who were less knowledgeable, and (c) to determine if consumers had a preference for using housing, clothing, or furnishings in meeting their thermal comfort needs. Four designs generated by the University of Tennessee-Energy Design competition were evaluated: a leisure outfit, a lounging dress, a water-storage collector (room divider and coffee tables), and a solar waterbed. Rogers and Shoemaker's perceived attributes of innovations model (relative advantage, compatability, and complexity) was utilized as a theoretical basis. The semantic differential scale and the gaming technique were selected as measurement/scaling devices. The underlying constructs of the design evaluations were determined by factor analysis and did correspond to Rogers and Shoemaker's attributes of compatibility and complexity. The relative advantage attribute was strontly economic for all of the designs except the leisure outfit. All of the designs were acceptable to survey participants on the basis of mean ratings. No significant differences in acceptability levels of participants who were knowledgeable in the home energy field and those who were less knowledgeable were found using the t-test. Consumers did have a preference for using housing in meeting their thermal comfort needs; clothing was the most frequent second selection; furnishings were selected by a similar number of respondents as second and third choices.

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TABLE OF CONTENTS

LIST OF TABLES

DEFINITION OF TERMS

Energy Design Competition (UT-EDC) - A design competition sponsored by the University of Tennessee Department of Textiles, Merchandising, and Design which sought entries in the areas of clothing, interior architecture, and furnishings that utilized an integrated approach to solutions for home energy problems. The competition was funded through a matching grant from the National Endowment for the Arts and the University of Tennessee-Knoxville.

Innovation - A newly introduced product (concept or object) which offers a change from past products.

Adoption-Decision Process - The mental processes involved between the knowledge of an innovation and the decision to adopt or reject the innovation.

Rate of Adoption - The speed at which an innovation is adopted by members of a social system.

Perceived Attributes of Innovations - The advantages of a new product as interpreted by the consumer. This study was based on three of the five attributes defined by Rogers and Shoemaker (1971) which included relative advantage, complexity, compatibility, trialability, and observability.

Semantic Differential Scale - A measuring device consisting of a number of scales with each scale being a pair of bipolar adjectives.

Gaming Technique - The abstraction of a complex problem through simulation which forces the participant to select among various alternatives.

INTRODUCTION

The consumer today is experiencing economic strain as the energy crisis continues to grow. Professionals in individual fields of science and design are seeking alternative and more efficient energy forms. Currently research is being conducted at the University of Tennessee-Knoxville in the Department of Textiles, Merchandising and Design which utilizes an integrated approach to design for home environmental energy conservation (Case and Orlando, 1979). The disciplines involved in this research are clothing, interior architecture, and interior furnishings. The integrated approach incorporates the limitations and advantages of each discipline to develop broader solutions and alternatives for achieving thermal comfort within the home economically.

The University of Tennessee research project began with a study of 15 passive solar and wood-burning homes in the Knoxville, Tennessee, and East Lansing, Michigan, areas. Students from the University of Tennessee and Michigan State University compiled data on each of the homes through interviews with family members and examinations of floor plans, furniture arrangements, and energy-efficient features within the homes. Research results from the study of these homes were converted to design criteria and specifications which provided the basis for the Energy Design Competition held in the fall of 1981. Four designs were selected from those submitted to the competition for further evaluation by consumers.

Researchers have found that evaluating the marketing potential of a design involves more than judging the technological advancement or apparent need for a design. Many well developed, innovative ideas and products generated by researchers are not adopted by consumers. The United States Department of Commerce predicts that 90% of all new products will fail within the first four years after their release (Rogers and Shoemaker, 1971). Undoubtedly, many of these failures will have theoretical merit and expert backing.

Analoze, a combination pain killer and stomach sweetener, is an example of the marketing failure of a product that appeared theoretically to have high marketing potential (Rogers and Shoemaker, 1971). The developers of Analoze responded to statistics showing that Americans were taking record quantities of pain killers by producing an analgesic that could be taken without water. Their product, a cherry flavored pill which dissolved in the mouth, was overwhelmingly selected by panel members who compared it with a traditional product requiring water. An expert advertising firm was used to develop advertisements proclaiming the advantages of an analgesic-antacid that worked without water. The product was released with extensive advertising to test markets. Despite the preparation, sales were extremely low and the product was eventually withdrawn from the market. After thorough examination, researchers concluded that the pill failed because people were accustomed to taking water with pills and unconsciously associated water with the cure. Apparently, the pill was not compatible with the existing values of the public (Rogers and Shoemaker, 1971). While it might be argued that it was the people, and not the pill, who were at fault, the result remains that the pill was not accepted through our

marketing system despite the apparent need for it. Studies of Analoze and other products have led researchers to recognize that people react to a product in part on the basis of what the product means to them rather than just the attributes of the product (Ziesel, 1981).

Also, technological advancements are not necessarily related to marketing success. Watson (1975) has compared the learning required by consumers before using an innovative product with the adoption rate of the product. He concluded that learning requirement is completely unrelated to the degree of technological advancement represented by the new design but is directly related to the rate of adoption. He found that products which required little learning were more quickly adopted than those which required more extensive learning. Conversely, products which degrade the skill of the consumer are also slow to be adopted. Professional painters were very slow to accept the paint roller, despite its ease of use, because they felt it did not use their skills. Thus, the adoption of a product appears to involve more than expert development and backing or technological advancement.

A model that could predict the marketing success of a product before the product is mass produced and distributed could conserve time, energy, and money. Several types of predictive models have been developed. They may be divided into consumer behavior models (Nicosia, 1966, Howard and Sheth, 1969, and Engel, Kollat, and Blackwell, 1968), risk models (Peter and Tarpen, 1975, Bonoma and Johnson, 1979, and Stampfl, 1978), and sales models ("New Product Development," 1978). Sales models may be subdivided into diffusion models (Midgley, 1977, and Ostlund, 1974), adoption models (Rogers

and Shoemaker, 1971), repeat purchase models (Ehrenbert, 1972). Each of these models has been carefully constructed to provide a framework for research. There is a need for a universal, standardized classification scheme that could be used for all products (Rogers and Shoemaker, 1971). Presently, a universal model has not been developed; but it is possible to select a model based on the product being evaluated and the consumer group that will be purchasing the product.

The Rogers and Shoemaker (1971) adoption model was deemed an appropriate framework for evaluating the energy-efficient designs in the present study. The primary purpose of this study was to evaluate consumers' attitudes toward the energy-efficient designs generated by the University of Tennessee-Energy Design Competition. The secondary purposes were (a) to compare the acceptability levels of the designs between participants who were knowledgeable in the home energy field and those who were less knowledgeable and (b) to determine if consumers had a preference for using interior architecture, clothing, or furnishings in meeting their thermal needs. It was hoped that these evaluations would assist in further development of the designs. It was also hoped that the survey would promote the integrated discipline approach and increase energy awareness levels of the survey participants so that they would become more energy-efficient consumers.

Objectives:

1. To measure consumers' attitudes toward the University of Tennessee-Energy Design Competition (UT-EDC) designs using Rogers and Shoemaker's perceived attributes of innovations principle.

2. To determine if consumers rate the UT-EDC designs as acceptable.

3. To determine if there is a difference in acceptability levels toward the UT-EDC designs between survey Group A (knowledgeable in the home energy field) and Group B (less knowledgeable).

4. To determine if consumers have a preference for using interior architecture, interior furnishings, or clothing in meeting the thermal comfort needs.

Hypotheses (null):

1. The semantic differential scale dimensions of the UT-EDC designs will not factor into Rogers and Shoemaker's attributes of relative advantage, compatibility, and complexity.

2. Consumers will not exhibit positive attitudes toward the UT-EDC designs as indicated by a mean rating on the positive side of the SDS scale (less than 5).

3. There will be no significant difference in overall acceptability levels of the UT-EDC designs between survey Group A and Group B.

4. There will be no difference in preference for interior architecture, interior furnishings, and clothing designs in meeting consumers' thermal comfort needs.

LITERATURE REVIEW

Summary of Consumer Research Model Types

Three major types of consumer research models were investigated for this study. Each model type was examined for relevance to the objectives of the study and the designs being evaluated.

1. The first models considered were consumer behavior models based on the works of Nicosia (1966), Howard and Sheth (1969), and Engel, Kollat, and Blackwell (1968). Although these models were thoroughly subdivided to provide a theoretical basis for research, they were eliminated because their primary purpose was to evaluate consumer behavior rather than the attributes of a product.

2. The second models examined were risk models based on the studies of Peter and Tarpen (1975), Bonoma and Johnson (1979), and Stampfl (1978). Their models were designed to measure perceived risk and the danger associated with risk. They included the areas of financial, performance, psychological, physical, social, and time risk. Since consumers normally associate a high degree of risk with an innovative product, risk study results would be expected to yield high-risk ratings for the innovative designs. These models were eliminated because they covered only risk rather than the broad scope of consumer attitudes involved in innovative product decisions.

3. The third group of models included sales models. They may be divided into diffusion models, adoption models, and repeat purchase

models ("New Product Development," 1978). Diffusion models were designed to investigate the communication of new ideas to consumers (Rogers and Shoemaker, 1971). Diffusion studies often concentrate on innovative purchasers who are the first of the five consumer adoptive groups. The actions of innovative purchasers are used to predict when early adopters, early majority, late majority, and lagger groups will purchase a product. The basic elements of diffusion models include the characteristics of the innovation, the communication process, the characteristics of the social system, and the passage of time ("New Product Development," 1978). Since neither time lapse after the purchase or communication processes were available for this study, diffusion models were eliminated. Repeat purchase models were not applicable since this project involved innovative products which had not been marketed.

Development of Adoptive Models

Adoptive models which examine the mental processes involved in a consumer's decision to adopt or reject an innovative idea or product were selected as most applicable to this study. The adoptive model can be used to predict a product's acceptance without the expense of actually manufacturing the product. The adoptive-decision process was first defined in literature in the mid-1950s and consisted of five stages. Although the process is more closely related to a flow of events than to a number of distinct stages, classification by stages was necessary to provide a conceptual framework for research. The five original stages were

1. Awareness. The individual knows of the new

idea but lacks sufficient information about it.

2. Interest. The individual becomes interested in the idea and seeks more information.

3. Evaluation. The individual makes a mental application of the new idea to his present mode of consumption and makes the decision either to try it or not.

4. Trial. The individual uses the innovation on a small scale to determine its utility for him.

5. Adoption. The individual accepts the innovation and commits himself to its use (Robertson, 1971, p. 58).

In the original model no provision was made for skipping or returning to stages. As the model was applied it became apparent that a consumer might omit the trial phase and go directly to adoption, or he might return to the interest stage to receive more information before making a final evaluation. Thus, there appeared to be a variation in number and order of stages in the adoptive-decision process.

This early model can be applied to the information-attitude-behavior theory of communication effect. In this theory the consumer receives information which he uses to form an attitude that results in an action. However, the model was not specifically designed for information-attitude-behavior theory use. In the early-1960s Lavidge and Steiner (1961) developed a hierarcy-of-effects scheme which was based on three basic psychological states relating to the information-attitude-behavior theory. The psychological states used by Lavidge

and Steiner were cognitive, involving consumer's thoughts; affective, involving emotions; and conative, involving motives. These psychological states were applied to a six stage adoptive-process model. The first two stages, awareness and knowledge, related to cognitive responses. The third and fourth stages, liking and preference, referred to emotions. The final stages, conviction and purchase, involved motives. This model is believed to be the first to explicitly rely on the information-attitude-behavior theory which is now considered to be a basis for consumer studies.

In applying their model Lavidge and Steiner (1961) recognized that the time spent in each stage might vary with the product's cost and the individual's decision time. They concluded, "The greater the psychological and/or economic commitment involved in the purchase of a particular product, the longer it will take to bring consumers up these steps and the more important the individual steps will be" (Lavidge and Steiner, 1961, p. 60). Their model added variation of time spent in each stage to previous variations in number and order of stages.

A number of other models were developed relating to the information-attitude-behavior theory. One of the most commonly used is the AIDA model which included awareness, interest, desire, and action stages. This model was developed for marketing and advertising research and recognized the influence of promotional techniques.

Each of these models was based on a rational approach to consumer decisions. Consumer behavior analysts found that consumers might act impulsively rather than rationally and that variation occurred between consumers. Recognizing the existence of nonrational decisions, Campbell (1966) developed four forms of the adoptive-decision process.

One of his forms, rational/innovation, is similar to the original adoptive model and begins with awareness of the product. The contrasting form, nonrational/innovation, also begins with awareness of the product but results in impulsive buying. In his other two forms it was recognized that process stages may vary and a consumer may begin with a problem and then progress to an awareness of a product. Rational problem solving begins with the problem and proceeds to awareness of the product. Its contrasting form, nonrational/problem solving, also begins with a problem but results in impulsive solutions to the problem. In addition to the variation found in rational and nonrational consumer behavior, other variations were found between consumers, depending on educational background, economic position, and personality traits. Midgley states, "A person's evaluation of the complexity of an innovation might well depend on his education and intelligence as well as the nature of the innovation" (1977, p. 68).

From analyses of these and similar studies, apparently there is no single form to which an adoptive-decision process must conform. The adoptive-decision process form selected should utilize the information-attitude-behavior theory and be based on the attributes of the product and the attitudes and background of the consumer.

Rogers and Shoemaker's Adoptive Model

This study of innovative energy ideas is primarily concerned with the attitude area of the adoptive-decision process. Rogers and Shoemaker (1971) have thoroughly subdivided the areas of their adoptive-decision process providing a framework for examining each

area separately. Their thorough description of the attitude area was selected to provide the basis for this study. The terminology used by Rogers and Shoemaker differs from, but corresponds to, the terminology used in earlier studies. Their innovative-decision process (adoptive-decision process) is divided into four areas: knowledge (information), persuasion (attitude), decision (behavior), and confirmation (behavior) (see Table 1).

Five attributes of innovations are included in Rogers and Shoemaker's (1971) persuasion stage. The attributes are described below and in Table 2.

1. "Relative advantage is the degree to which an innovation is perceived as being better than the idea it supersedes" (Rogers and Shoemaker, 1971, p. 138). Factors involved in relative advantage include economic profitability, low initial cost, reductions in time and energy allocations, immediacy of reward, comfort, and lower perceived risk. Donnelly and Etzel (1973) classified relative advantage as newness in their studies and measured dissimilarity between an innovative product and the products before it. There is a positive relationship between relative advantage and rate of adoption. The factor "lower perceived risk" if stated simply as risk would have a negative relationship to the rate of adoption. Ostlund (1974) used risk as a sixth attribute. However, Ostlund's work concerned low cost supermarket purchases rather than major innovations studied by Rogers and Shoemaker (Midgley, 1977). The primary purpose of Ostlund's studies was to identify innovativeness in the consumer rather than product adoption (Ostlund, 1974).

2. "Compatibility is the degree to which an innovation is

Table 1

Rogers and Shoemaker's Innovation-Decision Process Stages

Process Stages	Definitions	Variables
1. Knowledge	Individual is aware of the innovation and gains some understanding of how it functions	Receiver variables 1. Personality characteristics 2. Social characteristics 3. Perceived need for innovation Social system variables 1. Social system norms 2. Tolerance of deviancy 3. Communication integration
2. Persuasion	Individual forms a favorable or unfavorable attitude toward the innovation	Perceived characteristics of innovations 1. Relative advantage 2. Compatibility 3. Complexity 4. Trialability 5. Observability
3. Decision	Individual makes the choice to adopt or reject the innovation	Adoption 1. Continued adoption 2. Disenchantment Rejection 1. Continued rejection 2. Later adoption
4. Confirmation	Individual seeks reinforcement for innovation decision	

Note. The information for this table is from Rogers and Shoemaker, 1971.

Table 2

Summary of Rogers and Shoemaker's Attributes of Innovations

Attribute	Definition	Rate of Adoption Relationship
Relative advantage	Degree to which an innovation is perceived as being better than the idea it supersedes	Positive
Compatibility	Degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of the receiver	Positive
Complexity	Degree to which an innovation is perceived as being relatively difficult to understand and use	Negative
Trialability	Degree to which an innovation can be experimented with on a limited basis	Positive
Observability	Degree to which the results of an innovation are visible to others	Positive

Note. The information for this table is from Ostlund, 1974, p. 24, and Rogers and Shoemaker, 1971.

perceived as consistent with the existing values, past experiences, and needs of the receivers" (Rogers and Shoemaker, 1971, p. 145). An innovation may be compatible with the sociocultural values and beliefs of the consumer, his particular needs, or ideals previously introduced to him. Compatibility ensures greater security and, therefore, less risk. Risk does seem to be a factor in both relative advantage and compatibility in Rogers and Shoemaker's (1971) outline which may account for their decision not to list it as a separate factor. There is a positive relationship between compatibility and the rate of adoption.

3. "Complexity is the degree an innovation is perceived as being relatively difficult to understand and use" (Rogers and Shoemaker, 1971, p. 154). Complexity can, therefore, be divided into two areas: principle understanding and how-to-use understanding. Principle complexity would relate to the theories behind the development of an idea, while how-to-use knowledge would relate to the actual working of a product. Although it is possible to understand how to use a product without understanding the principles, Rogers and Shoemaker believe that the ability of individuals to judge innovations for prediction purposes is facilitated by principle knowledge. Therefore, both types of complexity should be evaluated in predicting adoption rates. Complexity of an innovation is negatively related to rate of adoption.

4. "Trialability is the degree an innovation can be experimented with on a limited basis" (Rogers and Shoemaker, 1971, p. 155). Trialability is more important to early adopters than later adopters because later adopters have had the opportunity to see their peers

using a product, thus they may not need to try it themselves. "Trialability provides one dimension with which to distinguish between major and minor innovations, in that items such as consumer durables cannot always be tried on a limited basis" (Midgley, 1977, p. 66). There is a positive relationship between trialability and rate of adoption.

5. "Observability is the degree to which the results of an innovation are visible to others" (Rogers and Shoemaker, 1971, p. 155). Rogers and Shoemaker cited an example, in agriculture, of an innovative farmer drying his hay on wire racks in view of neighboring farms. At the same time he was also using a new method of feeding his calves, but the feeding was done in a barn out of view of the neighbors. Seventy-six percent of the neighbors adopted the hay innovation, but only 22% changed to the calf feeding innovation (Rogers and Shoemaker, 1971, p. 156). "Observability relates more to later adopters who need information on the performance of an innovation than to innovators" (Midgley, 1977, p. 66). There is a positive relationship between observability and rate of adoption.

These five attributes can be used in evaluating a product's rate of adoption. Rate of adoption refers to the speed at which an innovation is adopted by members of a social system. The faster the rate of adoption, the higher the acceptability rate of a product. Rogers and Shoemaker (1971, p. 157) found that 49 to 87% of the variance in rate of adoption of a product could be explained by the five attributes. Other factors which influence the rate of adoption include (a) the type of innovation-decision which would include individual, authoritarian, or collective decisions, (b) the nature of

the communication channels, (c) the type of social system, and (d) the extent of the change agent's promotional efforts (Rogers and Shoemaker, 1971, p. 158).

Population Selection Considerations

In this study of energy-efficient innovations there will be no opportunity for trial or observability of an actual product. These two areas may be less necessary for innovative buyers who are more venturesome and willing to take risks than later purchasers. Innovators are the first 2.5% of the population to adopt an innovative ideal, followed by early adopters 13,5%, early majority 34%, late majority 34%, and laggers 16% (Rogers and Shoemaker, 1971, p. 182). As previously mentioned, diffusion studies often concentrate on innovative purchasers.

The characteristics of innovators may vary with the product being evaluated. A low-cost product may be purchased impulsively by an individual with quite different traits than those exhibited by innovative purchasers of more expensive items. Rogers and Shoemaker (1971) have developed an outline of the traits exhibited by innovative people who purchase major products with a high degree of financial or social risk. These individuals are generally well educated, intelligent, rational, cosmopolitan, socially integrated, and able to deal with abstractions. They have high social status, achievement motivations, inner direction, and exposure to mass media and interpersonal communication. They have positive attitudes toward credit, education, risk, and change. They collect relatively large amounts of information about an innovation and make their decision in a short period of time.

In his 1963 study, Bell found that innovators of functional products (products which offered new solutions to old problems as opposed to modifications of existing products) were generally younger, more educated, had higher incomes, were professional and managerial classes, had greater exposure to mass media, and were independent in frame of mind. The majority of them did not consult anyone outside their family regarding purchase decisions. Robertson and Kennedy (1971) found that innovators were venturesome, socially mobile, socially integrated, and privileged.

Although these and other authors have developed extensive lists of the traits of innovators, they have not developed an adequately tested instrument for identifying innovators. Labay and Kinnear (1981) state, "Although a few correlations emerge, considerable ambiguity and contradictory findings are also evident in identifying innovators" (Labay and Kinnear, 1981, p. 272). The traits listed for innovators might also be applicable to those who were more knowledgeable in the field of energy (more educated, professional, higher income, more exposure to mass media). Thus, it might be difficult to distinguish between an innovative purchaser and one who was knowledgeable in the area of home energy but did not exhibit other innovative traits. Labay and Kinnear (1981) and Rogers and Shoemaker (1971) have suggested that innovativeness might be product or situation specific.

Labay and Kinnear (1981) raised the question of whether or not the diffusion of passive solar energy systems has reached the point that true innovators have already adopted a system. Labay and Kinnear found support for their hypothesis that stated, "Attribute perceptions of residential solar energy systems are more effective than

demographic characteristics in predicting an individual's category membership as an adopter or nonadopter" (Labay and Kinnear, 1981, p. 273). Rogers and Shoemaker (1981) placed emphasis on using potential adopters, rather than specific groups, for their studies. It was decided that the emphasis for this study should be placed on devising an instrument for evaluating the product attributes and consumer attitudes rather than identifying innovators.

The area of prior knowledge, however, should not be overlooked in the selection of a population. Wilton and Pessemier (1981) report that the state of knowledge among potential adopters can seriously limit the analyst's capacity to predict the acceptance of a product. They state that new products and ideas which modestly extend current experience are easier to integrate into the potential adopter's perceptual framework. They suggest measuring the current state of the consumer's knowledge. If the knowledge level was low, knowledge could be advanced by advertisements or other educational methods until it reaches the point necessary for an adoptive decision. The process of educating the consumer would be most necessary for products which were unfamiliar to the consumer, such as those which would require new skills to operate or those with nontraditional designs.

Measurement Instrument Considerations

Consumer perception studies involve the measurement of an individual's subjective feelings toward energy efficient ideas. How an individual feels about a situation is determined by what the situation means to him; thus, it is perceived meaning or subjective feeling that is being measured. There are several ways of determining feelings.

One method is to simply ask the individual; however, this method would present several problems, one being that open-ended responses would not easily allow for statistical analysis or comparisons. Another problem is that people have difficulty finding descriptive words. Zeisel (1981) reported that people tasting ice cream could not adequately describe their flavors because they could not think of enough descriptive words, but they easily described their flavors when presented with a list of choice words. "The principle that people express the meaning things hold for them more completely when presented with a set of appropriate alternatives" is the basis for the coding technique used in the semantic differential scale (Zeisel, 1981, p. 168).

The semantic differential scale was developed by Osgood (1976) as a method of measuring meaning. The measuring device consists of a number of scales with each scale being a pair of bipolar adjectives. The scale is divided into an odd number of spaces to allow for a neutral or undecided response. Administration of the scale was originally done by personal interview or other personal contact such as a group meeting (Tull and Albaum, 1973). It was thought that the interviewer was needed to stress the importance of recording first thoughts to the participants. The rationale was that it is first impressions, or immediate feelings, that are relevant in measuring meaning. The respondents should, therefore, complete each scale as quickly and honestly as possible. Recent unpublished research by Tull and Albaum (1973) has shown highly reliable results by mail. The semantic differential scale may be used to measure feelings about an experience, such as comfort in an environment, or an object, event, or person that is evaluated by either looking at the actual

object or a picture of it.

Factor analysis can be applied to the semantic differential scale to determine the smallest number of underlying factors, or semantic features, which would account for the largest amount of the variance in judgment in a measurement (Osgood, 1976). Factor analysis reduces the components of attitude into three areas: evaluation, potency, and activity.

1. Evaluation refers to an individual's feelings toward the object being rated. Evaluation would correspond to the favorable or unfavorable rating on more traditional attitude scales. This factor is considered the most important factor and would involve words such as good, pleasant, valuable, beautiful, sweet, nice, honest, wise, positive, and reputable (Compton and Hall, 1972).

2. Potency refers to an individual's perception of the power of the concept being measured. Strong, rugged, hard, and heavy are examples of potency adjectives.

3. Activity refers to an individual's perception of the activity or motion of the object being rated. Active, fast, and sharp are applicable adjectives.

Rohles (1981, p. 32) reported, "The semantic differential scale appears to be the best instrument that has been developed to date" for measuring a person's impression of his environment in regard to feelings of comfort, discomfort, warmth, or coolness. In Rohles' studies people were actually subjected to an environment. Tull and Albaum (1973, p. 3) reported, "The semantic differential scale is a measurement and scaling technique that can be used rather easily and usefully in decisional survey research."

Some points to consider in developing a semantic differential scale include

1. Word pairs should be relevant to the object being evaluated. The author of the scale should select a word pair that specifically expresses the dimension being evaluated and confirm that it applies directly to the object. If an individual is asked to judge a chair as dreary-gay and he does not feel that dreary-gay applies to chairs, he may lose rapport with the entire measurement (Zeisel, 1981).

2. Scales should be relevant to the respondents. A group of respondents that is representative of a common population should be able to understand and relate to the measurement device (Alexander et al., 1978).

3. Modifiers should represent the common judgment criteria actually used. The modifiers should be simple for understanding; precise, so everyone would understand alike; and neutral, so the respondents are not biased. Modifiers should be carefully selected so that they are opposite in meaning; and midpoint modifiers, if used, should actually be midpoint. For example, neutral rather than comfort should be used as the midpoint between hot and cold (Winakor, 1978).

4. Number of spaces in a scale should allow for statistical analysis. The minimum number of points is 7 unless statistical analysis and hypothesis testing are not the goal of the research (Winakor, 1978). Rohles (1978) reported that people tend to avoid terminal categories; thus, if 7 points are needed, 9 should be used. Winakor (1978) used a 99-point certainty scale for university survey participants and a 9 or 11-point scale for nonuniversity participants. "The more steps in the scale the more closely the data meet the

assumptions of statistical analysis and the more precise the tests of the hypothesis" (Winakor, 1978, p. 136). Transformed raw data should push together the middle and stretch out the extremes because subjects who respond to end choices are considered more intense in their responses.

6. Judgment should be used in labeling spaces. Subjects sometimes object to labels, including midpoint, because the labels do not adequately express the respondent's desired meaning. Subjective meaning may also differ among subjects.

Two other methods considered for use in this study were paired comparisons and Likert attitudinal scales. The paired comparison or forced-choice instrument has been used for scaling values or products and in assessing attitudes. Subjects are asked to choose between two items at a time. Each item should be presented on the right side of the instrument as often as it is on the left side to avoid space error distorting the data. The number of pairs needed can be determined by the formula $n(n-1)/2$ (Compton and Hall, 1972, p. 277). Thus, 10 items would require 45 pairs. Paired comparisons are most useful when a relatively small number of items are being evaluated. The number of times a particular item is preferred is compared with other item preferences in analyzing the data.

The Likert attitudinal scale provides the subject with a statement and asks him to select his response as strongly agree, agree, uncertain, disagree, or strongly disagree. The cumulative scores from a number of statements concerning a design can indicate the subject's attitude toward the design (Zeisel, 1981).

The gaming technique was considered appropriate for this study

because it offered a quick, pictorial method of assessing participants' preferences which could be used with the more time consuming semantic differential scale. The gaming technique involves taking a complex problem and abstracting it through simulation (Sanoff, 1979). The participant is presented with several design simulations, usually drawings, and allowed to make decisions between them. A participant might be given a specified number of points and asked to select one design from a set of bath-bedroom floor plans and one from a set of living-dining-kitchen floor plans. The most desirable plans in each of the sets would total more than the allowable points, so the participant would be forced to select his first choice.

Considerations for measurements in general

1. Respondents should be able to see themselves as advice givers and valued participants in the research (Zeisel, 1981).

2. Questions should be stated so that general topics are listed first then followed by specific topics (Zeisel, 1981).

3. Questionnaires should be arranged from positive to negative so that the respondent does not become defensive (Zeisel, 1981).

4. Questions should be grouped by category to conserve time for the respondent (Zeisel, 1981).

5. Instruments should be designed to obtain the maximum amount of information while minimizing the participant's fatigue (Zeisel, 1981).

6. Mutually exclusive categories should be provided with no overlapping either numerically or conceptually (Zeisel, 1981).

7. To avoid position bias, designs should be randomized in a variety of up-down and left-right positions (Winakor, 1978).

8. When administering measurements personally, the researcher should begin with a few questions that are not vital to the research so that participants may discuss them. The questions should be relevant, since the information might be useful in later phases of the research project (Winakor, 1978).

9. Preference questions should not be asked directly, since intervening factors may influence the participant's selection. Specific questions on items such as comfort should be used to evaluate preference (Winakor, 1978).

METHODOLOGY

Treatment of Designs

The UT-EDC designs included a leisure outfit, a lounging dress, a water-storage room divider and coffee table, and a solar waterbed. Each design was reduced to fit a standard typing page. Changes were made only for simplification and consistency between designs. In the clothing designs, the faces were removed to prevent distracting or influencing the survey participant. The leisure outfit design, which originally contained a male and female version, was simplified to the female version so the participant would not be confused by two outfits and one set of scales. Clothing design features, which had been emphasized by a variety of inserted drawings in the original entries, were reduced and placed in similar sized circles for consistency. The water-storage divider and coffee table design was not simplified. The simplified version of this design would not have allowed the participant to visualize its use with furnishings, an actual part of the designer's integrated approach. The solar waterbed design was used as originally submitted. A brief written description was placed beneath each design to explain composition materials which could not be detected from the drawings. The description also included instructions for evaluation or use of the designs when needed (see Appendix for design drawings).

Development of the Survey Instrument

Semantic differential scale. Rogers and Shoemaker's (1971) model of the attributes of innovations was selected as the theoretical basis for evaluating consumers' attitudes toward the UT-EDC designs. The semantic differential scale (SDS) developed by Osgood (1976) was selected as the measurement/scaling technique. A standardized pretested instrument applicable to this study was not available. The process of preparing an instrument began with the development of a broad list of polar word pairs which corresponded to Rogers and Shoemaker's attributes of innovations. The basis for the list included word pairs from home economics related instruments developed by Delong and Larntz (1980), Winakor (1978), Alexander, Alexander, and Tzeng (1978), and Sanoff (1979).

Each word pair was compared with the antonyms in Roget's Thesaurus (1962) to assure that opposite meanings were represented. SDS words were carefully selected from this list for relevance to Rogers and Shoemaker's model. Several word pairs were compiled to correspond to the 11 dimensions associated with three of Rogers and Shoemaker's perceived characteristics of innovations which included relative advantage, compatibility, and complexity (see Table 3). These word pairs were then applied to each specific design in the UT-EDC group of designs. This comparison was to assure that each word was also relevant to the particular object being evaluated (Zeisel, 1981).

Eleven word pairs were selected for each of the UT-EDC designs. After several revisions, the word scales representing each design were given to memebers of the UT research group for pretesting and evaluation. Based on the research group's evaluation, it was concluded that

a common scale could be developed that would be relevant to all of the designs. A common scale would be simpler and less time consuming to administer and analyze. The revised common scale was re-evaluated by the UT group to assure that it was relevant to both Rogers and Shoemaker's perceived attributes of innovations and the individual designs being evaluated. Word pairs were also examined bo assure that they were simple, precise, and neutral so each word pair could be understood in the same way by all participants (Winakor, 1978). Selected word pairs are listed in Table 3.

Nine checking spaces were provided for the participant's use between each pair of polar words. Nine spaces allowed for the minimum of 7 spaces needed for statistical analysis (Winakor, 1978) plus 2 extra spaces. The extra spaces were included for participants who tended to avoid terminal categories (Rohles, 1978). The 9-point scale would provide 7 statistical spaces if terminal categories were avoided, or 9 statistical spaces if terminal categories were used.

The decision was not to use labels or numbers for each point on the scales or midpoint words to avoid the possibility that the designations might not adequately express the desired meaning and that participants might interpret them differently (Winakor, 1978).

Gaming technique. The primary purpose of this study was to evaluate consumers' attitudes toward the UT-EDC designs. It was believed that a relatively high degree of concentration was needed for survey participants to use the SDS instrument developed to evaluate consumers' attitudes toward the UT-EDC designs. The gaming technique was selected to meet the secondary purpose of determining whether or not consumers had a preference for using interior

Table 3

Selected SDS Word Pairs Based on Rogers and Shoemaker's Perceived Attributes of Innovations

Rogers and Shoemaker's Perceived Attributes and Dimensions	Selected SDS Word Pairs
Relative advantage	
Economic profitability	Reduces home energy costs - Increases home energy costs
Low initial cost	Inexpensive - Expensive
Savings in time and energy	Easy to maintain - Difficult to maintain
Immediacy of reward	Rapid financial compensation - Slow financial compensation
Comfort	Comfortable temperature - Uncomfortable temperature
Lower perceived risk	Safe - Hazardous
Compatibility	
Consistent with existing needs	Worthwhile - Worthless
Consistent with past experiences	Conventional - Unconventional
Consistent with needs of the receiver	Functional - Nonfunctional
Complexity	
Complexity of principle	Easy to understand - Difficult to understand
Complexity of use	Simple to use - Difficult to use
Trialability*	
Observability*	

*Not applicable to this study

architecture, clothing, or furnishings to meet their thermal needs. The gaming technique (Sanoff, 1979) was selected for use with the SDS instrument because it offered a quick, pictorial method of evaluating consumers' preferences.

The gaming instrument included the three categories of interior architecture, represented to floor plan drawings; clothing, represented by variations of a man's slacks-shirt ensemble; and furnishings, represented by variations of a couch design. Each category contained three design drawings. One design in each category rated low in energy-efficiency properties and was assigned a point value of one. The second designs in each category were medium in energy-efficient properties and were assigned a point value of two. The third designs had the highest ratings for energy-efficient properties and a point value of three. From the three designs pictured in each area, participants were to select one floor plan, one clothing ensemble, and one furnishing design. Their choices were to total exactly 6 points. It was not possible to select more than one of the 3-point designs and remain within the 6 points. A specific number of points was used to encourage participants to select their first choice from the highest rated energy-efficient designs. It was possible to avoid using a design from the highest rated area by selecting all medium, or 2-point, designs. The selection of all medium designs provided an alternative for participants who did not find any of the highly rated designs acceptable.

The interior architecture drawings used in the instrument were selected on the basis of simplicity and adaptability within the home energy field. A conventional, three-bedroom floor plan was used for the 1-point design of the interior architecture category. The

2-point design added a wood stove to the same three-bedroom house. The 3-point design added a greenhouse and heat-collecting and storage wall to the house and wood stove. The floor plan drawings were simplified by the removal of doors and kitchen and bath fixtures to allow survey participants to quickly view basic rooms. The basic floor plan used was obtained from the Tennessee Valley Authority's Design Portfolio (1979), solar house number eight.

The clothing designs consisted of three variations of a man's slacks-shirt ensemble. The 1-point design was a traditional ensemble. The 2-point design was based on the male version of the leisure outfit used in the SDS instrument. The 3-point design was based on a nonfinalist entry to the UT-EDC project.

The furnishings designs included three variations of a couch. The 1-point design was a traditional couch. The 2-point design was based on a UT-EDC entry. The 3-point design was based on suggestions from the UT research group. After completing the gaming section, participants were asked to rate the reasons for their selections in order of importance. Appearance, comfort, cost, energy efficiency, and tradition were the given reasons, or values, to be rated (see Appendix for gaming instrument).

Both the SDS and gaming portions of the instrument were pretested by a group of 14 randomly selected participants who attended the World's Fair. The pretest was given to assure that the instrument could be easily understood and to assess the time required to administer the instrument. The average time required for these individuals to complete the instrument was six minutes.

Demographic categories. Mutually exclusive categories were provided for age, family size, sex, state or country represented, home ownership status, education, and income. These categories were included to assure a cross section of survey participants and to provide a basis for data comparisons between participant groups. Two additional categories were included with the demographic areas to provide a method of distinguishing between survey Group A (knowledgeable in the home energy field) and Group B (less knowledgeable). These categories were provided to determine whether the participant had lived in an energy-efficient home or owned significant energy-efficient devices (see Appendix for demographic categories).

Target Population

The target population for this study was selected to meet the standards used by Rogers and Shoemaker (1971) in their adoptive model development. Their model was designed to be used with groups of potential adopters, or average consumers, rather than expert or selected groups. Thus, a random sample was needed to assure a cross section of potential customers. Originally a mail-out random sample was planned. With the advice of a statistician, this method was eliminated because the low predicted return would make the method economically unfeasible. The decision was made to administer the survey to individuals attending the 1982 World's Fair in Knoxville, Tennessee. The theme of the Fair, energy, was relevant to the purpose of the study, and the attraction of people from a variety of states offered a cross sectional population.

Administration of the Instrument

The legal department of the World's Fair was contacted to determine the procedure for obtaining permission to administer the instrument to visitors of the Fair. No permission was needed outside the entrance gates. Permission was needed from the Fair's administration and the individual exhibit areas for administration inside the gates.

It was decided to administer a second pretest of the instrument outside a gate to determine participants' willingness to take the survey. Of the first 11 people asked to participate, 10 willingly completed the survey. The researcher gave instructions to individuals or small groups of people. Instructing small groups was less time consuming than instructing individuals, since group members could work in their surveys at the same time. The total time required to administer the pretest was 35 minutes. Based on the results of the pretest, people were very willing to participate. It was decided to continue administering the survey outside the gate as this procedure provided a relaxed group of participants who could be met on an individual basis.

The instrument was administered outside the Cumberland Avenue entrance. Only people who were resting or waiting on benches were approached. An average of 37 surveys were completed on each of six mornings between 9:30 and 11:30 a.m. Twenty-two of the surveys were discarded because they were incomplete. The primary reason for not completing the survey was apparently lack of time. The survey was administered during May 1982, the opening month of the Fair.

Data Analysis

Statistical procedures were obtained from the Statistical Package for the Social Sciences (Nie et al., 1975). Factor analysis (varimax rotation method) was utilized to determine each design evaluation's underlying constructs for comparison with Rogers and Shoemaker's attributes.

Mean ratings and standard deviations were calculated for each design evaluation's (a) SDS dimensions, (b) Rogers and Shoemaker's attributes, and (c) total dimensions. Mean ratings were also used to evaluate consumers' preference in the gaming instrument.

The t-test was used to determine significant differences between Group A and Group B. Analysis of variance (ANOVA) was used to determine significant differences within demographic categories. The probability levels accepted were 0.01 (highly significant) and 0.05 (significant).

FINDINGS AND DISCUSSION

Null Hypothesis 1: The semantic differential scale dimensions used to evaluate the UT-EDC designs will not factor into Rogers and Shoemaker's attributes of relative advantage, compatibility, and complexity.

Factor analysis was applied to SDS ratings for each of the designs to reduce the evaluated dimensions to a smaller number of underlying constructs. The varimax rotation method was used (Nie et al., 1975). Highest factor loadings were listed for each dimension except for dimensions which loaded similarly on more than one factor. The SDS dimensions of the leisure outfit factored into two factors which are listed in Table 4. The two factors explained 100% of the variance.

Factor 1 corresponded to Rogers and Shoemaker's (1971) relative advantage and compatibility attributes in all but one dimension (easy to maintain). "Easy to maintain" was associated somewhat more strongly with complexity than relative advantage. Factor 1 was identified as a relative advantage factor in which participants viewed compatibility as a part of relative advantage rather than a separate attribute.

Factor 2 corresponded to Rogers and Shoemaker's complexity attribute and was identified as a complexity factor in the evaluation of the leisure outfit.

Table 4

Factor Analysis of Leisure Outfit Evaluations

R&S's Attributes	SDS Dimensions	Factor 1 Loadings	Factor 2 Loadings
Relative advantage			
	Reduces home energy costs	0.45223	
	Inexpensive	0.41207	
	Easy to maintain	0.38700	0.42893
	Rapid financial compensation	0.40318	
	Comfortable temperature	0.63455	
	Safe	0.51660	
Compatibility			
	Worthwhile	0.76636	
	Conventional	0.52673	
	Functional	0.52673	
Complexity			
	Easy to understand		0.57180
	Simple to use		0.84359

The SDS dimensions for the lounging dress divided into three factors which are listed in Table 5. The three factors explained 61% of the variance. Factor 1 was similar to Rogers and Shoemaker's compatibility attribute and was identified as a compatibility factor. Factor 1 also included two dimensions from the relative advantage attribute (comfortable temperature and safe) and one dimension which associated with both Factor 1 and Factor 2 (easy to understand). With the exception of the "inexpensive" dimension, Factor 2 corresponded to Rogers and Shoemaker's complexity attribute and was identified as a simplicity-complexity factor. Again, as with the leisure outfit, "easy to maintain" was apparently regarded as a dimension of the complexity attribute rather than relative advantage. Factor 3 was identified as an economic factor. Since a primary advantage of energy-efficient products is to reduce home energy expenditures,

participants may have interpreted economics as an indicator of relative advantage for energy-efficient products.

Table 5

Factor Analysis of Lounging Dress Evaluations

R&S's Attributes	SDS Dimensions	Factor 1 Loadings	Factor 2 Loadings	Factor 3 Loadings
Relative advantage				
	Reduces home energy costs			0.52825
	Inexpensive		0.32183	
	Easy to maintain		0.81271	
	Rapid financial compensation			0.59354
	Comfortable temperature	0.48424		
	Safe	0.53902		
Compatibility				
	Worthwhile	0.80462		
	Conventional	0.38568		
	Functional	0.58425		
Complexity				
	Easy to understand	0.54080	0.50553	
	Simple to use		0.63920	

The SDS dimensions of the water-storage heat collector factored into three factors which are listed in Table 6. The three factors explained 100% of the variance. Factor 1 was identical to Rogers and Shoemaker's complexity attribute. Factor 2 included dimensions from two attributes (relative advantage and compatibility) and was identified as a compatibility factor. Factor 3 was interpreted as an economic factor. "Easy to maintain" apparently was viewed as an economic consideration which may be an indication that participants believed maintaining the water-storage heat collector was either monetarily or time consuming. The dimension "conventional" loaded similarly in Factors 2 and 3, but was not strong in either factor. Thus, the

"conventional" dimension may represent a separate attribute of the consumers' perceptions of the water-storage heat collector. Perhaps this dimension is perceived as unconventional.

Table 6

Factor Analysis of Water-Storage Heat Collector Evaluations

R&S's Attributes	SDS Dimensions	Factor 1 Loadings	Factor 2 Loadings	Factor 3 Loadings
Relative advantage				
	Reduces home energy costs		0.52464	
	Inexpensive			0.65514
	Easy to maintain			0.47235
	Rapid financial compensation			0.42115
	Comfortable temperature		0.47025	
	Safe		0.31457	
Compatibility				
	Worthwhile		0.59287	
	Conventional		0.07431	0.17618
	Functional		0.71159	
Complexity				
	Easy to understand	0.90369		
	Simple to use	0.74366		

The SDS dimensions of the solar waterbed factored into four factors which are listed in Table 7. The four factors explained 68.2% of the variance. Factor 1 corresponded to Rogers and Shoemaker's compatibility attribute and was identified as a compatibility factor. Factor 1 included two dimensions from the relative advantage attribute (safe and comfortable temperature). Factor 2 was identified as a complexity factor and related to Rogers and Shoemaker's complexity, but included "reduces home energy costs." Factors 3 and 4 included economic considerations. Factor 3 (inexpensive and easy to maintain) was identified as an expense factor. Factor 4 (rapid financial compensation) was

identified as a cost-effective factor. Since these four factors explained only 68.2% of the variance, a larger number of constructs may be needed to interpret consumers' perceptions of the solar waterbed.

Table 7

Factor Analysis of Solar Waterbed Evaluations

R&S's Attributes	SDS Dimensions	Factor 1 Loadings	Factor 2 Loadings	Factor 3 Loadings	Factor 4 Loadings
Relative advantage					
Reduces home energy costs			0.37187		
Inexpensive				0.71996	
Easy to maintain				0.64973	
Rapid financial compensation					0.79384
Comfortable temperature		0.61243			
Safe		0.53356			
Compatibility					
Worthwhile		0.69081			
Conventional		0.28735			
Functional		0.66486			
Complexity					
Easy to understand			0.79447		
Simple to use			0.76661		

The underlying constructs for the UT-EDC designs appeared to correspond to Rogers and Shoemaker's complexity and compatibility attributes. The relative advantage attribute was strongly economic in all of the design evaluations except the leisure outfit. The variance in the relative advantage attribute may be due to the product type. Wilkening and Johnson (1961) state that the nature of the innovation may determine the type (economic or social) of relative advantage. Rogers and Shoemaker (1971) also note that their attributes are somewhat empirically interrelated although conceptually distinct. Null hypothesis 1 was only partially rejected since the dimensions used to evaluate the UT-EDC

designs did not factor precisely into Rogers and Shoemaker's perceived attributes of innovations.

Null Hypothesis 2: Consumers will not exhibit positive attitudes toward the UT-EDC designs as indicated by a mean rating on the positive end of the SDS dimension ratings (less than 5).

Mean ratings and standard deviations were calculated for each of the SDS dimensions for each of the designs. Results from the individual mean ratings indicated consumers' perceptions of specific dimensions of each design, and the standard deviations were indicative of variability within the sample. The mean ratings and standard deviations are listed in Table 8.

All of the mean ratings were in the acceptability range of less than 5 except the "inexpensive" dimension of the water-storage heat collector (5.90). Dimensions registering highly positive mean ratings (below 2) were "reduces home energy costs" for the water-storage heat collector and "simple to use" for the leisure outfit. Thus, the water-storage heat collector was apparently perceived as being an expensive innovation, but one that would reduce home energy costs. Dimensions registering mean ratings approaching the unacceptable range (above 4) included "inexpensive," rapid financial compensation" and "unconventional" for each of the designs.

Total mean ratings were also calculated for each design. The purpose of calculating total means was to establish an acceptability rating for each design. Acceptability levels as indicated by total mean ratings were 2.82 for the leisure outfit, 3.14 for the lounging dress, 3.31 for the water-storage heat collector, and 3.08 for the solar waterbed. Each of the designs was within the acceptability

Table 8

Mean Ratings and Standard Deviations for Each Design's SDS Dimensions

SDS Dimensions	Leisure Outfit		Lounging Dress		W-S Heat Collector		Solar Waterbed	
	Mean Rating	Standard Deviation	Mean Rating	Standard Deviation	Mean Rating	Standard Deviation	Mean Rating	Standard Deviation
Reduces home energy costs	2.17	1.42	2.28	1.47	1.81	1.16	2.45	1.61
Inexpensive	4.36	2.44	4.07	2.30	5.90	2.54	4.79	2.64
Easy to maintain	2.35	1.76	2.82	2.05	3.73	2.41	3.33	2.28
Rapid financial compensation	4.22	2.22	4.05	2.05	4.53	2.30	4.49	2.26
Comfortable temperature	2.91	2.03	3.04	1.94	2.88	1.67	2.83	1.71
Safe	2.12	1.57	2.73	2.01	2.30	1.58	2.11	1.47
Worthwhile	2.61	1.77	2.95	1.85	2.55	1.63	2.62	1.77
Conventional	4.04	2.44	4.86	2.45	4.94	2.66	4.38	2.43
Functional	2.15	1.44	2.86	1.95	2.28	1.56	2.45	1.60
Easy to understand	2.21	1.77	2.32	1.80	2.75	2.00	2.15	1.73
Simple to use	1.92	1.47	2.52	1.97	2.67	2.04	2.28	1.83

range (less than 5) stated in the null hypothesis.

In this study word pairs were selected to represent 11 dimensions of three attributes of Rogers and Shoemaker's perceived attributes of innovations model: relative advantage, compatibility, and complexity. Since three attributes were involved, total means may not be as relevant in indicating acceptability of designs as the means of individal dimensions or means of the attributes. Mean ratings and standard deviations for the attributes of each design are listed in Table 9.

Complexity received the most positive mean ratings for each of the designs. Compatibility rated second in all designs except the lounging dress. Relative advantage was third in all designs except the lounging dress. Consumers considered all four designs acceptable on the basis of mean ratings for each attribute. Null hypothesis 2 was rejected; thus, consumers did exhibit positive attitudes toward the UT-EDC designs indicating their acceptability of these product innovations.

Null Hypothesis 3: There will be no significant difference in overall acceptability levels of the UT-EDC designs between survey Group A and Group B.

Comparisons of acceptability levels as indicated by mean ratings were made between survey Group A and Group B. Group A was defined as knowledgeable in the home energy field and included respondents who had experience in living in an energy-efficient home or in using significant energy-efficient devices. Group B was less knowledgeable and included the remainder of the sample. Comparisions of mean ratings and standard deviations for Group A and B are listed in Table 10.

The t-test was computed and no significant differences were found

Table 9

Mean Ratings and Standard Deviations for Each Design's Attributes (R&S)

Attributes (R&S)	Leisure Outfit		Lounging Dress		W-S Heat Collector		Solar Waterbed	
	Mean Rating	Standard Deviation	Mean Rating	Standard Deviation	Mean Rating	Standard Deviation	Mean Rating	Standard Deviation
Relative advantage	3.02	1.20	3.16	1.24	3.53	1.13	3.33	1.28
Compatibility	2.93	1.52	3.56	1.65	3.26	1.35	3.15	1.48
Complexity	2.06	1.40	2.42	1.73	2.71	1.90	2.21	1.63

Note. Based on SDS dimensions subsumed in three of Rogers and Shoemaker's attributes.

Table 10

Design Acceptability Levels for Group A and Group B as Indicated by Mean Ratings and Standard Deviations

Design	Group A		Group B	
	Mean Rating	Standard Deviation	Mean Rating	Standard Deviation
Leisure outfit	2.84	1.01	2.81	1.14
Lounging dress	3.11	1.06	3.11	1.32
Water-storage heat collector	3.40	0.92	3.27	1.12
Solar waterbed	2.95	1.19	3.13	1.16

Note. Group A contained 59 participants; Group B contained 140 participants.

in the responses of Group A and Group B. Null hypothesis 3 was accepted; thus, knowledge in the home energy field, as defined in this study, did not significantly affect acceptability levels of the UT-EDC designs.

Demographic Categories. Since no significant differences were found in the acceptability levels of survey Group A and Group B, comparisons were then made to determine the effects of demographic categories on acceptability levels. Analysis of variance (ANOVA) computations indicated no significant differences in any of the UT-EDC designs based on family size, education, or income. Significant differences were found based on age, sex, and home ownership categories (see Table 11). Mean ratings for the leisure outfit were more favorable among participants who were in the above 30 age groups, females, and those who owned their homes. Mean ratings for the lounging dress were most favorable among the 30-59 age group participants, males, and those who rented their homes.

Significant differences were also found in mean ratings within age categories for the water-storage heat collector (50-59 most favorable) and home ownership categories of the solar waterbed (those who owned their homes were most favorable). The 50-59 age group participants (those approaching retirement age) may have perceived the water-storage heat collector as an effective innovation for reducing home energy costs without the expense of major home renovation. Participants who rented their homes may have perceived the solar waterbed to be incompatible with their lifestyle as it would be difficult to move and would require placement near a properly sized and positioned window for solar gain. Age, sex, and home ownership classifications did significantly affect

Table 11

Mean Ratings and Significant F-ratios for Design Evaluations Based on Age, Sex, and Home Ownership

Demographic Categories	Leisure Outfit Mean Rating	Leisure Outfit F-ratios	Lounging Dress Mean Rating	Lounging Dress F-ratios	W-S Heat Collector Mean Rating	W-S Heat Collector F-ratios	Solar Waterbed Mean Rating	Solar Waterbed F-ratios
Age (years)		3.96**		4.62**		3.28**		
under 20	3.19		3.44		3.62			
20-29	3.31		3.72		3.42			
30-39	2.82		3.01		3.32			
40-49	2.67		2.87		3.18			
50-59	2.41		2.58		2.85			
over 59	2.43		3.47		3.84			
Sex		6.57**		4.00*				
Male	3.05		1.09					
Female	2.65		1.18					
Home Ownership		6.12**		4.00*				6.25**
Own	2.72		1.16				2.96	
Rent	3.31		1.09				3.59	

* indicates $p \leq .05$
** indicates $p \leq .01$

acceptability levels of some of the UT-EDC designs.

Null Hypothesis 4: There will be no difference in preference for interior architecture, interior furnishings, and clothing designs in meeting consumers' thermal comfort needs.

Survey participants had a preference for using interior architecture (housing) in meeting their thermal needs as indicated by mean ratings and total responses. Mean rating values corresponded to point values for each preference in the gaming instrument. In each category 3-point selections were most preferable; one-point selections were least preferable. The mean rating value for housing was 2.7; clothing, 1.7; and furnishings, 1.6. Total participant responses for each design are listed by preference category in Table 12. The 3-point housing design was selected most often by participants. The 2-point clothing design was most preferable, while the 1 and 2-point furnishing designs were almost equal in number of responses. Null hypothesis 4 was rejected since both mean ratings and total responses indicated participants had a preference for using interior architecture in meeting their thermal needs.

Table 12

Respondents' Preferences for Using Housing, Clothing, and Furnishings in Meeting Thermal Needs

Preference	Number of Respondents Choosing		
	Housing	Clothing	Furnishings
First	147	4	10
Second	49	131	95
Third	3	64	94

Note. Total participants = 199

Participants were asked to rate the reasons (or personal values) for their preferences in using housing, clothing, or furnishings in meeting their thermal needs. The value choices given in the survey instrument were appearance, comfort, cost, energy, and tradition. Participants rated their choices using a scale of 1-5 with 1 being the most preferred value.

Mean ratings for participants' reasons were comfort, 1.8; appearance, 2.3; energy, 2.8; cost, 3.3; and tradition, 4.6. Thus, comfort was the most important value. Total participant responses for reasons are listed in Table 13. Comfort was most often selected as the first or second value. Appearance and energy were rated most often as first through fourth in importance. Cost was most frequently third and fourth in importance. Tradition was strongly indicated as the least important value given in this survey.

Table 13

Respondents' Reasons for Rating

Housing, Clothing, and Furnishing Preferences

Preference	Number of Respondents Choosing				
	comfort	appearance	energy	cost	tradition
First	90	52	40	15	3
Second	73	43	35	38	10
Third	29	52	59	50	9
Fourth	7	46	50	68	27
Fifth	0	6	15	28	150

Note. Total participants = 199

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The primary purpose of this study was to evaluate consumers' attitudes toward some of the energy-efficient designs generated by the University of Tennessee-Energy Design Competition. The secondary purposes were (a) to compare the acceptability levels of the designs between participants who were knowledgeable in the home energy field and those who were less knowledgeable and (b) to determine if consumers had a preference for using interior architecture, clothing, or furnishings in meeting their thermal needs.

A literature survey was conducted to provide a basis for the selection of a research model applicable to this study. Major consumer models evaluated included consumer behavior models (Nicosia, 1966, Howard and Sheth, 1969, and Engel, Kollat, and Blackwell, 1968), risk models (Peter and Tarpen, 1975, Bonoma and Johnson, 1979, and Stampfl, 1978), and sales models (Midgley, 1977, Ostlund, 1974, Rogers and Shoemaker, 1971, and Ehrenbert, 1972). A form of sales model, the adoption model, was selected as most relevant to this study. The model selected as the basis for the study was Rogers and Shoemaker's (1971) perceived attributes of innovations adoption model. This model provided a framework for evaluating both the innovations' attributes and consumers' attitudes and was structurally subdivided for use in the persuasion, or attitude, area of the adoption process.

The semantic differential scale developed by Osgood (1976)

was chosen as the measurement/scaling technique for evaluating the UT-EDC designs. The gaming technique (Sanoff, 1979) was selected for evaluation of consumers' preference for using interior architecture, clothing, or furnishings in meeting their thermal needs.

Statistical procedures used to evaluate consumers' responses included factor analysis (varimax rotation method), mean ratings and standard deviations, t-tests, and analysis of variance (ANOVA) (Nie et al., 1975). Probability levels accepted were 0.01 (highly significant) and 0.05 (significant).

Null hypothesis 1 stated that the semantic differential scale dimensions of the UT-EDC designs will not factor into Rogers and Shoemaker's attributes of relative advantage, compatibility, and complexity. The underlying constructs of the UT-EDC design evaluations were identified using factor analysis, and they corresponded to Rogers and Shoemaker's attributes of compatibility and complexity. The relative advantage attribute was strongly economic for all of the designs except the leisure outfit. Null hypothesis 1 was partially rejected since the dimensions used to evaluate the designs did not factor precisely into Rogers and Shoemaker's perceived attributes.

Null hypothesis 2 stated that consumers will not exhibit positive attitudes toward the UT-EDC designs as indicated by a mean rating on the positive side of the SDS scale (less than 5). Mean ratings for each design's attributes (relative advantage, compatibility, and complexity) were on the positive end of the SDS dimension ratings. Null hypothesis 2 was rejected.

Null hypothesis 3 stated that there will be no significant difference in overall acceptability levels of the UT-EDC designs

between survey Group A and Group B. Comparisons were made of acceptability levels as indicated by mean ratings between survey Group A (knowledgeable in the home energy field) and Group B (less knowledgeable). No significant differences were found on the basis of t-tests of acceptability levels of Group A and Group B. Null hypothesis 3 was accepted.

Null hypothesis 4 stated that there will be no difference in preference for interior architecture, interior furnishings, and clothing in meeting consumers' thermal comfort needs. Consumers had a preference for using interior architecture (housing) in meeting their thermal needs as indicated by mean ratings. Null hypothesis 4 was rejected.

It is recommended that further research be conducted to identify the remaining constructs in the design evaluations that did not result in factors which explained 100% of the variance (lounging dress and solar waterbed). It is also recommended that further evaluation be made of the economic advantages of each design particularly the water-storage heat collector. The development of design prototypes would allow for controlled laboratory evaluations to determine each innovation's cost-effectiveness.

APPENDIX

(survey instrument)

Dear Survey Participant,

The Department of Textiles, Merchandising and Design at the University of Tennessee is involved in a study of thermal comfort in the home. We would appreciate your helping us by evaluating the enclosed designs. Marketing specialist have found that products which appear to offer advantages to consumers are often not purchased because the consumer does not feel the product will fit into his lifestyle despite the apparent advantages. It is your feelings we are interested in measuring. Knowledge of energy related products is not needed. Please check all items with your first impressions. Thank you for helping us.

Sincerely,

Barbara Parks
Graduate Student

Jacquelyn DeJonge
Department Head

Instructions for Evaluating the Designs

There are nine spaces between each pair of words. If you feel that each word applies equally, check the middle space (number 5). If you feel very strongly that one of the words applies, check close to that word (number 1). Use the other spaces for feelings that are between extreme and neutral. You should have one check between each pair of words for a total of eleven checks per design.

Example:

Chair

	(1)	(2)	(3)	(4)	(5)	(4)	(3)	(2)	(1)	
soft	—	—	—	—	—	—	—	✓	—	hard
wide	—	—	—	—	—	—	✓	—	—	narrow

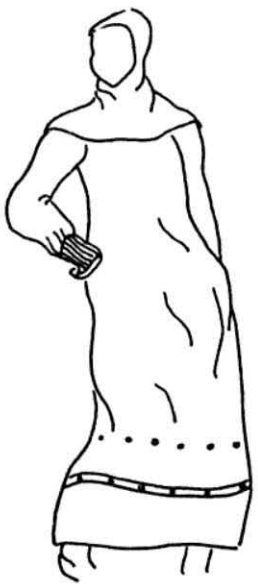
cowl collar worn as hood

cuff worn over hand

Leisure Outfit

Outfit is made of synthetic-blend, sweatshirt type fabric. Ribbed cuffs and waist prevent cool air from entering openings.

reduces home energy costs	increases home energy costs
inexpensive	expensive
easy to maintain	difficult to maintain
rapid financial compensation	slow financial compensation
comfortable temperature	uncomfortable temperature
safe	hazardous
worthwhile	worthless
conventional	unconventional
functional	nonfunctional
easy to understand	difficult to understand
simple to use	difficult to use



hood may be worn down or removed

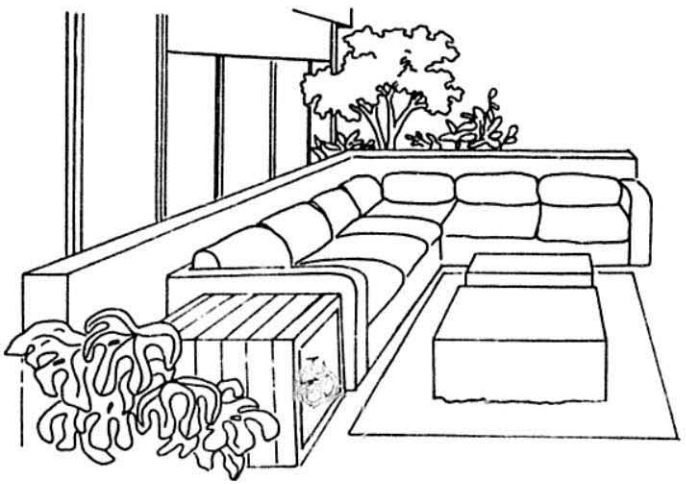
hand cover

draw string closure

Lounging Dress

Dress is made of synthetic-blend, sweatshirt type fabric. Snaps allow for adjusting to full length or knee length.

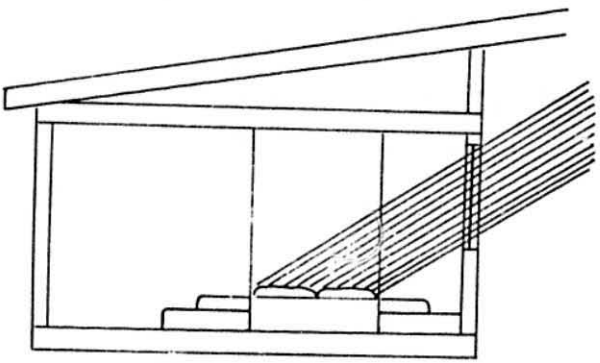
reduces home energy costs	_ _ _ _ _ _ _ _ _	increases home energy costs
inexpensive	_ _ _ _ _ _ _ _ _	expensive
easy to maintain	_ _ _ _ _ _ _ _ _	difficult to maintain
rapid financial compensation	_ _ _ _ _ _ _ _ _	slow financial compensation
comfortable temperature	_ _ _ _ _ _ _ _ _	uncomfortable temperature
safe	_ _ _ _ _ _ _ _ _	hazardous
worthwhile	_ _ _ _ _ _ _ _ _	worthless
conventional	_ _ _ _ _ _ _ _ _	unconventional
functional	_ _ _ _ _ _ _ _ _	nonfunctional
easy to understand	_ _ _ _ _ _ _ _ _	difficult to understand
simple to use	_ _ _ _ _ _ _ _ _	difficult to use



Water-Storage Heat Collectors

The divider behind the couch and the coffee tables are water-storage heat collectors. Heat from the sun is stored during the day and released in the evening to increase the room's warmth. The divider and coffee tables are made of dark laminated plastic. Although they are shown with furnishings, please evaluate only the divider and tables.

reduces home energy costs	_ _ _ _ _ _ _ _ _	increases home energy costs
inexpensive	_ _ _ _ _ _ _ _ _	expensive
easy to maintain	_ _ _ _ _ _ _ _ _	difficult to maintain
rapid financial compensation	_ _ _ _ _ _ _ _ _	slow financial compensation
comfortable temperature	_ _ _ _ _ _ _ _ _	uncomfortable temperature
safe	_ _ _ _ _ _ _ _ _	hazardous
worthwhile	_ _ _ _ _ _ _ _ _	worthless
conventional	_ _ _ _ _ _ _ _ _	unconventional
functional	_ _ _ _ _ _ _ _ _	nonfunctional
easy to understand	_ _ _ _ _ _ _ _ _	difficult to understand
simple to use	_ _ _ _ _ _ _ _ _	difficult to use



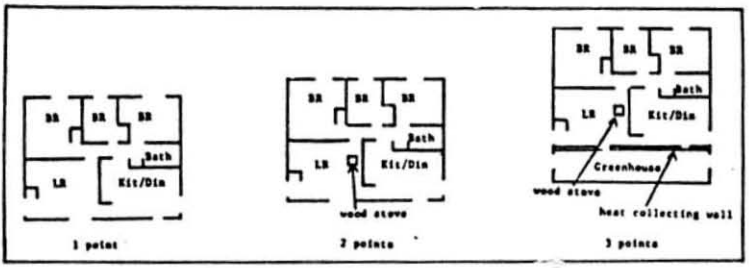
Solar Waterbed

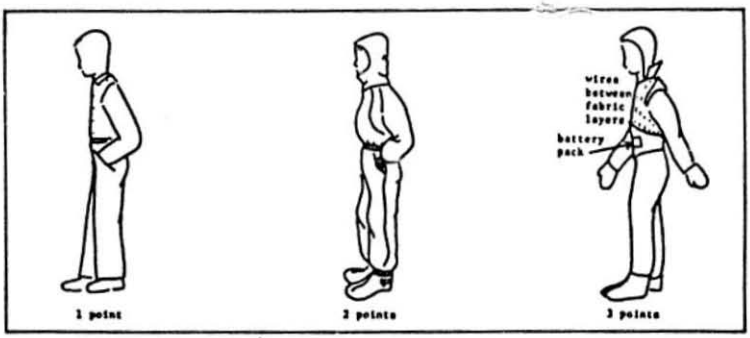
During sunny winter days, a thin, dark-colored fabric spread is placed on the bed. At sundown, an insulating quilt is placed over it.

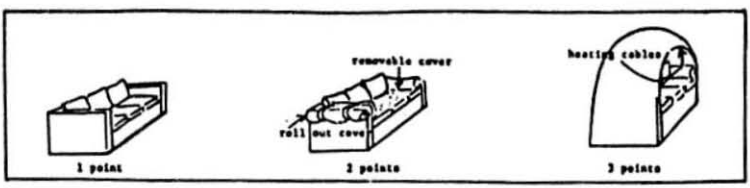
reduces home energy costs	_ _ _ _ _ _ _ _ _	increases home energy costs
inexpensive	_ _ _ _ _ _ _ _ _	expensive
easy to maintain	_ _ _ _ _ _ _ _ _	difficult to maintain
rapid financial compensation	_ _ _ _ _ _ _ _ _	slow financial compensation
comfortable temperature	_ _ _ _ _ _ _ _ _	uncomfortable temperature
safe	_ _ _ _ _ _ _ _ _	hazardous
worthwhile	_ _ _ _ _ _ _ _ _	worthless
conventional	_ _ _ _ _ _ _ _ _	unconventional
functional	_ _ _ _ _ _ _ _ _	nonfunctional
easy to understand	_ _ _ _ _ _ _ _ _	difficult to understand
simple to use	_ _ _ _ _ _ _ _ _	difficult to use

Directions: Please select one floor plan, one clothing ensemble, and one furnishing. Your choices should equal exactly 6 points. Circle your selections.

Purpose: This exercise is designed to identify the area in which you would be most willing to use energy efficient designs. If you are willing to use them in all areas, you will need to select your first preference to stay within the 6 points.







Please rate the reasons for your selections on the exercise where your choices totaled 6 points. Use number 1 for your most important reason.

appearance __
comfort __
cost __
energy efficiency __
tradition __

Please check the following:

Age: under 20 __ 20-29 __ 30-39 __ 40-49 __ 50-59 __ over 59 __

Size family: 1 __ 2 __ 3 __ 4 __ 5 __ 6 __ other ____

Sex: male __ female __

State or country living in: _____

Home ownership: own __ rent __

Have you ever lived in an energy efficient home? yes __ no __

Energy saving devices presently owned:
Woodstove ___
Thrombe wall ___
Greenhouse ___
Other _____

Highest level of education:
__ 8th grade
__ high school
__ some college or business school
__ associate or 2 year degree
__ 4 year degree
__ advanced degree

Income: under $15,000 __ $15,000-30,000 __ over $30,000 __

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