IDENTIFYING INNOVATORS AND EARLY ADOPTERS OF ENERGY CONSERVATION PRODUCTS

Final Report Prepared for
Consumer and Corporate Affairs Canada

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[1] Ian Fenwick, and Roger Heeler, are Associate Professors of Marketing, Patricia Simmie, Assistant Professor of Marketing, in the Faculty of Administrative Studies, York University.

[2] J. D. Wharton and C. W. Cullen are in the Faculty of Administrative Studies, University of Manitoba.

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1.0 INTRODUCTION

The purpose of this project is:

i) to identify early adopters of energy conservation products

ii) to identify opinion leaders in the area of energy conservation

iii) to analyze individuals' perceptions of innovative conservation products.

This report presents the project's literature review, development of survey methodology and initial, summary results.

2.0 ADOPTION AND DIFFUSION OF INNOVATION: THE TRADITIONAL APPROACH

The processes by which innovations are adopted by, and diffused through a community are complex and not always well understood. The volume of literature in this area is immense. Rogers and Thomas (1975) present a comprehensive bibliography of some 2,700 items, 144 of which are classified relating to consumer marketing (Rogers 1976). As they further suggest that the literature is increasing exponentially, doubling every two years, a comprehensive review of the literature on innovation and diffusion is clearly beyond the scope of this study (and if these growth rates continue must soon be beyond the scope of any study!) In fact, although details frequently conflict, and there are some methodological differences within the field, the key concepts are fairly well defined. This review will concentrate on marketing applications as far as possible, although as marketing applications have tended to build on earlier research, many non-marketing sources are reviewed. The aim of the review is to provide a solid framework for the questionnaire developed in Section 3.0. For our purposes the best way to structure the literature is to outline the traditional approach (the "dominant paradigm") paying particular attention to those objections/ modifications which are relevant for our study.

There are four basic building blocks for the traditional approach to adoption and diffusion research:

i) a consumer adoption process

ii) taking place within a social environment

iii) at different rates and at different points in time for different individuals

iv) all influenced by the characteristics of the innovation and its marketing methods

Within the innovation/diffusion framework marketing oriented researchers have focussed particularly on the characteristics of two key groups of "change agents":

v) those adopting the innovation early (innovators or early adopters) and those playing a major role in diffusion of the product (opinion leaders)

The following sections 2.1-2.6 review the relevant literature on these five topics with particular reference to the design of our study of energy conservation technologies. Although these six topics are presented individually they are certainly interrelated. For example, the characteristics of the social environment, discussed in 2.2, are known to affect the characteristics of opinion leaders and their overlap with innovators, discussed in 2.5 and 2.6.

2.1 THE CONSUMER ADOPTION PROCESS

One of the major contributions of the classic study of Iowa corn farmers and their adoption of hybrid seed corn (Ryan and Gross 1943), was the recognition that new product adoption involves a process. The consumer moves through a series of stages culminating in adoption. The original model, implicitly used by Ryan and Gross, appears in Figure 2.1. It is essentially a mechanistic model - all consumers eventually adopt, all flow through the same stages, and no stages may be skipped. The model is similar to the original AIDA model or more recently propounded consumer behaviour models such as the hierarchy of effects (also shown in Figure 2.1.1).

The role of such models is more conceptual than empirical. They remind the analyst that it is possible to measure diffusion prior to the innovation actually being adopted; unfortunately, the details of how such measurements should be made are debatable. Indeed within the rural sociology field Mason (1962) found evidence that all farmers did not move through the sequence of stages suggested. In fact, the only common element in the decision processes which he identified was a tendency for awareness almost always to precede adoption! Similarly, Fliegel et al (1968) found the same product could be adopted via different processes in different countries. In the marketing area Palda (1966) could discover no evidence for any hierarchy of effects, and suggested that for consumer goods even the temporal priority of awareness could be infinitessimal. Furthermore, there is considerable evidence that the adoption process continues beyond adoption. Mason (1962) identified post-adoption stages of further information search and product interest. The well-known concept of dissonnance reduction can rationalize such post-decision search and also throws doubt on the position of evaluation and interest in the adoption model. Adopters may envince interest in the product and provide a favourable evaluation as a consequence rather than a cause of innovation adoption.

Campbell (1966) extended the adoption process model in two directions. First, and of most relevance to our study, he recognized that consumers could be active. Thus the adoption process might begin not with awareness but with problem-solving. The consumer could recognize a problem, becoming aware of the innovation only after active search for a solution to that problem. From an energy conservation marketing viewpoint such a model would imply that innovators might be distinguished by their belief in an

"energy problem" and a consequent search for product information.

Campbell's second contribution was to relax the strongly rational orientation of the hierarchy models. He allowed consumers in some cases to make "impulsive" non-rational buying decisions: moving directly from an awareness to purchase without evaluation, preference or conviction stages. In the marketing literature Olshavsky (1980) has presented evidence that innovations are diffusing with increasing rapidity, which he suggests may "preclude any type of decision process". This emphasis on "non-rational" decision making has been taken up by a number of consumer researchers (eg. Robertson, 1976). However, the thrust of these models is mainly directed toward frequently purchased consumer goods and for our purposes this area of debate may be sidestepped (Van Esch and Heeler, 1981 present a lucid discussion of the possibility of integrating models of "rational" and "non-rational" decision making but at present such work is not sufficiently developed to be applicable.) Campbell's rational problem oriented model is shown in Figure 2.1.1

Rogers and Shoemaker (1971) identify three types of innovation decision: optional, collective and authority. Collective decisions (eg. water fluoridation) are suggested to be the slowest, as several persons must pass through an adoption process and eventually reach a consensus. Optional decisions are those taken by an individual without explicit reference to other members of the system. Rogers and Shoemaker see these as being faster than collective adoption decisions. Authority decisions (eg. auto emission controls) are imposed on the individual by an external powerful force and are supposed to lead to the most rapid diffusion (although the authority decision itself is presumably the outcome of a possibly lengthy

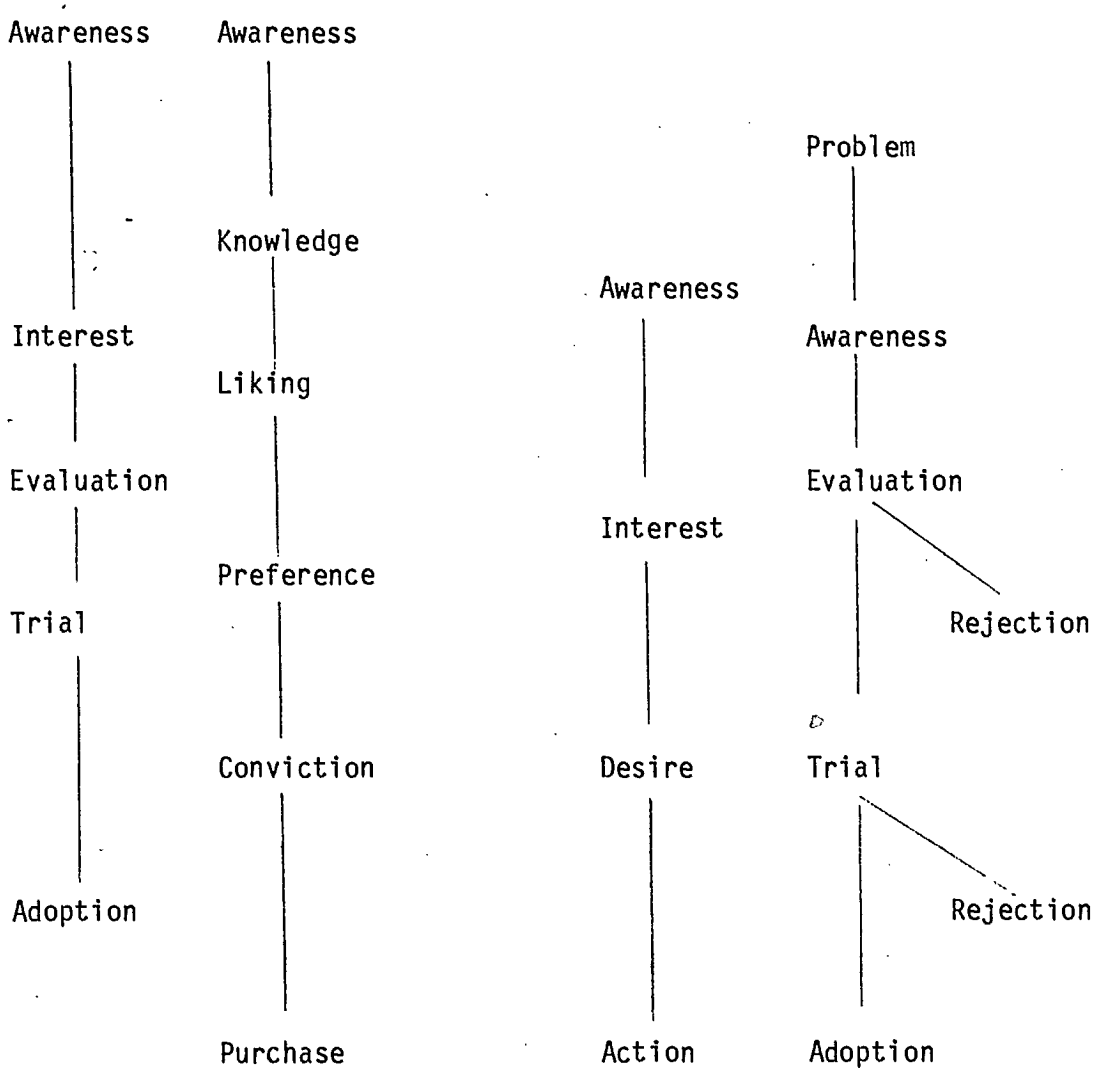
collective decision process!)

A final problem with adoption models is the definition of adoption. Robinson (1971, p. 57) points out the distinction in the case of frequently purchased goods between a single (trial) purchase and the purchase/re-purchase cycle implied by adoption. As our concern is solely with durable goods this particular distinction is academic. However, it is conceivable that a consumer could purchase an energy conservation product (eg. a set-back thermostat) and not in fact use it, or even in fact defeat its intended purpose (eg. by increasing the set-back temperature). Indeed to the extent that some purchases of energy conservation aids may be involuntary (eg. an appliance with a built-in energy saving feature, or an item included in a house-purchase - Quelch 1978) non-use could be considerable. As energy conservation is contingent on use not purchase, use, not ownership, should be the true measure of adoption.

2.2 THE SOCIAL SYSTEM

Adoption and diffusion take place within a social system which affects the likelihood of any individual adopting the innovation, and conditions the speed and extent of diffusion. Early diffusion work (mainly in the field of rural sociology) recognized a distinction between "traditional" and "modern" communities but otherwise tended to see diffusion as influenced by the individual and his personal characteristics. Finding, for example, that opinion leaders (see discussion 2.6) were early adopters only if the community were "modern". In "traditional" communities opinion leaders were of no more than average innovativeness (Rogers 1962 P. 245).

Rogers (1976) suggests that the social perspective in diffusion



2a	2b	2c	2d
Ryan/Gross (1943)	Hierarchy of Effect (Lavidge and Steiner 1961)	AIDA (Strong, 1925)	Rational-Problem Oriented (Campbell 1966)

Figure 2.1: Models of Adoption Process

research - the recognition that individual adoption decisions may be crucially conditioned by the social milieu in which they are made - has considerable potential. The classic study in this area is Coleman et al. (1966).

Coleman et al. examined diffusion of the drug "gammanym" among physicians in four mid-western communities. The distinctive feature of this study relative to the pioneering rural sociology research was the concentration on networks and social relations. This led to a focus on "from whom did you obtain information" and measures for individuals' integration into their society. Socially integrated individuals seemed to follow a different diffusion process from their non-integrated counterparts. Specifically, socially integrated doctors adopted earlier and held more closely to an S-shaped cumulative adoption curve. Doctors who tended not to be socially integrated adopted later and followed a roughly linear cumulative adoption path. This empirical result nicely supports the theoretical rationale for S-shaped cumulative adoption curves, i.e. that as the number of adopters increases so the volume of inter-personal communication concerning the innovation rises and pressure on non-adopter grows producing more rapid diffusion. Clearly non-integrated doctors are relatively immune from such inter-personal communication and so not expected to follow the S-shaped curve (see also Mendez 1966).

Although social systems play an obvious role in diffusion (which is after all essentially on an interaction concept) they also affect the individual's adoption decisions. Robertson (1968) finds neighbourhoods whose norms stress innovativeness, contain members who have adopted more than the average number of innovative products. Clearly causality could be

confused here: group norms could just as well be the result of innovativeness of group members.

The importance of the individual's immediate social sphere, as opposed to other (higher) social classes, is reinforced by Katz and Lazarsfeld (1955) and King (1963). Katz and Lazarsfeld (1955) find influence regarding food and household goods almost always flows in a horizontal (between equal status levels) rather than a vertical direction. King (1963) found similar results for fashions.

These results on the importance of proximate groups ("cliques") have led to a more recent development: "the strength of weak ties" (Granovetter 1973; Liu and Duff 1972). Most interactions occur within an individual's immediate, limited, environment, involving friends who are usually highly similar (in the vernacular of this strain of research "highly homophilous," Rogers 1973). As a result the diffusion of an innovation tends to be rapid within the immediate group but blocked from a wider circulation. To jump the group's boundaries requires individuals with contact outside the clique. These contacts outside the clique are by definition links to more dissimilar ("heterophilous") individuals. It is these "weak ties" to individuals who are either members of more than one clique ("bridges"), or associated in a non-member capacity with more than one clique ("liaisons"), that are vital for widespread diffusion. For example, Liu and Duff (1972) find the weak ties linking individuals, who are not themselves friends yet have a contact in common, were crucial in diffusing IUD's through the Phillipines. (Also "cosmopolitanism" has long been recognized as a characteristic of innovators, e.g. Tarde 1903, see discussion in 2.5).

Essentially the research discussed above elaborates the concept of socially integrated individuals by recognizing that social integration may be measured in the context of small groups rather than "society" in general. An important implication is that an individual's personal characteristics may not be a good predictor of their innovative behaviour. Instead, the individual's position within the groups with which he interacts may be of more relevance. It is quite possible that some of the currently accepted empirical findings concerning early adopters, opinion leaders, etc. may in fact be closely conditioned by the individual's social position (so Katz 1961 reconciles apparently conflicting descriptions of innovators by reference to their group norms).

There is, however, a major methodological problem in pursuing this sociometric networks style of research in our study. To produce valid measurements of individuals' positions within the groups of which they are members, it is necessary to concentrate data collection and perform a census within the community of interest. Each individual's interactions can then be plotted, both by their own claims to relationships and by the claims of their fellows, building a network of cross-validated relationships. This methodology is particularly appropriate where the community of interest can be narrowly defined (e.g. mid-West community doctors, Coleman et al 1966). In marketing applications it is only really feasible in quasi-experimental situations (e.g. using student residences, Arndt 1967). For innovations which are generally available, and which have a low incidence of adoption, those approaches would be enormously costly or require an exceedingly narrow community focus. Instead our research must rely on self-reported measures of individuals' positions in their communities.

2.3 DIFFERENCES IN INNOVATIVENESS

2.3.1 Date of Adoption

This is the heart of traditional diffusion research. Ryan and Gross (1943) credit popularization of the S-shaped diffusion curve, and its associated normal distribution of adoption over time, to F. Stuart Chapin, citing a 1928 source. Empirical work by Pemberton (1936) certainly applies the normal distribution as do Ryan and Gross themselves. The basic finding that relative frequency of individuals adopting is normally distributed over time has since been confirmed for a wide variety of innovations in agriculture and elsewhere (see Rogers and Shoemaker 1971, Table 5.1).

There are counter-findings, particularly in the marketing literature. For example, Bass (1969) notes several non-normalities, particularly for generic innovations (TVs, freezers) where distributions are positively skewed (see also Allvine 1968; Peterson et al. 1972 and Peterson 1973). However, the normal distribution is supported in the majority of studies.

The adoption distribution is usually divided into a number of more or less arbitrary categories. If there is an analysis which has considered the distribution as a whole, or used time of adoption as a continuous variable, it is certainly the exception.

Rural sociologists have almost all used 5 standard categories defined by date of adoption relative to the distribution's mean and standard deviation (North Central Sub-committee 1961) viz:

innovators adopt before $\bar{X} - 2\sigma$

early adopters adopt after $\bar{X} - 2\sigma$

early majority adopt after $\bar{X} - \sigma$

late majority adopt after $\bar{X}+\sigma$

laggards adopt after $\bar{X}+2\sigma$

(where $\bar{X}$ is the mean adoption time and σ the standard deviation of adoption times for the sample).

Given the approximately normal distribution of adoption times accepted by these analyses, innovators constitute 2.5% of the group, early adopters 13.5% early and late majority 34% each and laggards 16%.

To some extent these categories have also been used in marketing studies, although in typical marketing fashion researchers have not been slow to adapt or transform, or even to invent their own categorizations. For example, Bell (1963), Robertson (1968) and Robertson and Kennedy (1969) define innovators as the first 10% to adopt; King (1963) makes them the first 35% to adopt; Uhl et al. (1970) have 16% of buyers as innovators, 24% as laggards and 60% as 'other-adopters'. Baumgarten (1975) using a weighted index of product adoption (see below) classifies 26% of his sample as early adopters. Typically, these categorizations are justified only by the need to define "innovators" as a sufficiently large group for analysis. There is no a priori theoretical suggestion that the first 35% of King's adopters (King 1963) are in any sense equivalent to the first 10% studied by Bell (1963) and Robertson (1968) etc., in anything but the name "innovators" that is attached to them.

In fact a major question, which appears to be unasked in the literature, is why categorize the adoption distribution at all? Date of adoption is a continuous variable. Data analysis techniques are certainly available to handle adoption data as a normally distributed variable. It is only really appropriate to split such a continuous variable into discrete

portions if discontinuities are expected. For example, if it is believed that the characteristics of the first 2.5% to adopt are radically different from the characteristics of the next 13.5%, then definitions of innovators and early adopters make sense. However, no theoretical arguments seem to be presented to lead one to expect such discontinuities; if theoretical arguments were available they would presumably also define the points of discontinuity and such a range of "innovator" definitions would not be observed. Indeed, as the "innovator" definition is frequently pragmatic, resting explicitly on the need for a reasonable sample size, it is inconceivable that a discontinuity in consumer characteristics should coincide with the categorizations used. Nor is there consistent empirical evidence for discontinuities. Profiles of innovators/early adopters/early majority etc. tend to be related in a fairly linear fashion (Rogers and Shoemaker 1971, p. 190). The possible exceptions are leadership and usage of personal communications sources (Rogers 1961, Figure 6.2), which in some social settings are non-monotonically related to time of adoption. In the absence of convincing discontinuity it is more appropriate to model consumer characteristics as a continuous function of, say, time of adoption rather than using some arbitrarily defined adoption class.

The only classification scheme that looks for any sort of discontinuities is that used by Peterson (1973). Prompted by the non-normal distribution of adoption dates found in some marketing studies, Peterson employs cluster analysis to search for adopter classifications. He clusters on date of adoption, forming clusters until total within group sum of squares cannot be significantly reduced. This procedure is effectively looking for discontinuities in the date of adoption distribution, not in the

relationship between characteristics of adopters and date of adoption discussed above. However, if such discontinuities exist they may indicate a "natural" classification. Interestingly, the two empirical applications Peterson reports yield an earliest adopter category that is 14.8% of the sample in one case and 37.4% in another case. One problem with this method is its essentially ex post nature. If we are going to make no assumption as to the form of the date of adoption distribution, we can only perform the cluster analysis after all adoptions have taken place. So one of Peterson's examples pertains to an "innovation" launched 8 years earlier! Cluster analysis is also used in a multi-product study by Darden and Reynolds (1974) producing 6 innovator groups; however the clusters are essentially uninterpretable.

The ad hoc categorization approach is so ubiquitous that some of its other problems demand discussion. First, if the classifications are based on percentages of all adopters (e.g. innovators are the first 2.5% to adopt) it is necessary to develop an estimate of "all adopters" i.e. the final penetration of the innovation. Within the rural sociology field this is not a problem as there is a general assumption that <u>all</u> farmers eventually adopt the innovation. Clearly there are few products for which that final penetration exceeds estimates, "innovators" will really contain "early adopters"; to the extent that final penetration falls short of that estimated, "early adopters" will in fact contain "innovators". Clearly any analysis of the characteristics of different adopter groups is contingent on the accuracy of market penetration predictions.

Second, it is intuitively obvious that the definition of "innovators" should be in some way related to the "newness" of the innovation

involved. Robinson (1971 P. 87) points out that to be in the first 10% to adopt the third new brand of fluoride toothpaste is scarcely as innovative as being in the first 10% to adopt the first brand of fluoride toothpaste launched. Although our research will not involve "brands", it is reasonable to suspect that product modifications (e.g. double-glazed storms) may be considerably less "new" than totally innovative products (e.g. heat-pumps). As a result the characterization of innovators should be flexible enough to absorb product "newness" (the measurement of product newness is further considered below).

Third, are the categorizations to be applied to international, national, regional, community, or group time of adoption distribution? To be an innovator does an individual have to be in the first 2 1/2% to adopt in the world, or in Canada, or in Quebec, etc.? Presumably, the universe over which the 2 1/2% is defined should all have access to the product (i.e. only areas within which distribution has been achieved should be considered). But the discussion of social systems above (section 2.2) makes a strong argument for quite a local definition of innovation. However, if groups differ in terms of the innovative content of their norms (Robertson 1968), should innovativeness be measured within or across groups? If all your friends have heat pumps, solar power units and windmills, your set-back thermostat, although innovative within the city in which you live, is scarcely innovative in a group context.

These problems can be avoided to some extent by defining "innovativeness" by the time of adoption irrespective of the distribution of ownership times. For example, Burger et. al. (1967) define "early buyers" as anyone purchasing within the first 70 days. Again, the lack of any

theoretical structure and the quest for categories of sufficient size for analysis, produces a wide range of definitions: Donnelly and Ivanevich (1974) use 90 days; Haines (1966) "several months"; Boone (1970) and Taylor (1977) three months; Peat, Gentry and Brown (1975) four months; Feldman and Armstrong (1975) the first 2,500 buyers and Arndt (1967) 16 days! Even if categorizations were consistent, it would be difficult to define time-zero from which measurements should be made. For example, many product introductions are accompanied by pre-distribution promotion, should adoption dates be measured from the start of promotion, or the national product launch, or local availability? Typically, researchers seem to have used national product launch, although pre-publicity may have been varied and extensive (e.g. Peterson, 1975).

This method still requires estimation of the date of adoption. For consumer goods, objective verification of adoption date (purchase receipts, warranty cards, etc.) may not be available, and is certainly difficult to access. Yet there is evidence that even well-educated, responsible, highly motivated individuals are not reliable sources of such dates. Coleman et al. (1975) find doctors consistently claiming to have adopted an innovative drug earlier than their prescription records show. As discussed above (2.1) the definition of adoption for a consumer good is by report first trial date, and be classified as an innovator; another user reporting the date of final committment to continuing purchases may be classified as a late adopter, even though both tried the product together.

2.3.2. Number of Innovations Adopted

Instead of locating adopters by date of adoption of a single inno-

vation (a time series approach), it is possible to identify them by the number of innovations adopted, (a cross-section approach, e.g. Summers 1971, 1972; Darden and Reynolds 1974; Green et. al 1973 etc.). This requires less recall --- presumably it is easier to remember ownership than date of acquisition --- and may elicit more truthful responses --- after all, there is an implicit threat of ownership verification.

It is worth considering whether these two measurement methods (time series and cross-section) will in fact identify the same individuals. Are those who adopt a single innovation soon after its launch, also likely to own more new products than the average consumer? Clearly, if an early adopter of one product is also an early adopter of others, then a count of innovations adopted will allow us to identify innovators just as well as date of adoption. The evidence is that these conditions hold only if the innovations considered are within the same product category (and non-substitutes.) Graham (1956), Robertson and Myers (1969) and Frank et al. (1964) all find innovativeness to be essentially monomorphic, confined to a single product category. That category can be fairly widely defined, however. Whyte (1954) shows overlap of innovators between air conditioners, and other household products, similarly Robertson (1966) finds overlap within "appliances".

It is also possible to weight ownership data by either the innovativeness of the products concerned, or by the date of product adoption. Rogers and Rogers (1961) suggest combining data sources using number of, and date of adoptions, however, Rossiter and Robinson (1966) indicate such weightings add little to the analysis.

Baumgartern (1975) developes an index of "aggregate popularity

growth" which he claims eliminates the need for the researcher to estimate "newness" subjectively. However, this index is simply the ratio of intending purchasers to owners in the sample. While this certainly ensures that "kooky" styles, as Baumgarten puts it, are down-weighted, it really is not a measure of newness. Presumably, highly innovative individuals own styles to which others do not yet even aspire. Such "innovators" would not be identified by Baumgarten's approach.

Alternatively, all definitions can be thrown back onto the subjects (or a sub-set of respondents, "judges"). The sociometric approach calls for respondents to rate one another, allowing an overall consensus scale of "innovativeness" to be estimated. In the absence of a sociometric census, simple self reports could be used although these would lack the face validity offered by calculation of consensus (i.e. there would be no check on the accuracy of an individual's self-assessment). Indeed Summers (1968) finds rather little correlation between such self-ratings and innovative product ownership.

2.3.3 Comparing Methods

Kohn and Jacoby (1973) make a direct comparison of innovativeness as measured by a) new product purchase on a simulated shopping trip, b) self-reported innovativeness and c) reported ownership of innovative products. All three measures are taken on the same sample of consumers. Inter-measure correlations are very low and the authors conclude that the three methods tap essentially distinct constructs. This seems the most explicit empirical comparison of measurement methods. However, Uhl et al. (1970) in a study of laggards, find initial time of purchase and number of

new grocery products purchased "give approximately the same results", and Rogers (1961) reports cross-sectional (i.e. product ownership) classifications correspond well with self-reports of innovativeness and with ratings of external judges. Midgley and Dowling (1978) in an important paper, take a theoretical perspective, pointing out that time of adoption (time series) classifications, particularly when they are usually innovation specific, are tautological. The first 2 1/2% to adopt a new strain of seed corn are innovators, and innovators of seed corn are the first 2 1/2% to adopt: "innovativeness is what we measure and what we measure is innovativeness" (op. cit. P. 234). Without a link to an external measure (e.g. of innovativeness per se, or of another product's adoption experience) such a classification scheme is futile. At least the cross-sectional measurement (number of innovations adopted) elevates innovativeness to a product category, rather a single item.

Midgley and Dowling also suggest that as adoption is closely connected with group processes, in particular communication (see Section 2.2 above), there is a strong random (probablistic) element in date of adoption. If adoption depends on personal communication (most research shows this to be the case for most individuals, e. g. Rogers and Shoemaker 1971) then the dates of receipt of information items will affect date of adoption. Yet for any single innovation, date of receipt of communications depends upon the path by which information reaches an individual. Midgley and Dowling suggest that although this path depends in part on the characteristics of the individual (e. g. their gregariousness, social integration, product interest, etc.) for any particular product adoption it is also crucially conditioned by a host of situational and essential stochastic factors.

Interpersonal communication on a particular topic, between a particular set of individuals, is by no means a certain event. As a result the chain of communication by which an individual receives sufficient information to lead to product adoption is highly influenced by chance. If innovativeness is conceived as a personal trait, Midgley and Dowling argue, it is inherently unsatisfactory to measure it by a single product adoption with its largely non-personal (situational) influences. Date of adoption of a single product is likely to be highly unreliable as a measure of innovativeness. The only exception would be for individuals who do not use personal communications as an information source. They will, presumably, tend to adopt new products consistently early (or late or whatever).

This led Midgley in earlier papers (Midgley 1976, 1977) to develop the concept of innate vs. actualized innovativeness. Innate innovativeness is presented as a personality trait, applicable across all product classes, involving the extent to which an individual "makes innovation decisions independently of the communicated experience of others" (Midgley 1977). Actualized innovativeness refers to observed innovative behaviour. The measurement of innate innovativeness will involve cross-section measures of adoption dates of several innovations, from a variety of product classes (if innate innovation is to be maintained as a multi-product concept) or yet to be developed pencil and paper tests.

The Midgley and Dowling paper is of interest for our study as it presents strong support for multiple measures of innovativeness and advances theoretical arguments to support the methodology adopted here. Whether innate innovativeness is applicable across product classes need not concern us here. Pragmatically, we are concerned with identifying future

(actualized) innovations of energy-conservation products. Innate innovativeness of energy-conservation products will be the key predictor. There is no reason, a priori, to expect innate energy-conservation-product-innovativeness to be any harder to measure than "general" innate innovativeness. In fact from the Midgley-Dowling model, if inter-personal communication is affected by product class (e.g. via an individual's product-class interest) then our product class version of innate innovativeness will be a better predictor of future innovation adoption in that product class than will generalized innate innovativeness.

2.4 CHARACTERISTICS OF THE INNOVATION

So far, although differences in individuals' adoption speeds have been discussed, no rationale has been suggested for differences in products' rate of adoption. Not all products, even within a single product class, diffuse at the same rate. Clearly the product itself plays a role; or the consumer's perception of the product itself:

> "The ease or difficulty of introduction depends on the nature of the 'new' in the new product -- the new as the customer views the bundle of services he perceives in the newborn" (Wasson 1960)."

Although much innovation research (particularly in rural sociology) concentrates on explaining, ex post, reaction to a single innovation, marketing usually has a more predictive intent. If we can identify the components of the customer's perception of the 'new' in one innovation we may be able to use such components in assessing the viability

of future innovations.

Rogers (1962) presents 5 characteristics of innovations, which are potential general dimensions of consumers' evaluation of the "new": relative advantage, compatibility, complexity, trialability and observability. However, Rogers cautions that "each of these five is somewhat interrelated with the other four, but they are conceptually distinct", also that "further research will certainly be necessary before (these) five characteristics of innovations .... can be accepted as the five most important". Ten years later, Rogers and Shoemaker (1971) are still cautious and point out that a general classification of innovations is an objective that "we have not reached" and "our postulate of 5 attributes is ..... empirically defenceless". Despite these clearly stated reservations the 5 Rogers attributed have gained universal acceptance, the only addition to the original 1962 list being the occasional inclusion of "perceived risk".

It is important to remember that the individual's perception is the key variable. A new product as perceived by consumers may be quite different from that intended by its producers. In all of the following, attributes of innovations should be considered as perceived by potential adopters. Unfortunately, some of the scant research on innovation attributes fails to measure consumer perceptions at all, using instead the perceptions of "experts" or "judges" (e.g. Kivlin 1960; Tucker 1961).

The only direct evaluation of Rogers attributes seems to be provided by Ostlund (1973). Ostlund uses depth interviews in an attempt to uncover additional relevant product attributes, but finds none. He suggests that Rogers' attributes overlap however, and presents factor analysis re number of factors extracted, or gives any indication of the variance ria for

explained by his factor solutions. Without this knowledge his results must be treated with extreme caution. Ostlund presents separate factor structures for each of 6 products; sometimes extracting 3, sometimes 2 factors. Although not identical from product to product. The first factor usually measures "Ease of Use and Value of Trial" with high loadings on relative advantage, trialability and perceived risk (negative). The second factor measures "complexity" with high loadings on complexity, observability (negative) and sometimes compatibility (negative). In three factor solutions the third factor is "Perceived Risk" with high loadings of perceived risk, compatibility (negative) and sometimes communicability (negative).

Ostlund also finds product perceptions much superior to predispositional and demographic/socio economic variables in explaining a "measure of innovative behaviour" -- what measures he completely omits to specify!

2.4.1 The Rogers' Innovation Attributes: Relative Advantage

This is a straightforward measure of the degree to which an innovation is superior to existing products or practice: "the intensity of the reward or punishment resulting from adoption", (Rogers and Shoemaker 1971. p. 139). Sub-dimensions of relative advantage are suggested as "economic profitability, low initial cost, lower perceived risk, decrease in discomfort, savings in time and effort and immediacy of reward" (op. cit.).

For the adoption of energy conservation products the "immediacy of reward" may be particularly relevant. Rogers and Shoemaker suggest that lack of immediacy of reward explains the slow adoption of preventive innovations (disease control, seat belts, etc.). Perhaps conservation products can only expect a perceived advantage <u>after</u> the adverse effects of

rising energy costs have been firmly felt.

Also Rogers and Shoemaker cite evidence that economic profitability may be of less importance in the adoption decisions of peasants and small-scale farmers than those of large-scale farmers: "limited skill with numbers, ... crude accounting schemes, and ... lack of finesse with the scientific method of reaching conclusions all act to limit comparing ability". The same points could be made regarding adoption of energy conservation products. Recognition of conservation cost-savings demand a cost-related approach to household expenses which in turn may be stimulated only by rising energy costs. Energy costs could increase both the saliency and the size of relative advantages. A further point of interest is the role of grants and incentives in enhancing relative advantage and thereby speeding adoption. Rogers and Shoemaker note that careful studies are lacking, but that the available data suggests adoption ceases with the incentive if at all possible.

For the non-cost-conscious other sub-dimensions of relative advantage may be more important, or behaviour may be affected more by the other 4 innovation attributes.

Finally, Rogers (1961) points out the role of crises in emphasizing relative advantage. It seems that crises may both increase the saliency of a pre-existing relative advantage and create or intensify a relative advantage.

2.4.2 Compatibility

This refers to the degree to which an innovation is "consistent with existing values, and past experiences of adopters" (Rogers 1961, p.

126). Later Rogers and Shoemaker (1971, p. 145) include "consistent with consumers needs" in their definition, this surely brings compatibility back to relative advantage: a product which is more compatible with needs is one with a relative advantage.

The most celebrated incompatibility with cultural values is probably instant coffee. Projective research showed use of this innovation to be associated with idleness and lack of caring. Interestingly direct questions caused respondents to attribute their rejection to taste (relative advantage), although blind taste-testing found the innovation to be superior (Haire 1950).

It is particularly important that an innovation be compatible with adopters' past experience with the product which the innovation intends to supplant. The long gestation period of the electric typewriter has been attributed to its incompatibility with previous product experience.

Compatibility leads to the idea of a "complex of innovations". Once a consumer has adopted one innovative item, others associated with it, may be more easily accepted. Presumably, a chain could be developed taking the consumer by small stages away from existing pracices. Rogers and Shoemaker report the small empirical base for this concept, although it is intuitively plausible. For energy conservation it might be possible to press the adoption of a minor innovation compatible with existing habits as a precursor to more substantive adoptions. (This concept of a complex of innovations also supports measurement of innovativeness on a cross-sectional basis, see section 2.3.2 above).

2.4.3. Complexity

This is the degree to which an innovation "is perceived as

relatively difficult to understand and use" (Rogers and Shoemaker 1971, p. 154) and is usually expected to retard adoption (however see Graham 1956).

2.4.4. Trialability

This is "the degree to which an innovation may be experimented with on a limited basis" (op cit p. 155), earlier termed "divisibility" (Rogers 1961, p. 131). It is suggested that this may be particularly important for earlier adopters, who have no prior user evidence on the innovation. In a sense later adopters can make vicarious use of early adopters' trials. In that Rogers and Shoemaker link trialability to reduction of risk, this concept overlaps with "perceived risk" often added as a 6th characteristic of new products (e.g. Ostlund 1974).

2.4.5. Observability and Communicability

This is "the degree to which the results of an innovation are visible to others" (Rogers and Shoemaker 1971, p. 155), earlier, and perhaps more appropriately, termed "communicability" (Rogers 1961, p. 132). Their poor scoring on this attribute tends to retard preventive innovations. A pre-emergent weed-killer diffused slowly because there were no dead weeds to display (Rogers and Shoemaker 1971) -- but presumably there was an absence of weeds, equally observable, but probably less communicable. For conservation oriented products this suggests that adoption is likely only <u>after</u> bills have risen: to reduce energy payments is more observable and communicable than preventing their increase. Also many energy savings are not readily observable by others (except perhaps for the effects of roof insulation in preventing the melting of heavy snow) and so diffusion might

be slow.

2.4.6 Predicting Individual Adoption

All the studies reported above attempt to predict aggregate adoption rates from perceived product characteristics: they relate aggregate perceptions and product penetration. Rogers and Shoemaker (1971) recommend the investigation of individual differences in perceptions as an important area for further research. Ostlund (1974) presents the first attempt to follow this up by looking at product perceptions as a predictor of an individual's product adoption.

Measurement timing is a major problem for any study of perceptions and buying behaviour. If perceptions are measured prior to purchase, they may change before the innovation is adopted: if perceptions are measured post-purchase they will reflect usage, dissonance reduction etc. Ostlund measures perceptions by ratings obtained in a laboratory study 12 months prior to new product launch. Two months after product launch the original sample was reinterviewed (60% response rate) and aided, and unaided, purchase recall data collected. A discriminant analysis using only the product perceptions data correctly identified 70% of those claiming to have purchased the product (i.e. "early adopters" in the sense of having tried the product in the first 2 months). Use of respondent psychographic and demographic data improved this hit rate by at most 1 percentage point.

Ostlund (1974) also reports a similar study using panel members. Perceptual data was gathered 6 months prior to product launch as part of an ad-testing procedure. Three months after launch this perceptual data was used to discriminate between those whose diaries showed a purchase of the

product and those who had not then adopted. Again hit rates in a holdout sample were high: 79% correctly classified by perceptions alone, personal characteristics added only 4 percentage points to this.

In both studies relative advantage (or one of its sub-dimensions) was the most important predictor, followed in one case by compatibility, complexity and perceived risk and in the other by perceived risk, complexity and aspects of compatibility. Both studies placed observability and trialability as of minor importance (although there are some differences in the first study for aided purchase recall).

Ostlund concludes that "the perceptions of innovations by potential adopters can be very effective predictors of innovativeness". Unfortunately, it is not at all clear that his data supports this. Ostlund has shown that buyers (albeit in the first 2-3 months after launch) have different perceptions than non-buyers. In order to relate this to innovativeness it would be necessary to collect further data, at intervals after launch, and ensure that perceptions of later adopters do in fact differ from those of earlier adopters. As it stands Ostlund's evidence merely confirms that those with favourable product perceptions are more likely to purchase!

Feldman and Armstrong (1975) investigate the effect of perceived characteristics on adoption of the rotary engined Mazda. They conduct mail interviews in California with samples of innovators and later buyers. Innovators are here defined as the first 2,500 to buy, later buyers as those buying in December, January and February, eighteen months after product launch. Only two of the 5 Rogers' innovation characteristics differ significantly between these two groups. Innovators, as Rogers expects,

perceive the innovation as less complex (i.e. express greater agreement with "I understand how this car works"). Innovators also perceive the product as more risky, contrary to Rogers scheme (Rogers 1961 p. 131). However, Feldman and Armstrong operationalize perceived risk (or divisibility as they term it) by extent of disagreement with "when I purchased this car, I had complete faith that the dealer would stand behind the warranty". As they point out their findings here are seriously undermined by measurement timing error. Innovators (who bought the car about 18 months previously) have had more than sufficient time to change their perceptions. In particular, warranty perceptions are likely to change considerably with post-purchase experience of using the warranty.

The second part of the Feldman and Armstrong analysis uses mail interviews with mid-West Toyota and Mazda buyers. The first 2,500 Mazda buyers in the mid-West are defined as innovators, and purchasers of comparable Toyotas in the same time period are termed non-innovators. The two groups differ significantly on all five of the Rogers innovation attributes (although perceived communicability is actually lower for the innovators, Mazda buyers). Unfortunately, like Ostlund (1974), Feldman and Armstrong have shown only that Mazda buyers hold generally more favourable perceptions of Mazda than non-buyers. The perceptions held by later adopters of Mazdas in the mid-West are unknown.

Peat et al. (1975), in a comment on Feldman and Armstrong, do collect data on a sample of later Mazda buyers. Although Peat et al. report no perceptual data, their findings on the demographic characteristics of innovators and later buyers are quite different from those of Feldman and Armstrong.

More recently, LaBay and Kinnear (1981) examine the perceptions of solar energy adopters, unaware non-adopters and aware non-adopters. Overall the aware non-adopters are more like adopters than unaware non-adopters. Product perceptions tend to be more favourable for the adopters, although few significant differences can be found between adopters' perceptions and those of aware non-adopters. Product perceptions can correctly classify 62% of the sample and overall perceptions provide better classifications than do demographic variales. Again there is the problem of comparing buyers vs. later adopters. Part of the perceptual differences recorded by LaBay and Kinnear is probably the result of solar energy owners having revised their product perceptions since making the purchase decision. So the product perceptions as reported by adopters may be the consequence rather than the cause of adoption. LaBay and Kinnear do look at the effect on adopters' perceptions of date of adoption. Recent adopters perceived solar energy systems as being significantly more compatible and involving less social risk. There were no other significant differences.

It is strange that the influence of product attributes on innovation adoption has received so little attention in the marketing literature. Although product perceptions are recognized as a major component of purchase decisions, little attempt has been made to test or refine Rogers' original, tentative, innovation attributes. Of the five marketing-based studies of product perception reviewed here (two by Ostlund 1974, and two by Feldman and Armstrong 1975 and one by LaBay and Kinnear, 1981) four really show that buyers differ from non-buyers and the remaining study (Feldman and Armstrong 1975) confirms the significance of only one of Rogers' 5 attributes (LaBay and Kinnear as discussed above also offer some

support for one of Rogers' attributes).

2.5 CHARACTERISTICS OF INNOVATORS AND EARLY ADOPTERS

Many studies have attempted to describe innovators and early adopters, collectively known as earlier adopters. Most of the relevant research originates in the classic rural sociology studies.

Innovators are distinguished by their "venturesomeness" or willingness to try new ideas (Rogers and Shoemaker 1971, page 183). A finding typical of the tautological definition of innovators as discussed above (Section 2.3.3). Early adopters are characterized as "more respectable" than innovators, and more likely to serve as role models for later adopters (op. cit., page 184).

Earlier adopters (innovators and early adopters) are also reported to be better educated; to have higher social status; to be more upwardly mobile; and to be wealthier than later adopters. They also tend to be better connected to the social system. In particular, there is evidence that earlier adopters have greater exposure to mass media and to interpersonal communications, and may be more likely to seek out information about innovations. Studies of the personalities of earlier adopters suggest they have more favourable attitudes to change, risk, science and education than later adopters, and tend to hold higher aspirations for education, occupation etc. (the many findings in this area are summarized in Rogers and Shoemaker 1971, page 184 et seq).

Unfortunately, these findings tend to be undercut by the absence of any real discontinuities in the distribution of innovators (see Section 2.3.1 above). As a result it is quite possible that a small change in the definition of "earlier adopters (in itself quite arbitrary) could radically

affect the differences discovered between this group and later adopters.

2.6 CHARACTERISTICS OF OPINION LEADERS

Another group which has been of primary interest is opinion leaders. Rogers and Shoemaker (1971) define opinion leadership as "the degree to which an individual is able to influence informally other individuals' attitudes or overt behaviour in a desired way with relative frequency". (p. 199). This leadership can either be positive and speed the diffusion of an innovation, or negative and retard diffusion.

Opinion leaders achieve their position in the communication process through their greater exposure to information sources. The two-step flow of communication model was developed following a study of the 1940 U.S. Presidential election (Lazarsfeld et al, 1944). It was found that information tended to flow first to a group of influentials in the community, who then passed on both the information and their influence or opinion to other members of their communication network. Subsequent research has suggested that the two-step flow model is too restrictive. The hypothesis that opinion leaders obtain information <u>only</u> from mass media sources, and that <u>only</u> opinion leaders obtain information from mass media, has been shown to be true only in certain situations. Rogers and Svening (1969), found opinion leaders used interpersonal channels to gain information about an innovation, if they were the most appropriate source. Furthermore, as the innovation became less "new", many later adopters received their information directly from the mass media rather than from opinion leaders. The interpersonal communication network of an individual may be a crucial factor in the study of opinion leaders. While the group of friends with whom one

would discuss any particular topic tends to be highly similar, some contact or "bridge" with other groups is necessary to introduce new ideas (see Section 2.2 above). Opinion leaders may provide that bridge between communications networks.

Several studies have attempted to relate opinion leadership to other variables. Typically, opinion leaders are found to be more cosmopolitan, to participate more socially, to be more exposed to mass media and to be of higher social status than non-leaders (see for example Rogers and Shoemaker 1971). In addition there is some evidence that opinion leaders are particularly likely to participate in activities connected with the innovations studied; to have a greater knowledge of new developments and to read more specialized print media (Corey 1971). Whether opinion leaders are also innovative has been found to depend on the norms of the social system in which they operate: innovative norms are associated with innovative opinion leaders, traditional norms have opinion leaders with no more than average innovativeness (see Section 2.2 above). Even with innovative norms opinion leaders are more likely to be early adopters than innovators. Corey (1977) finds 60% of his "early adopters" were also opinion leaders, as opposed to 17% opinion leaders in the total sample. Engel, Kegerreis and Blackwell (1969) find innovators perceive themselves as more active in information giving, and seek more information prior to product trial. Baumgarten (1975) found 12% of his sample could be classified as both opinion leaders and early adopters.

Although these findings suggest a definite relationship between opinion leadership and innovativeness, the association is by no means one to one. As opinion leaders are a key group to influence in order to speed

diffusion, it is essential to include direct measures of opinion leadership in addition to measures of innovativeness.

2.7 MEASURING OPINION LEADERSHIP

Opinion leadership can be measured in any of three ways: by sociometrics, by key informants or by self-reports. As discussed above (2.2), the sociometrics approach, resting on individual reports from interlocking individuals, although probably the most accurate method demands data collection by census from a small, well-defined area. Such a census is rarely possible in any but the most artificial circumstances (see for example Arndt 1967).

Key informants are only appropriate when there are clearly acknowledged experts whose judgements on the identity of opinion leaders will be accurate. In consumer oriented research such acknowledged experts are rarely available. Self-reported opinion leadership is really the only possible method for large-scale survey research. The method rests on the ability and willingness of respondents to identify their own degree of opinion leadership. Strictly speaking self-reports measure self-perceived opinion leadership, not actual opinion leadership.

Self-reports have been used, with varying degrees of sophistication and success, in a wide range of innovation studies. Several researchers have used undisguised, single (or at best two) item evaluations of opinion leadership (eg. Silk 1966; Abelson and Rugg 1959; Corey 1971; Pessemier et al. 1967). Indeed Pessemier et al. claim that "the standard question from the literature" is:

"Would you say you are more likely

about as likely or less likely than
any of your friends to be asked
your advice about ....."(Pessemier et al 1967)

However, more reliable, and better worded, scales do exist. The most widely used is a 6-item scale proposed by Rogers (1961 pg. 230), this appears in Table 2.6. Items 1, 4 and 5 are intended to measure perceptions of past behavior; items 2, 3 and 6 aim to measure "self-image".

The major advantage of the Rogers scale is its known reliability and validity. Rogers and Cartano (1962) estimate split-half reliability as .70; Silk (1971) finds rather higher figures of .84 and .77, depending on product class. Although .80 is often recommended as the minimum reliability for applied analysis (Nunnally 1967), at least the Rogers scale approaches that level and its reliability appears fairly consistent from one study to another.

Rogers (1961, pg. 232) also reports tests of convergent validity, finding his self-reported scale correlates .64 with opinion leadership as measured by key informants and .30 with sociometric measures. Silk (1971) points out that Rogers' scale in its original form is open to response set effects, i.e. tendencies for respondents to maintain a particular response style - "yea-saying". In particular the scale is unbalanced. In five of the six items the first response offered indicates opinion leadership. This is likely to stimulate "column-running", unthinkingly identical responses to all items. Although such a response style would provide reliability (all scale items would be consistent) it would not reflect respondents' true feelings (the scale would lack validity). Also the dichotomous responses required by the items may exacerbate missing data problems. Respondents who

1. During the past 6 months have you told anyone about a new farming practice?

2. Compared with your circle of friends a) are you more or b) are you less likely to be asked for advice about new farming practices?

3. Thinking back to your last discussion about some new farming practices
   a) were you asked for your opinion or
   b) did you ask someone else?

4. When you and your friends discuss new ideas about farming practices, what part do you play? a) mainly listen or b) try to convince them of your ideas?

5. Which of these happens more often, a) do you tell your neighbours about some new farming practice, or b) do they tell you?

6. Do you have the feeling that you are generally regarded by your friends and neighbours as a good source of advice about new farm practices?

TABLE 2.6 Rogers' 6 Item Opinion Leadership Scale

do not wish to take a firm position are forced to refuse items.

Silk also tests the discriminate ability of the Rogers' scale and finds it meets requirements quite well. However, there is a marked tendency for respondents to match item responses across product categories. Responses to an item when the item refers to "cooking" are highly correlated with responses to that same item when it applies to "furniture" This response effect could create an impression of generalized opinion leadership even though correlations of responses to different items (within the Rogers' scale) when referred to different product categories are fairly low. Our study will use a modified version of Rogers' opinion leadership scale, designed to remove the defects criticized by Silk.

2.8 Hypotheses from Literature Review

The literature review and discussion suggest the following hypotheses of particular relevance for this study:

H1 Early adopter definitions should be consistent, in particular early adopters as defined cross-sectionally (by the number of energy conservation products owned) should have higher than average self-rated innovativeness scores.

H2 Early adopters will be socio-demographically distinct from other consumers. In particular early adopters will tend to be better educated, have higher social status and higher incomes than the average consumer.

H3 Early adopters of energy conservation products are likely to be opinion leaders.

H4 Early adopters of energy conservation products are likely to be highly socially integrated.

H5 Early adopters of energy conservation products will tend to use mass media sources for information on energy conservation.

H6 Early adopters of energy conservation products will have distinctive attitudes towards energy consumption and conservation.

In particular they will see the individual as playing a major role in energy conservation.

H7 The five product attributes suggested by Rogers (1961) (relative advantage, compatibility, communicability, complexity, and trialability) should explain the overall evaluation of energy conservation products for both early adopters and for other consumers.

H8 Early adopters of energy conservation products will have distinctive perceptions of energy conservation products, even products which they do not own. In particular they will perceive energy conservation products more favourably, i.e. as having:

- greater relative advantage
- as being more communicable
- as being more compatible with existing household behaviours
- as being more trialable
- as being less complex

H9 Early adopters of energy conservation products will form their evaluations of new energy conservation products in a distinctive way. In particular they will have a longer horizon in product evaluation and be prepared to adopt products with a longer payback period than would the average consumer.

These last two hypotheses (H8 and H9) are aimed at discovering the reason for early adopters being early adopters. Compared to those adopting later, early adopters should perceive conservation products as having more favourable characteristics (e.g. higher relative advantage etc.) and/or they should translate any given set of product characteristics into a more favourable overall evaluation (e.g. any given level of relative advantage, complexity etc. could produce a more favourable evaluation for earlier adopters)

The results of testing these hypotheses are given in Section 10.0 of this report.

3.0 SURVEY METHODOLOGY

The purpose of this study is:

i) to develop and apply a questionnaire designed to identify early adopters of energy conservation technologies.

ii) to identify opinion leaders.

iii) to determine consumers' reactions to a set of conservation product concepts.

iv) to relate such reactions to the consumers' innovativeness.

The aim is to build a questionnaire which is solidly grounded in the large body of existing innovation literature, as reviewed above. Wherever possible we wish to use multiple measures (i.e. have several ways of measuring the key concepts of the study -- innovativeness, opinion leadership etc.) and to use scales with proven reliability. Unreliable items (i.e. items whose responses contain a considerable portion of random error) will conceal the relationships which we are trying to find, and will weaken the predictive power of our analysis (Nunnally 1967).

3.1 SURVEY MEDIA

As the literature review makes clear, innovation involves many complex concepts. It is at once apparent that telephone interviews are unlikely to allow sufficiently detailed data collection. The major choice is between personal interviews and mail interviews. Several factors led to mail interviews being conducted.

First, personal interviews, professionally conducted, would be extremely expensive in this case. This study is particularly interested in

identifying innovators, or early adopters, of energy conservation products. By definition this is a low incidence group (see 2.3.1 above). Very little is known of their demographic characteristics and we were unable to discover any usable sampling frame directly relevant to this group. Any data collection method will face a contact problem: many approaches must be made to contact a few qualified respondents. Personal interviews have a high contact cost, mail interviews a low contact cost (really only printing, stuffing and postage). Mail interviews are therefore highly cost efficient in this case.

Second, the major drawback of mail interviews -- their low response rate -- is not of crucial concern in this study. In fact there is reason to believe that a low response rate may improve the study's efficiency. Our aim is not to produce a random sample of the population of Montreal and Winnipeg, if it were, mail surveys' low response rates would endanger the study. Instead we wish to develop a picture of a specific subset of the population: innovators and early adopters of energy conservation technologies. It is known that individuals are more likely to respond to a survey if they are interested in the topic of the survey (eg. Erdos 1974). By clearly signposting that the questionnaire has to do with energy conservation we should be able to increase the probability of those interested in energy conservation responding, and effectively over-sample the rare group (innovators and early adopters) with which we are concerned. Of course, the sample we obtain is unlikely to be representative of all households. And it will not necessarily provide good estimates of the true incidence of innovators and early adopters in the population. However, there is every chance that the innovators and early adopters that respond will be fairly typical

of innovators and early adopters. The only bias suggested in the mail survey literature that might affect us here is a bias against low literacy groups and members of large families. To the extent that these groups tend not to respond to mail surveys, they may be underrepresented amongst our innovators and early adopters. Fortunately, there is nothing in the literature on innovations to suggest that such groups play a particularly major role in the adoption of innovations so this bias is unlikely to be important.

Third, many of the questions to be used in measuring innovativeness (eg. the time of adoption measures) and in measuring household characteristics (eg. size of heating bills) require some consideration on the part of the respondent and may involve consulting purchase records, utility bills etc. Mail interviews provide the best environment for considered answers.

Finally, the loose ends identified in the literature review notwithstanding, there are a wide array of well-developed, tested and standardized measures of innovativeness, opinion leadership, product characteristics etc. Thus the power of personal interviews to collect unstructured data, or to allow measures to be adapted to respondent's conditions, is not really required. Were the area less well-developed, or were existing measures shown to be inapplicable to energy conservation products there would be a strong argument for personal interviewing. As it is, prudence demands that existing methods be tested <u>before</u> expending resources on alternatives that may not be necessary.

Having focussed on mail interviews, there are two alternatives open. Interviews can be conducted with a sample of households in the chosen

cities, or an existing mail panel can be used. The mail panel assures a higher response rate for the survey (typically 70 - 80% of members respond) by virtue of having screened out likely refusers when the panel was originally recruited (up to 90% of those contacted refuse to join a panel) and also by motivating panel members using a variety of inducements. Unfortunately, panel members may well be an atypical for our purposes. Although panels can be balanced (i.e. made representative) on any, or all, demographic characteristics, several panel organizers voiced a suspicion that their panels might under-represent innovators, although no hard evidence on this is available. Furthermore, as discussed above, response rate is of secondary consideration in this study. Accordingly, mail interviews were conducted with a sample of home-owners in Winnipeg and Montreal. The Institute of Behavioural Research, York University was sub-contracted to draw the samples, translate the questionnaire and conduct all fieldwork.

As this study was being prepared, parallel research was being designed and conducted at the University of Manitoba by Wharton and Cullen (see Wharton et al 1981). The methodology and findings of this research are summarized in Appendix B.

3.2 THE QUESTIONNAIRE

Eight versions of the questionnaire were employed: 2 rotations and 2 manipulations x 2 languages. All eight versions of the questionnaire (and the relevant covering letters) appear in Appendix A. For convenience we discuss Version 1 English first.

From the outset the topic of the questionnaire is clear. As discussed above those not interested in energy conservation are unlikely to be

in our target and need not be encouraged to respond. Question 1 asks for ownership, and time since acquisition of each of 11 energy conservation products. The products were chosen to span a range of innovativeness from "storm windows or doors" to "solar power unit". This question allows respondents' innovativeness to be measured cross-sectionally (by number of products owned), weighted cross-sectionally (by number and newness of the products) and by time series (by time since adoption). In addition the time series measure can be tested across products (eg. were early buyers of heat pumps also early buyers of shower flow restrictors).

Question 2a) identifies information sources used by the respondent. Answers to this question will help to describe innovators and, particularly, opinion leaders (see 2.6 above). Questions 2b through 2g form a standard scale to measure opinion leadership. It is an adaptation of the Rogers' scale (discussed above 2.7) having been balanced as suggested by Silk (1971) so that opinion leadership is indicated by making the response given <u>first</u> to items 2b, 2c, 2f and 2g but the respond given <u>second</u> to items 2d and 2e.

Questions 3 and 4 are basic, undisguised, measures of conservation practice and motivation to conserve, respectively. Question 5 includes items designed to measure a variety of concepts. The items are randomly ordered to ensure that order effects do not pollute any particular concept. Items 5a, 5c, 5i and 5m are designed to measure social integration: suggested in the literature as an important influence on innovativeness (see Section 2.2). Items 5b, 5d, 5f, 5q and 5j measure response set, or "yea-sayings". The items are drawn from the YN2 scale as summarized in Wells (1968). It has been suggested that those who rate themselves as

highly influential (opinion leaders) tend to be yea-sayers (Bylund and Sanders 1967, Silk 1971).

Items 5h, 5k, 5n, 5g and 5r are designed to measure self-reported innovativeness. In particular 5h and 5k are suggested as measures of generalized innovativeness by Midgley and Dowling (1978), see discussion above in Section 2.3.3.

Items 5e, 5l, 5o, and 5p provide a measure of attitude to energy conservation and are based on the measures used in an earlier personal interview study conducted by Wharton et al. (1981).

Pages 4, 5, 6, and 7 of the questionnaire elicit respondents' perceptions of four product concept statements. These product concepts are rated on items measuring each of the 5 product attributes deemed by Rogers (1962) to be relevant to diffusion (see 2.4 above). Items g, j, l, m and n measure perceived relative advantages; items b, d and i measure observability/communicability; items a, f and o measure complexity; item c measures triability and items e, k and h measure compatibility. Item p measures prior awareness of the product and q and r are measures of the acceptability of the concept.

The four product concepts administered to each respondent were designed to span a range of values on Rogers 5 product attributes. Each concept was administered at one of two levels and the order of presentation of the concepts was reversed in half the questionnaires. The level of concept and the order of presentation were randomly assigned within cities.

Table 3.1 shows the product concepts used. Table 3.2 indicates the expected score for each concept on the Rogers attributes. The manipulations focussed on two aspects of relative advantage: price and payback

period. And on two aspects of compatibility: compatibility with lifestyle and compatibility in installation. Respondents evaluations of each concept's acceptability will allow us to relate product characteristics to product acceptance.

This product concept procedure has a number of methodological strengths. First, the product concepts are used to assess the perceptions and evaluations of early adopters and of other respondents. They are not used to define early adopters. As we saw in the literature review (Section 2.4.6 above) previous research used the same product both to define early adopters and to compare their perceptions with those of later adopters (or usually non-adopters). This confounds the effect of being an early adopter with that of being a product owner. Previous research (in particular Ostlund 1974; Feldman and Armstrong 1975; and LaBay and Kinnear 1981) cannot distinguish between perceptual differences that are the result of being early adopters and those that are the result of being product owners. For obvious reasons product owners tend to report favourable perceptions of products they own, whether these perceptions are the cause or effect of ownership is undecided.

Our approach of defining early adoption by ownership of one set of products and product perceptions by responses to a different set of products at least mitigates the problem. Some confusion is still present in that early adopters are probably more likely to be owners of the products described in the product concepts. Indeed we deliberately allow the set of products used for early adopter definition to intersect that used for perceptions (the shower flow restrictor is common to both groups) to provide the opportunity to assess the effect of ownership relative to that of early

adoption (although this comparison is outside the scope of this report).

Second, the product concepts involve a mixture of replicated and repeated measurements. It would clearly be methodologically unsound to invite a single respondent to rate both a $10 and a $20 light bulb. Such a comparison would be unrealistic and invalid. If we are to make a realistic assessment of the effect of price in this case we use a replicated measure: one individual rates the $10 light bulb, another rates the $20, results are analyzed across individuals (across replications). Unfortunately replicated measures are expensive. More treatments require a larger sample. In order to maximise cost efficiency without jeopardizing methodology, we use a mixture of replication and repeated measures. Direct manipulations are only performed by replication. So whenever we have two product concepts differing only on a single attribute ($10 vs $20 light bulb; 1 year vs. 2 year payback for the energy monitor etc.) each individual rates only one of the concepts. But to increase cost efficiency, indirect manipulations are made by repeated measurement. So each individual rates 4 product concepts which differ on a variety of attributes (light bulb, energy monitor, solar economizer, showerflow restrictor etc.) This design removes the gross biases of repeated measure on highly similar concepts. The only cost is that some comparisons across product attributes are confounded with product differences. To compare large changes in price, say from $10 to $465 we have to compare from a light bulb to a solar economizer. Greater price manipulation within the same product concept would be methodologically desirable but would require replicated measures and a concomittant increase in sample size and cost.

The final section of the questionnaire (pages 8-10) gathers basic

socio-demographic data on the respondent, their family and their residence (i.e. type of home, number of rooms, orientation etc.). Item 24 asks for approximate annual heating costs and deliberately offers a "Don't Know" response. The aim is to test knowledgeability of heating costs, in addition to collecting data on cost levels.

1. LIGHT BULB:

Either:

The energy efficient light bulb, not available to the public until at least 1982, has an energy efficiency three times that of currently available bulbs and will last up to four times longer. The new bulb will be about the same size as conventional bulbs and will fit all regular sockets. The new bulbs will retail for $10 each. The makers state that, depending on usage, consumers will recover the price of the bulb in electricity savings within about two years of normal use.

Or:

The energy efficient light bulb, not available to the public until at least 1982, has an energy efficiency three times that of currently available bulbs and will last up to four times longer. The new bulb will be about the same size as conventional bulbs and will fit all regular sockets. The new bulbs will retail for $20 each. The makers state that, depending on usage, consumers will recover the price of the bulb in electricity savings within about two years of normal use.

2. ENERGY MONITOR:

Either

This is an electronic device that continually monitors a household's energy usage. It allows you to set an energy budget and will flash a warning if the budget is exceeded. Its digital display can show any of 7 items of information: current $ cost of energy used, projected $ amount of next energy bill, $ amount of last energy bill, billing date, energy budget set, date and time of day. The energy Monitor is expected to sell for $295 and its makers state that some users will be able to reduce energy bills by at least that amount within one year.

Or

This is an electronic device that continually monitors a household's energy usage. It allows you to set an energy budget and will flash a warning if the budget is exceeded. Its digital display can show any of 7 items of information: current $ cost of energy used, projected $ amount of next energy bill, $ amount of last energy bill, billing date, energy budget set, date and time of day. The energy Monitor is expected to sell for $295 and its makers state that some users will be able to reduce energy bills by at least that amount within two years.

TABLE 3.1 PRODUCT CONCEPTS USED (contd. on next page)

3. SOLAR ECONOMISER:

Either:

The solar economiser uses the principle of solar heating. It is a solar panel attached to the outside of the home, under a window (preferably on a southern exposure). Cool air is drawn from the room into the solar panel, there it is heated by the sun and recirculated back into the room. The solar economiser can be installed by the average homeowner. The solar economiser costs $465 and its makers state that, depending on usage conditions, the unit will pay for itself within 3 years.

Or

The solar economiser uses the principle of solar heating. It is a solar panel attached to the outside of the home, under a window (preferably on a southern exposure). Cool air is drawn from the room into the solar panel, there it is heated by the sun and recirculated back into the room. The solar economiser requires expert installation. The solar economiser costs $465 and its makers state that, depending on usage conditions, the unit will pay for itself within 3 years.

4. SHOWER FLOW RESTRICTOR

Either

The shower flow restrictor is a pipe segment added between the shower pipe and the shower head. It cuts water flow and thus reduces the amount of hot water used. The shower flow restrictor costs about $5 and the makers state that, depending on usage habits, it may pay for itself in 3 months.

Or

The shower flow restrictor is a pipe segment added between the shower pipe and the shower head. It cuts water flow and thus reduces the amount of hot water used. There is some reduction in shower quality. The shower flow restrictor costs about $5 and the makers state that, depending on usage habits, it may pay for itself in 3 months.

TABLE 3.1 Contd. PRODUCT CONCEPTS USED.

Concept:		Manipulation:	Relative Advantage	Compatib-ility	Complex-ity	Trial-ability	Observa-bility
Light Bulb	-	$10	Better	High	Low	High	Low
	-	$20	Worse	High	Low	High	Low
Energy Monitor	-	2 yr payback	Worse	Low	High	Low	Medium
	-	1 yr payback	Better	Low	High	Low	Medium
Solar Economizer	-	self-installation	?	Better	High	Medium	High
	-	expert installation	?	Worse	High	Medium	High
Shower Flow Restrictor	-	reduces shower quality	?	Worse	Low	High	Low
	-	no change in shower quality	?	Better	Low	High	Low

TABLE 3.2 EXPECTED PRODUCT CONCEPT SCORES ON ROGERS ATTRIBUTES

4.0 SURVEY RESULTS

4.1 Response Rates

5186 questionnaires were mailed to a random sample of homeowners in Winnipeg and Montreal in the last week of December 1981. By the cut-off date (February 2, 1982) 1022 usable questionnaires had been received: 549 from Winnipeg and 473 from Montreal. Table 4.1 shows mail out and response rates by language and city. Overall response rate was 19.7%. The response rate for French questionnaires (14.2%) was considerably, and significantly, below that for English questionnaires (23.6%). And the response rate for English questionnaires in Montreal (31.7%) was significantly higher than that of any other group.

It must be remembered that a high response rate (on a per questionnaire mailed basis) was not required for this study. It was intended that response should be skewed towards "energy conservation concerned" households and towards energy conservation innovators. To the extent that the sample receiving questionnaires (homeowners) covers households not in the target population (i.e. not energy conservation concerned homeowners), a low response rate is expected. Furthermore the lower French language response could be explained if households receiving French questionnaires in Montreal were in fact less likely to be "energy conservation concerned homeowners" than households receiving English questionnaires, for cultural or demographic reasons.

The success of the study in skewing responses towards energy conservation innovators is shown in Table 4.2. This table compares ownership of a range of energy conservation products in our sample with the best available national estimates (usually trade guesstimates). Sample

	CITY		
	Winnipeg	Montreal	TOTAL
QUESTIONNAIRES MAILED			
English	2500	536	3036
French	2[b]	2148	2150
TOTAL	2502	2684	5186
USABLE QUESTIONNAIRES RETURNED			
English (response rate)[a]	547 (21.9%)	170 (31.7%)	717 (23.6%)
French (response rate)	2[b]	303 (14.1%)	305 (14.2%)
TOTAL (response rate)	549 (21.9%)	473 (17.6%)	1022 (19.7%)

TABLE 4.1 RESPONSE RATES BY CITY AND LANGUAGE

[a]The figure in parenthesis shows the response rate, here defined as (usable questionnaires returned) ÷ (questionnaires mailed).

[b]It was not intended to mail French questionnaires in Winnipeg, these 2 respondents requested and returned French questionnaires.

PRODUCT OWNERSHIP
WITHIN SAMPLE

PRODUCT	WINNIPEG	MONTREAL Anglo-phone	MONTREAL Franco-phone	TOTAL SAMPLE	NATIONAL ESTIMATED OWNERSHIP
Solar Power Unit	.8%	1.6%	.4%	.8%	
Diesel Engined Car	1.0%	5.4%	1.2%	1.8%	
Heat Pump	1.9%	4.9%	8.5%	4.3%	.5-2%
Water Heater Timer	10.0%	4.9%	9.3%	8.6%	
Showerflow Restrictor	13.5%	17.3%	8.9%	12.7%	
Microwave Oven	21.0%	11.4%	6.6%	14.8%	9%
Setback Thermostat	28.1%	31.4%	20.5%	26.3%	5-10%
Portable Electric Space Heater	36.7%	47.6%	29.3%	36.9%	
Storm Windows or Doors	89.8%	93.0%	90.4%	90.6%	45-50%

TABLE 4.2 PRODUCT OWNERSHIP BY CITY AND LANGUAGE AND CANADIAN COMPARISON

ownership, in both cities, is much higher than national figures would suggest. Clearly the low response rate per questionnaire mailed has skewed the sample as desired.

It should be noted that in this study, as in any other having less than a 100% response rate, significance tests must be interpreted with caution. Significance testing rests on the assumption that questionnaires returned constitute a random sample from the target population. Although there is no reason to suspect that returns are not a random sample of "energy conservation concerned" households, this is an untestable assumption.

4.2 Sample Composition

Table 4.3 gives a comparison of our sample with 1971 Census results for Winnipeg and Montreal. As our target population was intentionally restricted to homeowners the sample achieved is clearly upscale of the general population. In both Winnipeg and Montreal the proportion of our sample who live in single detached houses is much larger than in the population as a whole (95% versus 63% in Winnipeg; 79% versus 24% in Montreal). The Montreal sample is older than the general population of Montreal and anglophones are more heavily represented (40% in our sample versus 22% in the population of Montreal).

Comparing the Montreal and the Winnipeg samples, the Montreal sample tends to be more educated (44% with a University education versus 24% in the Winnipeg sample). And the Montreal sample has higher incomes (median household income is over $40,000 in the Montreal sample

TABLE 4.3: SAMPLE CHARACTERISTICS

	PRINCIPAL DEMOGRAPHICS OUR SAMPLE:				1971 CENSUS POPULATION STATISTICS*	
	Winnipeg		Montreal		Winnipeg	Montreal
Population:					540,265	2,743,210
Sex of person filling in questionnaire:						
male	86.7%		85.1%		48.8%	49.0%
female	13.3		14.9		51.2	51.0
	100.0		100.0		100.0	100.0
Age of person filling in questionnaire:						
under 25	.9		0.4		7.2	5.2
25 - 34	21.9		11.1		22.5	24.9
35 - 44	28.4		29.6		21.4	25.0
45 - 65	36.0		52.0		35.6	35.4
over 65	12.8		6.9		12.6	9.5
	100.0		100.0		100.0	100.0
Occupation of person filling in questionnaire:						
professional	27.2		31.2			
managerial	17.2		32.5			
sales	6.7		8.0			
service	12.9		8.9			
blue collar	13.5		2.0			
clerical/secretarial	5.0		4.3			
not working	17.6		13.2			
	100.0		100.0			
Language spoken (mother tongue in census):						
French	15	2.8	259	55.4	5.7	66.0
English	505	93.0	185	39.5	71.0	21.7
Other (includes "English & French")	23	4.2	24	5.1	23.3	12.3
		100.0		100.0	100.0	100.0

cont'd.

TABLE 4.3 CONT'D.

	PRINCIPLE DEMOGRAPHICS OUR SAMPLE:		1971 CENSUS POPULATION STATISTICS*	
	Winnipeg	Montreal	Winnipeg	Montreal
Respondent's Education:				
Elementary	10.7	5.1		
Secondary	43.1	22.8		
Technical/Senior College	22.7	27.7		
University	23.5	44.4		
	100.0	100.0		
Income				
under $10,000	4.9	2.6		
$10,000 - 19,999	18.8	9.4		
$20,000 - 29,999	26.8	15.5		
$30,000 - 39,999	24.0	17.4		
$40,000 - 49,999	13.1	19.6		
$50,000 - 59,999	4.6	14.6		
over 60,000	7.8	20.9		
	100.0	100.0		
Type of dwelling:				
single, detached house	94.7	79.0	63.0	23.7
apartment	.4	.6	32.0	50.0
duplex, triplex or 4-plex	3.1	17.3		
other (includes rowhouses)	1.8	3.0	5.0	25.6
	100.0	100.0	100.0	100.0
Ownership class:				
own outright	43.0	42.6	59.0	35.2
mortgage	56.5	57.0		
other	.6	.4		
	100.0	100.0		

cont'd.

TABLE 4.3 CONT'D.

	PRINCIPAL DEMOGRAPHICS OUR SAMPLE:		1971 CENSUS POPULATION STATISTICS*	
	Winnipeg	Montreal	Winnipeg	Montreal
Type of fuel used:				
oil	3.6	70.7		
natural gas	91.5	3.5		
electricity	4.5	25.2		
wood	.4	.7		
	100.0	100.0		
Direction house faces:				
north	24.1	26.6	n.a.	n.a.
south	29.8	26.6		
east	21.7	25.1		
west	24.4	21.6		
	100.0	100.0		

*SOURCE: Census of Canada, 1971, Population, Household and Family Characteristics, Census Metropolitan Statistical Areas, Statistics Canada, Ottawa.

and just under $30,000 in the Winnipeg sample), and is older with a greater preponderance of professionals and managers. These differences are explained by the generally lower incidence of homeowners in the population of Montreal (see Table 4.3), making home-ownership a more upscale feature. Other measures suggest the samples are random. For example the percentage of homes facing north, south, east and west are as expected approximately equal.

Table 4.4 compares anglophones and francophones in our Montreal sample. Statistics Canada does not publish comparable data. It is clear that the anglophones in our Montreal sample come from higher income groups (median income greater than $50,000 for anglophones, versus about $35,000 for francophones) and higher occupational and educational levels than the francophones. These statistics for Montreal anglophones are also significantly upscale from the Winnipeg sample. A larger proportion of the Montreal anglophone sample live in detached houses versus duplexes or apartments (94% of anglophones live in detached houses, 70% of francophones).

A comparison of ownership of energy conserving products is given in Table 4.2 above. Ownership of heat pumps is higher in the Montreal sample, while the Winnipeg sample owns more microwave ovens. Montreal francophones report particularly low ownership levels for microwave ovens, setback thermostats and showerflow restrictors. Montreal anglophones have a relatively high ownership of diesel-engined cars.

TABLE 4.4: MONTREAL SAMPLE ANGLOPHONES AND FRANCOPHONES

	Anglophones (n=182)		Francophones (n=258)	
Occupation:	%		%	
Professional	42.9		23.5	
Managerial	35.8		31.1	
Sales	6.6		9.2	
Service	2.2		13.2	
Blue collar	1.1		2.8	
Clerical/Secretarial	1.1		5.6	
Not working	10.4		14.8	
	100.0		100.0	
Education:	%		%	
Elementary	2.2		7.4	
Secondary	14.8		29.1	
Tech/Senior College	22.0		31.0	
University	60.1		32.6	
	100.0		100.0	
Income:	%	Cumulative %	%	Cumulative %
Less than $10,000	2.2		2.8	
$10,000 - 19,999	3.9	6.1	11.5	14.3
$20,000 - 29,999	5.0	11.1	23.4	37.7
$30,000 - 39,999	17.9	29.0	19.1	56.8
$40,000 - 49,999	19.0	48.0	19.8	76.6
$50,000 - 59,000	17.3	65.3	12.7	89.3
over 60,000	34.6	100.0	10.7	100.0
	100.0		100.0	
House type:		%		%
single, detached house		94.0		69.7
duplex, triplex or 4-plex		3.3		25.6
apartment		.5		.8
other (includes rowhouses)		2.2		3.9
		100.0		100.0
Home ownership:		%		%
own		38.2		46.6
mortgage		60.7		53.4
other		1.1		.0
		100.0		100.0

4.3 Summary

Overall response rate was 19.7%. The response rate for the French questionnaire was significantly lower than that for the English questionnaire. Low response is not necessarily a drawback for this study as we seek to identify a particular group - early adopters of energy conservation products - rather than produce a random sample of the entire population. The survey procedure was certainly successful in skewing the sample towards energy concerned individuals. Ownership of energy conservation products within the sample was 2-4 times higher than estimates of ownership in the Canadian population as a whole. Consistent with these high ownership levels, and with targetting homeowners, the sample is considerable upscale of the population of Winnipeg and Montreal. This is particularly apparent in the Montreal anglophone sample. However, on variables not connected with homeownership (e.g. direction home faces, etc.) the sample appears unbiased.

5.0 DEFINING EARLY ADOPTERS

As discussed in the literature review (Section 2.3) there are three methods of defining innovators. Cross-sectional methods count the number of innovations adopted; time series methods look at the date of adoption of a single innovation; self-report methods use individuals' ratings of their own innovativeness. Although all three methods can be used here, we concentrate on cross-sectional definitions. As reviewed in Section 2.3, cross-sectional definitions have the attraction of spreading an individual's innovativeness measure over several products and so reducing the likelihood of being misled by chance early, or late, adoptions. This is particularly important to our study for four reasons.

First, some energy conservation products may be adopted for non-conservation reasons (e.g. a microwave oven although conserving electricity may be adopted primarily for convenience). Second, some energy conservation products may not be adopted by an innovative household because the product is not appropriate for that household (e.g. a heat pump is difficult to adopt for a high rise apartment owner), or because current equipment does not yet require replacement. Third, some households adopt energy conservation products on moving into a new home. If our definition of innovation were confined to a single product we could not be confident that the availability of that product in the new home was at all salient to the individual. By looking at ownership of a number of products we at least improve the probability that the energy conservation implications of the new home were recognized by the household. Whether product adoptions on moving into a new home in fact differ form the more

active adoption of products for existing homes is a topic for further research. Finally, there are marked differences within our sample in the ownership of particular products which may be culturally based. For example, ownership of microwave ovens is much lower in Montreal than in Winnipeg (Table 4.2). Definition of innovativeness on a single product basis could introduce an unnecessary cultural bias.

Ownership data was specifically requested for the 9 products listed in Table 4.2. In addition respondents were asked whether they had "improved" their weatherstripping and insulation levels. Data on these two activities was ambiguous because of the word "improved". It was possible that no improvements had been made simply because existing levels of weatherstripping and insulation were adequate. As a result weatherstripping and insultation were not included in any of the analyses.

Respondents were also invited to write in up to two "other energy conservation products owned". The high motivation level of the sample is reflected in the fact that 26% of respondents used these write-in facilities. The write-ins were carefully scrutinized, irrelevant comments (less than 2% of all write-ins), and comments relating to energy conservation activities (e.g. turning off lights, setting back the thermostat) rather than energy conservation products were eliminated. The remaining write-in comments are summarized in Appendix C.

There are now a number of ways of calculating the number of products owned by household. We can look only at products purchased (as opposed to those "in home when bought"); we can look only at the eight products listed in Table 4.2 (and ignore write-ins); we can measure product ownership at any point in time (i.e. look at all products owned,

or those owned for more than 5 months, or those owned for more than 11 months, etc.).

First, dealing with write-in products, writing-in products did not appear to be a response-style effect. The percentage of respondents using the write-ins was approximately the same for anglophones and francophones, and in both cities. Furthermore, the vast majority of write-ins were acceptable as energy conservation products. Accordingly write-ins were included in determining number of products owned.

Table 5.1 shows the correlation between number of products owned using either purchases only or purchases and "in-home when bought", and calculated at different points in time. All the measures are fairly closely correlated (suggesting a fairly close relationship between cross-sectional and time series measures of innovativeness). Only when ownership is measured on the basis of products owned for at least 5 years do correlations fall drastically, and this is primarily due to the number of individuals having zero scores on that basis. Therefore it was decided to use total number of products owned now and to include write-ins and in home when bought as the base measure of product ownership.

Table 5.2 tabulates the total number of products owned against city and language. In both test cities, and for both francophones and anglophones, there is a marked rise in ownership in going from "4 or more products" to "3 or more products". 17% of the sample reported owning 4 or more products whereas 42% reported owning 3 or more products. Although francophone ownership is somewhat lower the same discontinuity occurs at the "4 or more point". As a result owning 4 or more products was adopted as the criterion for being an early adopter. Using this definition identifies 170

TOTAL PRODUCTS OWNED

		INCLUDING "IN HOME WHEN BOUGHT"					EXCLUDING "IN HOME WHEN BOUGHT"			
		Now	Over 5 mths	Over 11 mths	Over 2 yrs	Over 5 yrs	Now	Over 5 mths	Over 11 mths	Over 2 yrs
INCLUDING "IN HOME WHEN BOUGHT"	Now	1								
	Over 5 mths	.9	1							
	Over 11 mths	.8	.9	1						
	Over 2 yrs	.7	.8	.9	1					
	Over 5 yrs	.4	.4	.5	.5	1				
EXCLUDING "IN HOME WHEN BOUGHT"	Now	.7	.5	.5	.4	.5	1			
	Over 5 mths	.6	.6	.6	.4	.5	.9	1		
	Over 11 mths	.6	.6	.6	.5	.5	.9	.9	1	
	Over 2 yrs	.5	.5	.6	.6	.6	.8	.8	.9	1
	Over 5 yrs	.3	.4	.4	.5	.8	.6	.6	.7	.8

TABLE 5.1 CORRELATIONS BETWEEN ALTERNATIVE PRODUCT OWNERSHIP MEASURES

NUMBER OF PRODUCTS

OWNED

		Own no energy conservation product	Own[1] 1 or more	2 or more	3 or more	4 or more	5 or more	6 or more
WINNIPEG:		20	529	401	243	98	35	5
			96.4%	73.0%	44.3%	17.9%	6.4%	.9%
MONTREAL:	Anglophones	3	182	154	82	34	17	9
			98.4%	83.2%	44.3%	18.4%	9.2%	4.9%
	Francophones	13	246	164	89	33	6	1
			95.0%	63.3%	34.4%	12.7%	2.3%	.4%
	Other	1	28	20	14	5	2	-
Montreal	Total	17	456	338	185	72	25	10
			96.4%	71.5%	39.1%	15.2%	5.3%	2.1%
	TOTAL	37	985	739	428	170	60	15
			96.4%	72.3%	41.9%	16.6%	5.9%	1.5%

[1]Out of 9 listed and up to 2 written in.

TABLE 5.2 NUMBER OF ENERGY CONSERVATION PRODUCTS OWNED BY CITY AND LANGUAGE

respondents as early adopters, 72 in Montreal and 98 in Winnipeg.

5.1 CHARACTERISTICS OF EARLY ADOPTERS: DEMOGRAPHICS

Examination of the demographic differences between early adopters and non-early adopters is clouded by a marked tendency for early adopters to be anglophone (18% of anglophones are early adopters vs. 13% of francophones). This difference is not quite significant at the 5% level. This also means that more early adopters are from Winnipeg (18% of the Winnipeg sample are early adopters vs. 15% of the Montreal sample), but notice that amongst anglophones city does not affect incidence of early adoption (18% of Montreal anglophones are early adopters). In order to prevent anglophone characteristics being confused with early adopter characteristics it is necessary to analyze the data controlling for city and language. Unfortunately such control reduces cell size to such an extent that statistically significant effects are very difficult to discover.

Both francophone and anglophone early adopters tend to be slightly older (average early adopter is 48, average non-early adopter, 47); to have higher incomes (18% of early adopters report household incomes in excess of $60,000 vs. 13% of non-early adopters) and to live in single, detached houses (91% of early adopters vs. 87% of others). Anglophone early adopters, tend to have post-high school education (64% of anglophone early adopters vs. 54% of non-early adopters); for francophones this effect is reversed. Although these differences are not quite significant at the 5% level, they do suggest that early adopters are slightly upscale of an already very upscale sample. If we compare early adopters to the population profiles of Montreal and Winnipeg (see section 4.2 above) they are clearly

and significantly different. Yet being upscale is not sufficient to define early adopters, as we see many non-early adopters are almost as upscale. For a more distinctive description of early adopters we need to look at attitudinal variables. Hypothesis H2 (see Section 2.8) that early adopters be demographically distinct, gets only limited support.

5.2 CHARACTERISTICS OF EARLY ADOPTERS: ATTITUDINAL VARIABLES

5.2.1 Reliability

Before comparing early adopters on attitudinal scales it is necessary to evaluate the scales themselves. In particular, we need to be confident that scales are reliable (i.e. relatively free from random error). The basic test used here is Cronbach's alpha, widely accepted as one of the best tests of reliability for multi-item scales (Nunnally 1978). Cronbach's alpha basically measures the consistency of the items composing a multi-item scale by examining pairwise inter-item correlations. To the extent that a scale is free of random error, individuals' response to items in that scale should be quite highly correlated; if inter-item correlations are very low the items are not measuring the same thing and should not be combined into a single scale. Indeed low inter--item correlations may indicate that the items are measuring nothing, and that respondents are making essentially random responses. Alpha is calculated by:

$$\text{ALPHA} = N\bar{r}/(1+\bar{r}(N-1))$$

where N = the number of items in the scale
$\bar{r}$ = the average inter-item correlation

Cronbach's alpha is a conservative test in that it can be shown

to be the lower bound of the reliability of an unweighted scale (Novick and Lewis 1967). Alpha ranges from 0 to 1, 1 indicating perfect reliability. Clear cut-offs between acceptable and unacceptable reliabilities are not available, however most authors find alpha values of .80 very acceptable and scales with reliabilities of over .70 are widely used (see for example, Carmines and Zeller 1979; Nunnally 1978).

The impact of unreliable scales is to weaken inter-scale relationships. In fact a reliability coefficient (e.g., Cronbach's alpha) can be interpreted as the percentage of the true correlation between perfectly reliable scales that will be estimated using unreliable scales: if two scales are in theory perfectly correlated, yet each is in fact measured with a reliability of only .7, the measured inter-scale correlation will be .7.

5.2.2 Opinion Leadership

Opinion leadership was measured by a 6 item scale developed by Rogers(1961, pg. 230) here modified as recommended by Silk (1971) (see discussion above, Section 2.7). Table 5.3 shows inter-item correlations for this scale. Cronbach's alpha is .84 for Anglophones and .78 for Francophones. These reliabilities compare well with those found by previous users of similar scales: Rogers and Cartano (1962) estimated reliability as .70, Silk (1971) found .84 and .77 in two applications. Certainly this reliability justifies combining the items into an overall opinion leadership scale (defined in Table 5.3) and all future references to opinion leadership will use this scale. The minimum scale score becomes 6, the maximum 13. In order to maintain sufficiently large cell sizes for meaningful analysis the

TABLE 5.3: OPINION LEADERSHIP SCALE

Inter-Item Correlations

	1	2	3	4	5	6
During the past year have given anyone advice or information about energy conservation?	1 1	Anglophone (Francophone)				
Compared with your circle of friends and neighbours how likely are you to be asked your advice about energy conservation?	2 .44[1] (.47)	1				
Thinking back to the last discussion you had about energy conservation did you mainly ask others for advice or did they mainly ask you?	3 -.31 (-.31)	-.49 (-.41)	1			
When you discuss energy conservation what part do you play?	4 -.38 (-.30)	-.40 (-.32)	.52 (.56)	1		
What happens more often: I tell friends and neighbours about energy conservation <u>or</u> they tell me?	5 .45 (.26)	.45 (.27)	-.46 (-.10)	-.54 (-.30)	1	
Do you have the feeling that you are regarded as a good source.... about energy conservation?	6 .46 (.49)	.53 (.54)	-.47 (-.38)	-.54 (-.40)	.61 (.38)	1
OVERALL OPINION LEADERSHIP SCALE[2]	-.67 (-.68)	-.78 (-.78)	.72 (.66)	.75 (.68)	-.78 (-.55)	-.80 (-.76)

1 Read: Correlation between Item 1 and Item 2 = .44 for Anglophones
= .47 for Francophones

2 Overall Opinion Leadership Scale
= (3-Item 1) + (4-Item 2) + Item 3 + Item 4
+ (3-Item 5) + (3-Item 6)

scale is collapsed into three categories.

Previous research suggests that early adopters will be opinion leaders only if social norms favour innovation (see Section 2.2 above). Table 5.4 tabulates opinion leadership scores against early adopter classification. Early adopters, both francophone and anglophone are much more likely to score highly on opinion leadership. 38% of early adopters have opinion leadership scores of 12 or 13 points vs. only 23% of the non-early adopters, a difference significant at the 1% level.
ENERGY CONSERVATION PRODUCT EARLY ADOPTERS ARE ALSO OPINION LEADERS.
Hypothesis H3(see Section 2.8) is supported.

As early adoption is associated with opinion leadership, the characteristics of early adopters should also be those of opinion leaders. However, given the importance of opinion leaders in their own right, Appendix D presents the characteristics of opinion leaders.

5.2.2.1 Information Sources

Previous research also suggests that opinion leaders will tend to gather information from impersonal mass media sources whereas opinion followers will use personal information sources (the 2-step flow of communication theory, see Section 2.6 above).

As we have seen that early adopters tend to be opinion leaders, we now examine early adopters' information sources (Table 5.3.1). Our results do not support the 2-step flow of communication. Early adopters are not different from others, in both groups mass media sources are overwhelmingly important. Hypothesis H5 (see Section 2.8) is supported in that early adopters do use mass media sources, but early adopters are not

distinctive in this.

5.2.3 Social Integration

Social integration was measured by a 4 item scale. Inter-item correlations are shown in Table 5.5. This scale also has highly satisfactory reliability (Cronbach's alpha is .80 for anglophones and .78 for francophones) and justifies combining the items into a single social integration scale as shown in Table 5.4. The new scale ranges from 4 to 20 and again is collapsed into three points to maintain sufficient cell size for analysis.

Previous research suggests that early adopters are more socially integrated than later adopters (see Section 2.2 above) and that opinion leaders are also more socially integrated than non-opinion leaders (Section 2.6 above).

Table 5.6 tabulates social integration against early adopter classification. Overall 31% of early adopters and 22% of non-early adopters have high integration scores, a difference significant at 5% level. However this overall effect conceals francophone-anglophone effects. Francophone early adopters do not differ significantly from francophone non-early adopters in their social integration. Whereas anglophone early adopters are much more likely to be highly socially integrated than anglophone non-early adopters (33% vs. 22%, significant at 1% level).

ANGLOPHONE EARLY ADOPTERS ARE SIGNIFICANTLY MORE LIKELY TO BE HIGHLY SOCIALLY INTEGRATED THAN OTHER ANGLOPHONES. THIS RESULT DOES NOT HOLD FOR FRANCOPHONES. Hypothesis H4 (see Section 2.8) is supported only

TABLE 5.4 EARLY ADOPTERS AND OPINION LEADERSHIP

	Opinion Leadership Score				
	Low	Medium	High		
EARLY ADOPTERS	(6-7)	(8-11)	(12-13)		n
Anglophone	17%[1]	45%	37%	100	99
Francophone	16%	44%	41%	100	32
ALL	17%	45%	38%**	100	131
OTHERS					
Anglophone	28%	46%	25%	100	452
Francophone	28%	54%	18%	100	192
ALL	28%	49%	23%**	100	644

[1]Read: 17% of Early Adopter Anglophones had low Opinion Leadership Scores.

** difference significant at 1% level.

TABLE 5.4.1 EARLY ADOPTERS AND INFORMATION SOURCES

"What is your main source of information about energy conservation?"

		Friends/ Relatives/ Neighbours	Newspapers/ Magazines/ TV Radio	All of Those	Other		n
EARLY ADOPTERS	Anglophones	6%	79%	5%	10%	100	124
	Francophones	8%	75%	14%	3%	100	36
OTHERS	Anglophones	9%	80%	5%	7%	100	556
	Francophones	6%	81%	7%	6%	100	236

TABLE 5.5 SOCIAL INTEGRATION SCALE

		1	2	3	4
As a rule I like to meet new people, go to social gatherings and generally get around a lot.	1	1	Anglophone (Francophone)		
I do volunteer work for a hospital or service organization on a fairly regular basis.	2	.25[1] (.20)	1		
I like to work on community projects.	3	.32 (.32)	.53 (.53)	1	
I am an active member of more than one service organization.	4	.27 (.17)	.47 (.52)	.54 (.51)	1
OVERALL SOCIAL INTEGRATION SCALE[2]		.57 (.57)	.80 (.78)	.79 (.81)	.78 (.77)

[1]Read: Correlation of item 1 ("As a rule I like.....") and item 2 ("I do volunteer work.....") was .25 for anglophones and .20 for francophones.

Cronbach's Alpha = .80 for Anglophones
.78 for Francophones

2Overall Social Integration Scale = Item 1 + Item 2 + Item 3 + Item 4

SOCIAL INTEGRATION SCALE

	Low (4-10)	Medium (11-13)	High (14-20)		n
EARLY ADOPTERS					
Anglophone	31%	36%	33%	100	125
Francophones	39%	36%	25%	100	36
ALL	33%	36%	31%**	100	161
OTHERS					
Anglophones	46%	32%	22%	100	536
Francophones	43%	34%	22%	100	228
ALL	45%	33%	22%**	100	764

** difference significant at 5% level

TABLE 5.6 EARLY ADOPTERS AND SOCIAL INTEGRATION

for anglophones.

5.2.4 Self-rated Innovativeness

Self-rated innovativeness was measured by a 5 item scale; 3 items from previously used self-rated innovativeness scales and 2 items suggested by Midgley and Downing (1978) as measures of generalized innovativeness (see Section 2.3.3 above). Table 5.7 shows inter-item correlations. The two generalized innovativeness items clearly do not belong in this scale, they have close to zero correlations with the other scale items and correlate only .19 with each other. Even dropping these two items, the self-rated innovativeness scale does not have very good reliability. Cronbach's alpha is .69 for francophones and .66 for anglophones. This is the result of low inter-item correlations and few items in the scale. With only 3 items now in the scale a reliability coefficient of .8 demands an average inter-item correlation of close to .60 (compared to the .40 obtained here). The low reliability of this scale will dilute its relationship to other scales.

Table 5.8 tabulates self-rated innovativeness against the early adopter classification from product ownership. Despite the low reliability of the self-rated innovativeness scale it is clearly related to our cross-sectional definition. Overall 50% of early adopters have high self-rated innovativeness scores compared to 34% of non-early adopters (a difference significant at the 1% level). This significant relationship holds for both anglophones and francophones.

Table 5.9 looks at the 2 items which were intended to measure generalized innovativeness. We have already seen that these items do not

Item:

Item:		1	2	3	4	5
		Anglophone (Francophone)				
I like to try new and different things.	1	1				
I often try new products before my friends do.	2	.46[1] (.46)	1			
I often talk to my friends about new appliances.	3	.34 (.36)	.39 (.46)	1		
I rely on friends' advice when making up my mind on new products.	4	.01 (.06)	-.01 (.08)	.10 (.03)	1	
I have difficulty in deciding whether to buy new food products.	5	-.10 (-.16)	-.14 (-.19)	.02 (.06)	.19 (.12)	1

Cronbach's Alpha = .52 for anglophones
.55 for francophones

Excluding items 4 and 5:

Cronbach's Alpha = .66 for anglophones
.69 for francophones

[1]Read: the correlation between Item 1 ("I like to try new.....") and Item 2 ("I often try new.....") was .46 for anglophones and .46 for francophones.

TABLE 5.7 SELF-RATED INNOVATIVENESS SCALE

SELF-RATED INNOVATIVENESS

	Low (3-7)	Medium (8-10)	High (11-15)		n
EARLY ADOPTERS					
Anglophones	14%	39%	46%	100	126
Francophones	9%	29%	63%	100	35
ALL	13%	37%	50%**		161
OTHERS					
Anglophones	17%	53%	30%	100	551
Francophones	12%	45%	44%	100	234
ALL	16%	50%	34%**		785

**difference significant at 1% level

TABLE 5.8 EARLY ADOPTERS AND SELF-RATED INNOVATIVENESS

relate to self-rated innovativeness this table indicates that they do not relate to early adopter classification either! The only significant effect is for francophones to be slightly more likely to disagree with "I have difficulty in deciding to buy new food products". There are no effects relating to early adopters.

SELF-RATED INNOVATIVENESS IS NOT VERY RELIABLY MEASURED BUT NONETHELESS HAS A SIGNIFICANT RELATIONSHIP TO EARLY ADOPTION. THE GENERALIZED INNOVATION MEASURES RELATE TO NO OTHER INNOVATION MEASURES. Hypothesis H1 (see Section 2.8) is supported.

5.2.5 Energy Attitudes

Four energy attitude items were included in the questionnaire, drawn from previous energy research studies and the relevant literature. Inter-item correlations are shown in Table 5.10. Unfortunately these items are not closely related and do not constitute a reliable scale (Cronbach's alpha is only .23). No other reliability measures for energy attitude scales could be located, although such scales are frequently used, so we do not know if this unreliability is a general finding for energy attitude scales or confined to this study.

Looking at the 4 items individually, offers some interesting comparisons (Table 5.11). The only energy attitude item to distinguish early adopters from others is "I try to drive less now than in the past". 73% of early adopters agreed with this item compared to 59% of non-early adopters (a difference significant at the 1% level). Presumably driving less could be interpreted as a further energy conservation action which is adopted along with the conservation products that define our early

"I rely on friends' advice when making up my mind on new products".		DISAGREE	NEUTRAL	AGREE		n
EARLY ADOPTERS:						
	Anglophones	51%	29%	20%	100	126
	Francophones	57%	26%	17%	100	35
OTHERS:	Anglophones	46%	30%	25%	100	554
	Francophones	53%	26%	22%	100	234
"I have difficulty in deciding whether to buy new food products".						
EARLY ADOPTERS:						
	Anglophones	51%	31%	18%	100	126
	Francophones	50%	25%	25%	100	36
OTHERS:	Anglophones	49%	31%	20%	100	549
	Francophones	52%	23%	26%	100	235

TABLE 5.9 EARLY ADOPTERS AND GENERALIZED INNOVATIVENESS

Item:

Item:		1	2	3	4
It would be hard for me to cut down on the use of energy in the home.	1	1	Anglophone (Francophone)		
There is not much the average citizen can do to save energy.	2	.20[1] (.13)	1		
I try to drive less now than in the past.	3	.03 (.08)	-.13 (.03)	1	
Energy costs for most people are higher than they were a year ago.	4	.01 (.03)	.00 (.05)	.04 (.12)	1

[1]Read: the correlation between Item 1 ("It would be hard for me.....") and Item 2 ("There is not much.....") is .20 for anglophones and .13 for francophones.

TABLE 5.10 ENERGY ATTITUDES

"I try to drive less now than in the past".		DISAGREE	NEUTRAL	AGREE		
EARLY ADOPTERS	Anglophone	13%	17%	71%**	100	126
	Francophone	9%	11%	80%**	100	35
OTHERS	Anglophone	22%	21%	58%**	100	549
	Francophone	20%	18%	62%	100	233

**difference significant at the 1% level

"It would be hard for me to cut down on the use of energy in the home".						
EARLY ADOPTERS	Anglophone	63%	13%	23%	100	126
	Francophone	50%	6%	44%	100	36
OTHERS	Anglophone	59%	17%	23%	100	556
	Francophone	44%	14%	42%	100	234

"There is not much the average citizen can do to save energy".						
EARLY ADOPTERS	Anglophone	89%	2%	9%	100	125
	Francophone	89%	3%	8%	100	36
OTHERS	Anglophone	88%	4%	8%**	100	553
	Francophone	80%	5%	15%**	100	236

**difference significant at the 1% level

"Energy costs for most people are much higher than they were a year ago".						
EARLY ADOPTERS	Anglophone	5%	2%	93%	100	125
	Francophone	--	3%	97%	100	36
OTHERS	Anglophone	5%	2%	93%	100	556
	Francophone	4%	2%	94%	100	236

TABLE 5.11 EARLY ADOPTERS AND ENERGY ATTITUDES

adopters. This effect holds for francophones and anglophones.

The other energy attitude item showing significant differences is "It would be hard for me to cut down on the use of energy in the home". This fails to differentiate between early adopters and others, but shows a remarkable difference between anglophone and francophone respondents. 23% of all anglophones agree with this statement compared to 42% of all francophones (a difference significant at much better than the 1% level). Given that anglophones in our sample own more energy conserving products than francophones this response is presumably not a reflection of existing conservation actions, but rather a measure of francophones greater tendency to view their energy consumption as an external given which cannot be reduced.

However, both anglophone and francophone respondents overwhelmingly disagree with the statement that "There is not much the average citizen can do to save energy": 86% of respondents disagree with this (francophone disagreement is significantly lower, but still 80% of francophones do disagree). It would appear that, particularly for francophones, the "average citizen" is seen as being capable of energy savings that "I" can emulate only with difficulty. At first sight this result could be due to the francophone sample being less likely to live in single detached homes (94% of all anglophones vs. 70% of all francophones live in single detached homes) and perceiving energy conservation as the province of the single, detached home owner.

Table 5.11A compares anglophone and francophone owners of single, detached homes. Even within this subgroup the same anglophone /francophone differences are found. If anything the effect is slightly

"It would be hard for me to cut down on the use of energy in the home"	DISAGREE	NEUTRAL	AGREE	n
All Anglophones	60%	16%	23%**	682
All Francophones	45%	13%	42%**	270
Single, detached home owners only				
Anglophone	61%	17%	23%	643
Francophone	45%	12%	43%	189
"There is not much the average citizen can do to save energy".				
All Anglophones	88%	4%	8%**	678
All Francophones	81%	5%	14%**	272
Single, detached home owners only				
Anglophone	89%	4%	8%**	640
Francophone	78%	6%	16%**	189

**difference significant at the 1% level

TABLE 5.11a OWNERS OF SINGLE, DETACHED HOMES: ENERGY ATTITUDES

greater.

EARLY ADOPTERS ARE SIGNIFICANTLY MORE LIKELY TO REPORT THEY DRIVE LESS. FRANCOPHONES ARE SIGNIFICANTLY MORE LIKELY TO THINK THAT IT WOULD BE HARD FOR THEM TO CUT DOWN ON USE OF ENERGY IN THE HOME AND YET DO NOT AGREE THAT THE AVERAGE CITIZEN CAN NOT DO MUCH TO SAVE ENERGY. Hypothesis H6(see section 2.8), that early adopters will have distinctive attitudes to conservation, is not well supported.

5.3 Summary

Early adopters, defined on a cross-sectional basis as owners of 4 or more energy conservation products, tend to be upscale in demographics, to be opinion leaders, to be socially integrated (although this result is not significant for francophones), to rate themselves as more innovative and to agree that they drive less.

Whereas the measures of social integration and opinion leadership are highly reliable, measures of self-rated innovativeness are less reliable and energy attitude measures are not yet at all well developed. The generalized innovativeness items suggested in the literature are found here to be unrelated to other innovativeness measures.

6.0 MEASURES OF PRODUCT PERCEPTIONS

A key part of the questionnaire was the description of four energy conservation products which respondents rated on a variety of scales indicating their perceptions of each product, its usefulness and their interest in buying. The concepts were designed to span a range of values on the 5 attributes which Rogers postulated as affecting new product diffusion: relative advantage, compatibility, complexity, trialability and observability (see Section 2.4 above). Two versions of each concept were used varying on a specific attribute; each respondent however saw only one version of each concept. Table 3.2.1 shows the combinations of attribute levels that the concepts were intended to cover.

In this section of the report we examine the five product attributes to assess their reliability and independence, and check that the product concepts did in fact cover the range of attributes expected.

6.1 Relative Advantage

Table 6.1 shows inter-item correlations for the 5 items designed to measure relative advantage. The scale has acceptable reliability (Cronbach's alpha is .75 for anglophones and .76 for francophones) and inter-item correlations are very similar for anglophones and francophones. An overall relative advantage scale can be formed (see Table 6.1) and will be used in subsequent discussion of relative advantage.

6.2 Compatibility

3 items were intended to measure compatibility. Table 6.2 shows their inter-item correlations. Although the items were drawn from other

ITEM		ITEM 1	2	3	4	5
The price of this device is too high for me to consider purchasing it.	1	1	Anglophone (Francophone)			
This device would soon pay for itself.	2	-.50[1] (-.50)	1			
I doubt this device could save the amount of energy claimed.	3	.42 (.44)	-.54 (-.54)	1		
Compared to other ways of saving energy, this one is superior.	4	-.18 (-.18)	.47 (.43)	-.38 (-.39)	1	
It would be hard to determine how much energy this device saves	5	.19 (.27)	-.31 (-.33)	.44 (.50)	-.34 (-.30)	1
OVERALL RELATIVE ADVANTAGE SCALE[2]		-.69 (-.70)	.79 (.78)	-.78 (-.80)	.60 (.64)	-.63 (-.66)

[2]Read: correlation between responses to item 1 ("The price of this device...") and item 2 ("This device would soon...") was -.50 for anglophones and .50 for francophones.

[2]Overall Relative Advantage Scale = (6 - Item 1) + Item 2 + (6 - Item 3) + Item 4 + (6 - Item 5).

TABLE 6.1: RELATIVE ADVANTAGE SCALE

ITEM:		ITEM: 1	2	3	4	5
The use of this device would require big changes in our daily household routine.	1	1				
Using this device would be inconvenient for our family.	2	.53[1] (.18)	1			
This device could be easily in installed in my home	3	-.30 (-.13)	-.30 (-.27)	1		
This product would be easy to use.	4	-.43 (-.20)	-.42 (-.22)	.48 (.51)	1	
This device appears too complicated.	5	.47 (.25)	.42 (.31)	-.40 (-.25)	-.48 (-.34)	1
OVERALL COMPATIILITY SCALE[2]		-.74 (-.56)	-.72 (-.62)	.69 (.68)	.76 (.70)	-.75 (-.66)

[1]Read: correlation between Item 1 ("The use of this device...") and Item 2 ("Using this device...") is .53 for anglophones and .18 for francophones.

[2]Overall Compatibility Scale = (6-Item 1) + (6-Item 2) + Item 3 + Item 4 + (6-Item 5)

TABLE 6.2: COMPATIBILITY SCALE

studies, their reliability is rather poor, especially for francophones (alpha is .64 for anglophones and .42 for francophones). Furthermore factor analysis, and inspection of the complete inter-item correlation matrix, suggests that two further items are associated with the compatibility scale, although not originally designed for that purpose. These two additional items (items 4 and 5 in Table 6.2) are "This product would be easy to use" and "This device appears too complicated", originally intended to measure complexity but empirically more related to compatibility. Inclusion of these items raises the reliability coefficient to a highly acceptable .79 for anglophones and a reasonable .64 for francophones. This extended 5 item compatibility scale is used in all subsequent analysis, however there are some differences in the interrelationships of these items for francophones. In particular inter-item correlations are rather low and there is a tendency for compatibility items to correlate with relative advantage items for francophones.

6.3 Observability and Communicability

3 items were designed to measure this attribute: "The results of using this product would show up clearly", "It would be difficult to explain the operation of this device to my friends" and "If I had this product my friends would be interested to hear about it". Table 6.3 shows inter-item correlations. In fact these items do not fit together well at all. Reliability is an unacceptable .44 for anglophones and .43 for francophones.

Factor analysis, and inspection of the complete inter-item correlations matrix, shows the first observability/communicability item

		1	2	3
The results of using this product would show up clearly.	1	1	Anglophone (Francophone)	
It would be difficulty to explain the operation of this device to my friends.	2	-.21[1] (-.21)	1	
If I had this product, my friends would be interested to hear about it.	3	.29 (.32)	-.13 (-.08)	1

[1]Read: correlation of Item 1 ("The results of using this product...") and Item 2 ("It would be difficult...") is -.21 for Anglophones and -.21 for Francophones.

TABLE 6.3: OBSERVABILITY/COMMUNICABILITY SCALE

("The results of using this product would show up clearly") to be more closely associated with relative advantage; the second ("It would be difficult to explain the operation of this device to my friends") to be more closely-associated with complexity; and only the third item ("If I had this product my friends would be interested to hear about it") to be a possibly new measure. Accordingly this last item alone is used to measure observability/communicability, and the inadequacy of existing measures of this concept is noted.

6.4 Complexity

Although three items were originally intended to measure complexity ("I understand how this device is supposed to work", "This product would be easy to use" and "This device appears too complicated") as discussed above the latter two of these items are more closely associated with compatibility. And another item "It would be difficult to explain the operation of this device to my friends" was fairly well related to complexity. As a result the complexity scale is formed from two items "I understand how this device is supposed to work" and "It would be difficult to explain the operation of this device to my friends". These give a scale with reliability of .6, acceptable by many researchers' standards (e.g. Deshpande and Zaltman, 1982) but certainly not an ideal measure.

6.5 Trialability

Only a single item was intended to measure this concept, "This product could easily be tried out on a small scale".

6.6 Summary

Measures of the 5 Rogers product attributes which influence new product adoption and diffusion were in the main successful. Relative Advantage and Compatibility were measured reliably and by the items expected. Observability/communicability was not measured by all the items expected and a single item was chosen to represent this dimension. Complexity was measured by two items with fair reliability. Trialability was only intended to be measured by a single item. Given the number of studies that have employed Rogers 5 attributes, using measures similar to those applied here, it is surprising that scale reliabilities are not more analyzed and that better items have not been devised.

7.0 DIFFERENCES IN PRODUCT PERCEPTIONS

Each product concept was presented in one of two versions, i.e. the energy efficient light bulb was priced at $10 or $20; the solar economiser could be installed by an expert or by an average homeowner; the energy monitor promised a two year payback or a one year payback; the shower restrictor was said to give a slight reduction in shower quality or shower quality was unspecified. Each respondent saw only one version of each concept.

These variations of each product concept were designed to increase the range of attributes spanned by the concepts. Two of these variations operated on the relative advantage dimension, as previous research (such as it is, see 2.4.6 above) suggests relative advantage is the key variable. Each variation looked at a separate component of relative advantage; the light bulb variations manipulating price, the energy monitor variations manipulating payback period. The other two variations manipulated compatibility (also found important in previous investigations, see 2.4.6 above). The solar economiser versions working on the installation aspect of compatibility. The shower flow restrictor versions manipulating usage aspects of compatibility. Table 7.1 shows the intended direction of variations.

For the sample as a whole we can now make two sorts of comparisons: within concept and across concept. A within concept comparison looks at the ratings given to one version of a concept compared to those given to the other version of the same concept, e.g. it compares the $10 light bulb with the $20 light bulb. This is a severe test of the product

Concept:		Manipulation:	Relative Advantage	Compatibility	Complexity	Trialability	Observability
Light Bulb	-	$10	Better	High	Low	High	Low
	-	$20	Worse	High	Low	High	Low
Energy Monitor	-	2 yr payback	Worse	Low	High	Low	Medium
	-	1 yr payback	Better	Low	High	Low	Medium
Solar Economiser	-	self-installation	?	Better	High	Medium	High
	-	expert installation	?	Worse	High	Medium	High
Shower Flow Restrictor	-	reduces shower quality	?	Worse	Low	High	Low
	-	no change in shower quality	?	Better	Low	High	Low

TABLE 7.1 INTENDED MANIPULATIONS OF PRODUCT CONCEPTS

concepts in that it involves comparisons of ratings by different groups of individuals. As each respondent saw only one version of each concept, any comparisons across versions is also across respondent groups, i.e. we compare the relative advantage rating of the $10 light bulb given by one group of respondents with the relative advantage rating of the $20 light bulb as given by a different group of respondents. Product versions were used as a replicated not repeated measure. This is a more powerful procedure methodologically. We would expect within concept comparisons to yield significant results, although absolute rating differences may well be small. Differences in response style, the way the respondent uses the rating scale, their underlying values etc. will cloud within concept comparisons.

An across concept comparison looks at the ratings given to one concept (averaged over both versions) compared to those given to another (averaged over both versions), e.g. it compares the light bulb with the energy monitor. Here we are making comparisons within the same group of respondents. All respondents rated a light bulb (although its price differed), all respondents rated an energy monitor (although its payback period differed). As a result across concept comparisons can also be analysed on an individual basis by examining rating differences (i.e. for each individual their relative advantage rating for a light bulb could be subtracted from their rating for an energy monitor). In either case across concept comparisons should show bigger, more significant, differences than within concept comparisons. This combination of across concept comparisons (involving the same individuals) and within concept comparisons (involving different individuals) is particularly strong, and allows a range of

products to be tested without huge samples and without a great burden on the respondent.

7.1 WITHIN CONCEPT COMPARISONS

As expected the $10 light bulb was given significantly higher relative advantage ratings than the $20 light bulb, and the two versions of this concept do not differ significantly on any other attribute (see Table 7.2).

The energy monitor was also rated as expected, with the 1 year payback being perceived as significantly higher on relative advantage than the 2 year payback. No other significant differences were perceived.

The solar economiser manipulations were not quite so clearcut. The intention was for the self-installed monitor to be perceived as more compatible than the expert-installed version. In fact, although the difference in overall compatibility ratings was as expected, it was not significant. The major reason for this is that the overall compatibility rating combines compatibility in use with compatibility in installation, yet only the latter element was affected by this manipulation. In fact significant differences are found on the compatibility in installation scale.

An unexpected finding was a significant tendency to perceive the expert installed solar economiser as having greater relative advantage. We can rationalize this result in several ways. As the price of the concept was the same in both versions, respondents may have felt that the price included installation for the expert installed version lending it an extra relative advantage. Alternatively expert installation may lend the

AVERAGE RATINGS:

	RELATIVE ADVANTAGE	COMPATIBILITY	COMMUNICABILITY	COMPLEXITY	TRIALABILITY
Light Bulb					
Price $10	13.3*	20.1	3.7	2.7	3.8
Price $20	12.7*	20.0	3.7	2.6	3.7
Energy Monitor:					
2yr payback	12.7**	16.0	3.6	2.9	3.5
1yr payback	13.2**	16.0	3.7	2.8	3.4
Solar Economiser:					
Self-installed	14.0**	17.3	3.8	2.6	3.5
Expert-installed	14.6**	17.1	3.8	2.5	3.4
Showerflow Restrictor:					
Reduces shower quality	15.9*	19.1**	3.4	2.2	3.7
No quality effect	16.3*	19.7**	3.5	2.2	3.8

* Indicates significant difference at 5% level

** Indicates significant difference at 1% level

TABLE 7.2: AVERAGE PRODUCT CONCEPT RATINGS
(Within Concept Comparisons)

product additional legitimization and lead respondents to expect superior performance. Looking at the effect more closely, it turns out to be mainly the result of francophone ratings. Those francophones who rated the self-installed solar economiser give it an average 14.1 points, those who rated the expert installed solar economiser give it an average 15.1 points (a difference easily significant at the 1% level). The effect for anglophones was much smaller and insignificant.

The shower flow restrictor was rated as expected. The version which reduced shower quality was rated as having significantly lower relative advantage and being significantly less compatible than the version which did not reduce shower quality. No other significant differences were observed in the other attributes of this product.

These results are very reassuring. There are measurable and significant differences in product concept ratings across concept versions despite these comparisons involving different groups of individuals. These differences are in all cases as expected, and only for one item are there any unforseen differences between concept versions.

In examining the single variable relative advantage it is interesting to note that all the differences between concept versions are approximately the same. The effects on average relative advantage ratings of increasing price, increasing payback period or reducing service quality are virtually identical.

7.2 ACROSS CONCEPT COMPARISONS

The predicted ordering of concepts along product attributes is shown in Table 7.1. The actual ordering was as predicted with a few

AVERAGE RATING (over both concept versions):

	RELATIVE ADVANTAGE	COMPATIBILITY	COMMUNICABILITY	COMPLEXITY "Difficult to explain"	TRIALABILITY
Light Bulb:	13.0**	20.1**	3.7	2.7**	3.7**
Rest:	14.5	17.6	3.6	2.5	3.5
Energy Monitor:	13.0*	16.0**	3.6	2.8**	3.5
Rest:	14.5**	18.9	3.7	2.5	3.6
Solar Economiser:	14.3*	17.2**	3.8**	2.5	3.4**
Rest:	14.0	18.5	3.6	2.6	3.6
Showerflow Restrictor:	16.1**	19.4**	3.5**	2.2**	3.8**
Rest:	13.4	17.8	3.7	2.7	3.5

* Indicates significant difference at 5% level

** Indicates significant difference at 1% level

TABLE 7.3: AVERAGE PRODUCT CONCEPT RATINGS (Across Concepts)

exceptions (see Table 7.3).

On the compatibility dimension products were perceived exactly as expected. The light bulb was significantly more compatible than other concepts; next most compatible was the shower flow restrictor; followed by the solar economiser and finally the energy monitor.

On the communicability dimension the concepts were not very widely spread. They followed the expected order however with the exception of the light bulb which was perceived as more communicable than expected. The solar economiser was seen as the most communicable concept followed by the energy monitor (and light bulb) and lastly the shower flow restrictor.

The ordering of the products on the complexity dimension differed over the two items measuring that attribute. On understandability the shower flow restrictor scored highest (as expected) followed by the solar economiser (perceived as easier to understand than expected), the energy monitor and finally the light bulb (perceived as much more difficult to understand than expected). This ordering is probably explained by the fact that the item asks, "I understand how this product <u>works</u>", respondents may have had trouble understanding the <u>working</u> of the light bulb although the concept itself was simple. Similarly the solar economiser was easy to understand in principle (respondents were familiar with the idea of solar power) although it may be technically more complex.

On the other item used to measure complexity ("This product would be difficult to explain") concepts followed the expected order. The energy monitor was seen as the most difficult to explain followed by the solar economiser, the light bulb and the shower flow restrictor. The

light bulb was seen as significantly more complex than the shower flow restrictor.

On trialability, products followed the expected order except for the energy monitor which was not seen as less triable than the solar economiser. The idea was that the energy monitor is not trialable at all (you have it or you do not), whereas the solar economiser can be installed on a room by room basis.

No prior predictions were made as to the positioning of products on the relative advantage dimension (except for within concepts as discussed above, 7.1). In fact the products were well spread with the shower flow restrictor seen as by far the highest relative advantage product, followed by the solar economiser, the light bulb and the energy monitor. The relative ordering of these last two depending on the particular version of the concept.

Overall the product concepts span a range of values on all dimensions. The means shown in Table 7.3 in fact reflect a wide range of values covering the entire product attribute scales.

7.3 ANGLOPHONE/FRANCOPHONE

Table 7.4 compares anglophone and francophone ratings of the product concepts. Looking first on an overall basis, pooling data across all product concepts, there are significant differences between francophones and anglophones in all aspects of product perception but not in product evaluation. Francophones on average rate the products as having greater relative advantage and greater trialability but being less communicable, less compatible and more complex. This combination of

perceptions explains the absence of an evaluation effect: francophone perceptions are more favourable on relative advantage and trialability, but less favourable on the other three characteristics.

These aggregate comparisons may be misleading as they pool data over dissimilar product concepts. Examining individual product concepts (also in Table 7.4) we see that relative advantage ratings are indeed consistently higher for francophones. This effect is particularly marked for the expert-installed solar economiser and the shower flow restrictor which does not affect shower quality. Trialability ratings are also consistently, and significantly, higher for francophones, every product concept is perceived as more trialable by francophones. Compatibility ratings tend to be significantly lower for francophones although the energy monitor is rated as more compatible by francophones.

For complexity effects vary over products, however the shower flow restrictor is, surprisingly, rated as much more complex by francophones than by anglophones. Francophones place the shower flow restrictor almost alongside the solar economiser in complexity. For communicability effects are mixed and francophone mean ratings span a narrow range. Francophones tend to rate the more communicable products lower than anglophones and the less communicable products higher than anglophones.

The only significant difference in evaluations occurs for the shower flow restrictor with no effect on shower quality, this is rated as significantly more useful and of greater buying interest by francophones. Francophones also tend to have significantly lower awareness of the products. This is particularly marked for the shower flow restrictor. Shower flow restrictors are currently on the market, and francophones are

Product Concept:		Relative Advantage	Commun-icability	Compati-bility	Complex-ity	Trial-ability	Useful-ness	Buying Interest	Heard of
$10 Light Bulb	Anglophone (Francophone)	13.1[1] (13.4)[2]	3.7 (3.6)	20.3 (19.7)	2.7 (2.7)	3.7 (3.8)	3.2 (3.1)	2.9 (2.9)	2.7* (2.5)*
$20 Light Bulb	Anglophone (Francophone)	12.7 (12.9)	3.6 (3.7)	20.4** (19.1)**	2.7 (2.6)	3.6* (3.8)*	3.1 (3.1)	2.6 (2.7)	2.6* (2.3)*
Energy Monitor 2 year payback	"	12.6 (12.8)	3.6 (3.5)	16.1 (16.1)	2.8* (3.0)*	3.3** (3.7)**	2.6 (2.6)	2.2 (2.3)	2.2 (2.2)
Energy Monitor 1 year payback	"	13.2 (13.5)	3.7 (3.6)	15.8* (16.5)*	2.8 (2.8)	3.4** (3.7)**	2.7 (2.8)	2.3 (2.4)	2.2 (2.4)
Solar Economiser self-installed	"	14.0 (14.1)	3.9** (3.6)**	17.7** (16.5)**	2.4** (2.8)**	3.4** (3.7)**	3.2 (3.0)	2.7 (2.7)	3.2* (3.0)*
Solar Economiser expert-installed	"	14.4 (15.1)	3.9 (3.7)	17.2 (17.0)	2.4 (2.5)	3.2** (3.7)**	3.1 (3.2)	2.6 (2.7)	3.2 (3.1)
Showerflow Restrictor (reduces shower quality	"	15.8 (15.9)	3.4 (3.4)	19.4** (18.5)**	2.1** (2.5)**	3.7 (3.8)	3.0 (3.0)	2.8 (2.8)	3.2** (2.7)**
Showerflow Restrictor (No effect on quality)	"	16.2 (16.8)	3.4* (3.6)*	19.8 (19.5)	2.1** (2.4)**	3.7 (3.8)	3.2** (3.5)**	3.1* (3.4)*	3.2** (2.9)**
ALL PRODUCTS	"	14.0* (14.3)*	3.7* (3.6)*	18.3** (17.9)**	2.5** (2.7)**	3.5** (3.8)**	3.0 (3.0)	2.6* (2.7)*	2.8** (2.6)**

[1]Average perception of anglophones
[2]Average perception of francophones

*Indicates a difference significant at the 5% level
**Indicates a difference significant at the 1% level

TABLE 7.4 PRODUCT PERCEPTIONS BY LANGUAGE

significantly less likely to have heard of these products.

Notice that it is difficult to explain the differences observed simply by response style. In particular, francophone ratings are not consistently higher or lower than anglophone ratings, the difference depends on particular scale examined. Nor do francophone ratings have consistently greater or smaller variance (looking at all rating scales for each product concept francophones having significantly higher variances on 12 occasions, and significantly lower variances on 9 occasions, the vast majority of scales show no significant differences in variances).

However, there is a lower incidence of early adopters in the francophones sample (13% of francophones are early adopters vs. 18% of anglophones) and this could explain at least part of the francophone-anglophone differences. In the next section we look at the differences between early adopters and the rest of the sample. These comparisons are made for the entire sample, for anglophones and for francophones.

7.4 EARLY ADOPTERS vs. OTHERS

One way in which early adopters are expected to differ from other respondents is in their perceptions of the product concept descriptions. One explanation of early adoption would be favourable product perception.

Table 7.5 shows the mean ratings of early adopters and the rest of the sample pooled over all product concepts, and for each concept individually. There are very few differences between early adopters and others. Over all concepts early adopters are significantly more likely tohave heard of the product already (this ties in to the status of early

Product Concept:		Relative Advantage	Commun-icability	Compati-bility	Complex-ity	Trial-ability	Useful-ness	Buying Interest	Heard of
$10 Light Bulb	early adopters	12.9	3.7	20.2	2.6	3.8	3.3	2.8	2.8
	(others)	(13.4)	(3.7)	(20.1)	(2.7)	(3.8)	(3.2)	(2.9)	(2.6)
$20 Light Bulb	early adopters	12.9	3.7	20.1	2.7	3.6	3.3	2.7	2.7
	(others)	(12.7)	(3.7)	(19.9)	(2.6)	(3.7)	(3.0)	(2.7)	(2.5)
Energy Monitor 2 year payback	"	12.4 (12.8)	3.6 (3.6)	16.1 (16.0)	2.9 (2.9)	3.4 (3.5)	2.7 (2.6)	2.3 (2.2)	2.2 (2.2)
Energy Monitor 1 year payback	"	13.1 (13.2)	3.7 (3.6)	16.1 (16.0)	3.0* (2.8)*	3.2* (3.5)	2.8 (2.8)	2.3 (2.3)	2.4 (2.2)
Solar Economiser self-installed	"	13.7 (14.1)	3.8 (3.8)	17.7 (17.2)	2.4 (2.6)	3.5 (3.5)	3.2 (3.1)	2.7 (2.7)	3.3 (3.1)
Solar Economiser expert-installed	"	15.1 (14.5)	3.8 (3.8)	17.6 (17.0)	2.5 (2.5)	3.3 (3.4)	3.5** (3.1)**	2.8 (2.6)	3.5** (3.1)**
Showerflow Restrictor (reduces shower quality	"	16.2 (15.8)	3.4 (3.4)	19.2 (19.1)	2.2 (2.1)	3.7 (3.7)	3.2 (3.0)	2.9 (2.8)	3.3** (2.9)**
Showerflow Restrictor (No effect on quality)	"	16.6 (16.3)	3.6 (3.5)	19.8 (19.7)	2.3 (2.2)	3.7 (3.8)	3.5 (3.3)	3.2 (3.2)	3.3 (3.1)
ALL PRODUCTS	"	14.1 (14.1)	3.7 (3.7)	18.4 (18.1)	2.6 (2.6)	3.5 (3.6)	3.2** (3.0)**	2.7 (2.7)	2.9** (2.7)**

*Indicates a difference significant at the 5% level
**Indicates a difference significant at the 1% level

Average perceptions of non-early adopters are shown in parentheses.

TABLE 7.5 PRODUCT PERCEPTIONS: EARLY ADOPTERS VS. OTHERS

adopters as opinion leaders) and rate products as significantly more useful. Both these differences, although statistically significant, are small. Otherwise there are no overall differences in perceptions. Hypothesis H8 (see Section 2.8), that early adopters will have distinctive perceptions, is not well supported.

Looking at individual product concepts, there are some consistent effects. However statistically significant differences are very few; partly because on an individual product basis cell size is very small, partly because there is a lot of variability within early adopters, and perhaps partly because significance testing in these cases involve the assumption of normally distributed ratings in the population as a whole.

There is evidence that early adopters are more discriminating in assessing relative advantage. So early adopters have a wider spread of mean relative advantage ratings, giving even higher scores than the rest of the sample to the high relative advantage products (the shower flow restrictors and the expert-installed solar economiser) and even lower scores than the rest of the sample to the low relative advantage products (the energy monitors, the $10 light bulb and the self-installed solar economiser).

There is evidence that early adopters are less affected by price in their relative advantage assessments. On average early adopters give the same relative advantage rating to the $10 and the $20 light bulb, while other respondents rate the $20 bulb as significantly lower advantage. In contrast early adopters are more affected by payback period; moving from a 2 year to a 1 year payback boosts their relative advantage ratings very significantly.

Early adopters are also distinctive in their reaction to expert installation. As expected the necessity to use an expert to install the solar economiser reduces its relative advantage very considerably. However, surprisingly, respondents who are not early adopters see expert installation as slightly increasing the product's relative advantage. Presumably expert installation provides a welcome reduction in risk for the less experienced non-early adopters. Early adopters also give higher than average compatibility ratings for all products; higher than average usefulness ratings for all products; and higher than average awareness ratings for all products. But early adopters are not an homogenous group as regards their product perceptions. In fact over all the product concepts and rating scales shown in Table 7.5 it is rarely possible to reject the hypothesis that variance within early adopters is just as great as that within all other respondents.

Separating the sample into anglophones and francophones isolates early adopter effects from language effects. Table 7.6 compares mean scale ratings for anglophone early adopters and other anglophones, Table 7.7 presents the comparable analysis for francophones. These tables show no effects not already discussed above. For francophones, cell size in the early adopter category is often small (as few as 18 francophone early adopters rated some products) and standard errors tend to be large leaving few significant effects. Anglophone early adopters rated products as significantly more useful than did their later adopting counterparts, but otherwise showed very few differences in perception.

Product Concept:		Relative Advantage	Commun-icability	Compati-bility	Complex-ity	Trial-ability	Useful-ness	Buying Interest	Heard of
$10 Light Bulb	early adopters	12.7[1]	3.7	20.5	2.6	3.7	3.3	2.8	2.9
	(others)	(13.2)[2]	(3.7)	(20.2)	(2.7)	(3.8)	(3.2)	(2.9)	(2.6)
$20 Light Bulb	early adopters	13.4	3.7	20.2	2.7	3.7	3.4*	2.8	2.8
	(others)	(12.6)	(3.7)	(20.4)	(2.7)	(3.6)	(3.1)*	(2.6)	(2.6)
Energy Monitor 2 year payback	"	12.6 (12.6)	3.6 (3.7)	16.3 (16.1)	2.8 (2.8)	3.4 (3.3)	2.8 (2.6)	2.4 (2.2)	2.2 (2.2)
Energy Monitor 1 year payback	"	13.3 (13.1)	3.7 (3.7)	16.0 (15.8)	3.0 (2.8)	3.2 (3.4)	2.8 (2.7)	2.4 (2.3)	2.5 (2.1)
Solar Economiser self-installed	"	14.0 (14.0)	3.9 (3.9)	18.1 (17.6)	2.3 (2.5)	3.5 (3.4)	3.4* (3.1)*	2.8 (2.7)	3.4 (3.2)
Solar Economiser expert-installed	"	14.9 (14.3)	3.9 (3.9)	17.4 (17.2)	2.5 (2.4)	3.1 (3.2)	3.5** (3.1)**	2.8 (2.5)	3.4 (3.2)
Showerflow Restrictor (reduces shower quality	"	16.4 (15.7)	3.4 (3.4)	19.3 (19.4)	2.0 (2.1)	3.8 (3.7)	3.3** (2.9)	3.0 (2.7)	3.4 (3.1)
Showerflow Restrictor (No effect on quality)	"	16.9* (16.1)*	3.6 (3.4)	20.2 (19.8)	2.1 (2.1)	3.7 (3.8)	3.5* (3.2)*	3.4 (3.1)	3.5 (3.2)
ALL PRODUCTS	"	14.2 (14.0)	3.8 (3.7)	18.5 (18.3)	2.5 (2.5)	3.5 (3.5)	3.2** (3.0)**	2.8** (2.6)**	3.0** (2.8)**

[1]Average perception of anglophone early adopters
[2]Average perception of other anglophones

*Indicates difference significant at 5% level;
**Indicates difference significant at 1% level;

TABLE 7.6 PRODUCT PERCEPTIONS: ANGLOPHONES BY EARLY ADOPTERS

Product Concept:		Relative Advantage	Commun-icability	Compati-bility	Complex-ity	Trial-ability	Useful-ness	Buying Interest	Heard of
$10 Light Bulb	early adopters	13.1[1]	3.6	18.9	2.7	4.1	3.1	3.1	2.2
	(others)	(13.5)[2]	(3.6)	(19.9)	(2.7)	(3.8)	(3.1)	(2.9)	(2.5)
$20 Light Bulb	early adopters	12.6	3.8	19.5	3.0	3.6	3.2	2.6	2.5
	(others)	(13.0)	(3.7)	(19.1)	(2.5)	(3.8)	(3.1)	(2.7)	(2.3)
Energy Monitor 2 year payback	"	12.1 (12.9)	3.6 (3.4)	16.1 (16.1)	3.2 (3.0)	3.6 (3.7)	2.4 (2.7)	2.0 (2.3)	2.2 (2.2)
Energy Monitor 1 year payback	"	13.4 (13.5)	3.7 (3.6)	16.4 (16.5)	3.1 (2.8)	3.4 (3.8)	3.0 (2.8)	2.5 (2.4)	2.5 (2.3)
Solar Economiser self-installed	"	12.7 (14.3)	3.4 (3.6)	16.5 (16.5)	2.8 (2.8)	3.5 (3.7)	2.6* (3.1)*	2.2* (2.7)*	2.8 (3.0)
Solar Economiser expert-installed	"	15.5 (15.0)	3.9 (3.7)	18.2* (16.9)*	2.5 (2.5)	3.6 (3.8)	3.5 (3.1)	2.8 (2.6)	3.4 (3.0)
Showerflow Restrictor (reduces shower quality	"	15.8 (15.9)	3.3 (3.5)	19.1 (18.4)	2.8 (2.5)	3.6 (3.8)	3.0 (3.0)	2.8 (2.8)	3.0 (2.6)
Showerflow Restrictor (No effect on quality)	"	16.7 (16.8)	3.7 (3.6)	18.9 (19.6)	2.6 (2.4)	3.5 (3.9)	3.5 (3.5)	3.1 (3.4)	3.1 (2.9)
ALL PRODUCTS	"	14.0 (14.4)	3.6 (3.6)	18.0 (17.9)	2.9* (2.6)*	3.6 (3.8)	3.0 (3.0)	2.6 (2.7)	2.7 (2.6)

[1]Average perception of francophone early adopters
[2]Average perception of other francophones

*Indicates difference significant at 5% level;
**Indicates difference significant at 1% level;

TABLE 7.7 PRODUCT PERCEPTIONS: FRANCOPHONES BY EARLY ADOPTERS

7.5 SUMMARY

The product concepts used were very successful in generating a range of respondent perceptions along the 5 Rogers attributes. Looking at differences in perceptions within different versions of the same product concept is a strong test of manipulations in that it involves replicated rather than repeated measures (i.e. each respondent sees only one version of every concept). Yet within concept comparisons showed 3 of the 4 manipulations to be exactly as intended; the fourth, involving compatibility, was in the direction expected but not significant.

Across product comparisons, looking at different products, provided the expected spread of perceptions on compatibility and very close to the expected spread on all other dimensions.

There were some anglophone/francophone perceptual differences. In particular francophones tended to give most products higher ratings on relative advantage and triability, and lower ratings on compatibility.

It had been expected that early adopters would show distinctive product perceptions: that they would perceive the energy conservation products more favourably. Although this was confirmed in direction, differences were small and mostly insignificant. Early adopters did rate the new products as slightly, but significantly, more useful, were more discriminating in their relative advantage assessments (providing a wider spread of relative advantage ratings) and tended to see the products as more compatible. Early adopters were also more likely to claim to be aware of the new products already. However there were considerable differences within the early adopter group itself on all aspects of product perception. To analyze such differences would require a much larger group of early adopters than was available here.

8.0 THE EFFECT OF PRODUCT PERCEPTION ON PRODUCT EVALUATION

Two measures of overall product concept evaluation were taken: a rating of agreement with "This device would be very useful in my home", and a rating of agreement with "I would be interested in BUYING this device". These two measures as expected were highly correlated (r = .73). A combination of these two scales gives an overall Product Evaluation index with a reliability of .84. In the following we will consider the separate usage and buying intention scales, as differences in evaluations on the two scales may illuminate the distinction between favourable evaluation and purchase intention.

The relationship between product evaluations and product characteristics can be investigated in a number of ways. First, using bivariate analysis methods we can examine the relationship between evaluation and product perceptions on an attribute by attribute basis. Second, using multivariate methods we can model the overall relationship between the set of attributes describing each product and its evaluation. The multivariate methods employed are discriminant analysis and regression.

8.1 BIVARIATE ANALYSIS

Table 8.1 shows each product's evaluations on the usage and buying intention scales. The shower flow restrictor with no adverse effect on shower quality obtains the highest evaluation on usage and buying intention scales; the energy monitors receive the lowest ratings on both scales. All products score less well on buying intention than on usefulness -- i.e. respondents are likely to agree that a product is

	"Useful"	Buying Intention	Useful - Buying Intention
LIGHT BULB:			
$10	3.2	2.9**	.3
$20	3.2	2.7**	.4
** Indicates difference significant at 1% level			
ENERGY MONITOR:			
2 yr payback	2.6	2.2	.4
1 yr payback	2.8	2.3	.5
SOLA ECONOMISER:			
Self-installed	3.1	2.7	.4
Expert-installed	3.2	2.6	.6
SHOWERFLOW RESTRICTOR:			
Reduces quality	3.0**	2.8**	.2
No quality effect	3.3**	3.2**	.1
** Indicates a difference significant at 1% level			

TABLE 8.1: PRODUCT EVALUATIONS

useful but not to wish to buy it. This gap between usefulness and purchase intention is smallest for the shower flow restrictor and the $10 light bulb, presumably a reflection of the low purchase price of these products. The greatest drop off is for the solar economiser, expert installed, which is the highest price concept ($465) even without installation expenses. PRODUCT PRICE CLEARLY AFFECTS TRANSLATION OF USEFULNESS INTO BUYING INTENT.

Within product comparisons show that the $10 light bulb receives significantly higher buying interest than the $20 light bulb (although, sensibly, its usefulness ratings do not differ significantly). And the shower flow restrictor with no effect on shower quality receives significantly higher usefulness and buying interest ratings than its shower quality reducing counterpart. However the energy monitor's payback periods do not significantly affect buying interest, and the solar economiser's installation methods do not significantly affect its buying interest. So although significant differences in relative advantage were perceived for the two versions of the energy monitor and the solar economiser (see Table 7.1) they did not have a significant effect on the products' evaluations. A $10 PRICE CHANGE IN A LIGHT BULB AND A SHOWER QUALITY REDUCTION IN A SHOWER FLOW RESTRICTOR HAVE A SIGNIFICANT EFFECT ON PRODUCT EVALUATIONS; CHANGES IN PAYBACK PERIODS AND INSTALLATION METHOD DO NOT.

However across product comparisons suggest that price is not everything. In particular the solar economiser (the most expensive item) achieves almost the same buying intention rating as the $20 light bulb (a product which is $440 cheaper!).

Table 8.2 shows pairwise correlations between product attributes, usefulness and buying intention scores. The table shows both composite scales and the individual items to allow more detailed diagnosis of the attribute-evaluation relationship.

Relative advantage is the attribute most closely related to both usefulness and buying interest. The relationship is slightly stronger for francophones than for anglophones (correlations of .60 wih usefulness and .67 with buying interest for francophones). Within the relative advantage scale the ability of the device to pay for itself is the most important item. This item is particularly important for francophones, correlating .59 with usefulness and .63 with buying interest. The price of the device is an important influence on buying interest, but not on usefulness. This lends support to the validity of the ratings -- price should affect only buying interest and not usefulness -- and confirms the suggestion above that the gap between usefulness and buying interest was affected by price. The relative advantage scale also illustrates the strength of reliable scales as compared to individual items. The correlation of the overall relative advantage scale with usefulness and buying interest is higher than that of any of its component items.

Compatibility has the next highest correlation with buying interest. Again the effect is stronger for francophones than for anglophones (francophones' correlation between Compatibility and Usefulness is .43, between Compatibility and Buying Interest .41). The most important item in the scale is the rating of convenience in use. For francophones this is an especially important consideration, correlating .57 with usefulness and .52 with buying interest. Whether a product requires a

	USEFULNESS	BUYING INTEREST
RELATIVE ADVANTAGE:	.58	.64
The price of this device is too high for me to consider purchasing it.	-.28	-.44
This device would soon pay for itself.	.56	.59
I doubt this device could save the amount of energy claimed.	-.44	-.47
Compared to other ways of saving energy, this one is superior.	.51	.48
It would be hard to determine how much energy this device saves.	-.30	-.28
COMPATIBILITY:	.38	.36
The use of this device would require big changes in our daily household routine.	-.12	-.12
Using this device would be inconvenient for our family.	-.39	-.37
This device could be easily installed in my home.	.28	.26
This product would be easy to use.	.31	.28
This device appears too complicated.	-.24	-.26
OBSERVABILITY/COMMUNICABILITY:		
If I had this product, my friends would be interested to hear about it.	.41	.33
COMPLEXITY:		
I understand how this device is supposed to work.	.17	.16
It would be difficult to explain the operation of this device to my friends.	-.15	-.15
TRIALABILITY:		
This product could easily be tried out on a small scale.	.27	.25

TABLE 8.2: PRODUCT EVALUATIONS AND PRODUCT PERCEPTIONS: CORRELATIONS

change in routine is also an important item in explaining evaluation.

Observability/communicably correlates much more closely with usefulness than with buying intention. This could be a reflection of other attributes of the products (e.g. high observability products could have other characteristics that limit buying interest). This effect will be examined further in the multivariate analysis section. Yet again this attribute is more closely related to evaluation for francophones than anglophones.

Complexity is only weakly related to product evaluation. However this is partly a reflection of the unreliability of single scales. Our measure of complexity has random elements which reduce its ability to explain product evaluation. Trialability suffers from an identical problem.

RELATIVE ADVANTAGE HAS A MUCH CLOSER RELATIONSHIP TO PRODUCT EVALUATION THAN ANY OTHER VARIABLE. PRODUCT EVALUATIONS BY FRANCOPHONES ARE PARTICULARLY WELL CORRELATED WITH INDIVIDUAL PRODUCT ATTRIBUTES.

8.2 MULTIVARIATE ANALYSIS

The bivariate analysis above can only examine product attributes one at a time. To relate the whole set of product attributes to product evaluation requires multivariate analysis. Multivariate analysis can show the simultaneous effect of all the product attributes making up a particular product concept. Two methods are used, discriminant analysis and regression analysis.

Discriminant analysis and regression analysis are dependence methods, i.e. they relate one (dependent) variable to a set of predictor

(or independent) variables. The object of these analyses is to discover how well the dependent variable can be predicted, and to estimate the contribution made by each predictor to the dependent variable's level. The difference between discriminant and regression analysis is in the type of scale used for the dependent variable. Discriminant analysis uses a dependent variable which has a number of discrete levels representing different categories or groups (e.g. intending buyers/non-buyers, early adopters/later adopters, etc.). Regression analysis requires that the dependent variable represent a continuous, interval-scaled, score (e.g. $ sales, temperature, etc.).

In our case the choice of method depends on our assumptions regarding the five point "usefulness" and "buying interest" scales. The most tenable assumption is that these scales represent a grouping of respondents. Those respondents that "agree", or "strongly agree" with the statement that "This device would be very useful in my home" form a <u>favourable</u> group. Respondents that "disagree" or "strongly disagree" with that statement form an <u>unfavourable</u> group. Viewing the product evaluation scales in this way suggests the use of discriminant analysis. We will attempt to predict whether a respondent is favourable or unfavourable towards a product given information on their product attribute ratings. Discriminant analysis is attractive in that the exact extent of agreement or disagreement is probably of less interest, and less reliable, than the <u>direction</u> of agreement or disagreement.

A more exacting assumption about the product evaluation sales is that they represent continuous, interval measurements. This is the tacit assumption of the bivariate analysis where average evaluations were

calculated. If the evaluation scale is to be considered as continuous and interval-scaled, the differences between the points on the scale ("strongly agree" "agree" "neutral" "disagree" "strongly disagree") have to be decided upon. Standard practice is to assign the numbers 1, 2, 3, 4, 5 to the scale points. This assumes that scale points are equidistant. If this assumption is false (i.e. if the respondent's subjective use of the scale is not based on equidistant points) the predictive power of the model will be underestimated. There is some evidence that the impact of such scaling problems is usually not severe. However regression analysis does involve more rigorous scaling assumptions for the evaluation measures than does discriminant analysis.

Both methods require that the predictor variables are continuous interval-scaled variables. It is possible to relax this assumption by using dummy variables to represent each level of each predictor. Unfortunately this approach expands the predictor set from 5 product attributes to 25 product attributes levels, and for technical reasons renders discriminant analysis inapplicable. In this case we followed normal practice of assuming predictors to be sufficiently close to interval scales.

8.2.1 Discriminant Analysis

Two sets of discriminant analyses were performed, one using respondent's evaluation of "usefulness" the other using their evaluation of "buying interest". In both cases respondents were grouped as favourable or unfavourable in their evaluations. Those giving neutral evaluations were omitted from the analysis.

Table 8.3 shows the discriminant coefficients for the whole

PREDICTORS:

DEPENDENT VARIABLE:	Relative Advantage	Communi-cability	Compati-bility	4 Complex-ity	3 Trial-ability	% Correct Classi-fication
"USEFULNESS"						
all	1.53	.78	.71	.25	.23	84%
	(1.49)[1]	(.81)	(.67)[1]			(84%)
early adopters	1.56	.68	.80	.19	.18	84%
	(1.54)	(.68)	(.81)			(84%)
others	1.53	.82	.69	.27	.25	84%
	1.49	(.83)	(.65)			(84%)
francophones	1.60	.92	.77	.23	.25	84%
	(1.57)	(.99)	(.73)			(85%)
anglophones	1.46	.73	.71	.26	.23	84%
	(1.43)	(.72)	(.68)			(84%)
"BUYING INTEREST"						
all	2.03	.53	.71	.24	.13	86%
	(1.99)	(.54)	(.66)			(86%)
early adopters	2.51	.52	.51	.01	.04	89%
	(2.52)	(.52)	(.52)			(89%)
others	1.96	.54	.76	.29	.15	86%
	(1.90)	(.55)	(.68)			(85%)
francophones	2.32	.66	.80	.25	.22	88%
	(2.25)	(.75)	(.72)			(88%)
anglophones	1.96	.48	.73	.20	.11	86%
	(1.93)	(.48)	(.69)			(86%)

[1]Figures in parentheses show coefficients for analyses using only 3 predictors (relative advantage, communicability and compatibility).

TABLE 8.3 PRODUCT EVALUATIONS AND PRODUCT PERCEPTIONS: DISCRIMINANT COEFFICIENTS

sample, for early adopters, for others, for anglophones and for francophones. To be able to interpret individual predictor coefficients it is necessary to ensure that the predictors are not themselves correlated. If predictors are correlated individual effects may be misestimated, coefficients may be unstable and standard errors unnecessarily large. Table 8.4 shows the pairwise correlations between the predictors used. The largest absolute correlation (r = -.38) is between complexity and compatibility. Although this correlation is not sufficiently high to warrant a different analysis method, the asociation between complexity and compatibility should be remembered when interpreting their coefficients.

Looking first at the analyses based on "usefulness", discriminant coefficients are fairly similar over all sub-groups of the sample. In particular perceived relative advantage of the product is by far the most important variable in predicting whether a respondent rates the product as useful or not. (All predictors in Table 8.3 are standardized so the sizes of coeffiecients indicate their relative importance). Compatibility is the second most important predictor for early adopters, although it is rather less important for later adopters. Communicabiity is the third most important variable. The final two predictors, complexity and trialability are much less important, particularly for early adopters.

The coefficient on "complexity" has the wrong sign in all the analyses, this may be the result of the correlation between complexity and compatibility as noted above. In any case, neither "complexity" nor "triability" contribute to explanatory power. The effect of removing these two variables is shown by the coefficients in parentheses in Table 8.3. Really very little changes when these variables are omitted.

	RELATIVE ADVANTAGE	COMPATIBILITY	OBSERVABILITY/ COMMUNICABILITY	COMPLEXITY	TRIALABILITY
RELATIVE ADVANTAGE	1				
COMPATIBILITY	.31	1			
OBSERVABILITY/ COMMUNICABILITY	.25	.25	1		
COMPLEXITY	-.26	-.38	-.13	1	
TRIALABILITY	.23	.30	.17	-.11	1

TABLE 8.4: CORRELATIONS BETWEEN PREDICTORS

Goodness of fit of the discriminant analysis is measured by the number of cases that are correctly classified (i.e. the number of respondents whose product perception ratings allow us to correctly deduce whether they give favourable or unfavourable usage ratings). For every analysis this correct classification rate is very high, never dropping below 84%. CLEARLY THE MAJOR FACTORS DETERMINING WHETHER A RESPONDENT RATES A PRODUCT AS USEFUL OR NOT USEFUL ARE RELATIVE ADVANTAGE' COMMUNICABILITY AND COMPATIBILITY. THESE THREE VARIABLES ALONE ALLOW US TO CORRECTLY CLASSIFY 84% OF ALL RESPONDENTS.

Hypothesis H7 (see Section 2.8), that the Rogers attributes should explain evaluation is supported.

This correct classification rate is considerably above that which would be obtained by chance alone. The prior probabilities of group membership were set at .5, ensuring a chance correct classification rate of 50%. Classification rates were also validated by a number of jackknife analyses (see Fenwick 1979, for a discussion of the use of the jackknife in discriminant analysis). An example of the classification tables obtained appears as Table 8.5. Notice the classification rate is equally good for early adopters and for others. These correct classification rates are considerably better than those previously reported in the literature. Ostlund (1974) correctly identified 70% of early adopters in one study and 79% in another. LaBay and Kinnear (1981) correctly classify only 62% of solar power adopters (see the discussion above Section 2.4).

Results of "buying interest" analyses were even stronger. Correct classification rates ranged from 86% to 89%. Relative advantage was by far the most relevant variable, particularly for early adopters.

		PREDICTED GROUP MEMBERSHIP		
		Favourable Buying Interest	Unfavourable Buying Interest	Total
ACTUAL GROUP MEMBERSHIP	Favourable Buying Interest	228 (87.4%)	33	261
	Unfavourable Buying Interest	14	161 (92.0%)	175
	Total	242	194	436

Overall Correct Classification Rate = 89%

TABLE 8.5: CLASSIFICATION TABLE FOR PREDICTING "BUYING INTEREST" AMONGST EARLY ADOPTERS

Again the three predictors relative advantage, communicability and compatibility were the most important with complexity and trialability providing no additional explanatory power.

Looking at early adopters compared to others, there are only minor differences. For early adopters relative advantage is extremely important and compatibility although relevant does not play quite such a major role as it does for later adopters. Complexity and trialability have near zero coefficients for early adopters, but these variables have very little explanatory power for any group.

The extreme importance of relative advantage in forming early adopters' product evaluations fits with what we have already discovered about early adopters' product perceptions (Section 7.4). Early adopters were found to be more discerning with regard to relative advantage (rating high advantage products even higher than does the rest of the sample, and rating low advantage products even lower). Hypothesis H9 (see Section 2.8) that early adopters will form their evaluations in a distinctive way, gets only minor support.

8.2.2 Regression Analysis

The discriminant results show that the direction of an individual's evaluation of a product can be rather well predicted. In almost 90% of all cases we can correctly predict whether an individual will favourably evaluate a product (i.e. "agree" or "strongly agree" that "I am interested in buying this product"). Regression analysis attempts to go a step further and predict an individual's level of evaluation. We attempt to predict whether an individual will "strongly agree", "agree", be

"neutral", "disagree" or "strongly disagree". This is clearly a more difficult task, and given that individuals may differ in the meaning they attach to "very" it is not obvious that predicting the level of evaluation is necessarily meaningful.

Separate regression analyses were performed using the "usefulness" rating of the product (i.e. agreement, measured on a 5 point scale, with the statement "This device would be very useful in my home") and the "buying interest" rating (i.e. agreement, measured on a 5 point scale, with the statement "I would be interested in BUYING this device").

The model fitted is a linear relationship between product evaluation ("usefulness" and "buying interest") and the 5 Rogers attributes. Regression coefficients are reported in Table 8.6, as all variables were standardized the coefficients reported are measures of each predictor's relative importance.

For the sample as a whole we can explain 45% of the variation in usefulness ratings and 48% of the variation in buying interest ratings. These are comparatively strong results. Whenever we try to explain ratings across individuals R^2 values tend to be low. Many factors affect an individuals' ratings in addition to the 5 product attributes measured here (e.g. individuals' rating styles, their interpretation of scale positions, how they felt at the time, their peculiar situation etc.). Given the wide variety of essentially unpredictable variables involved, explanation levels of around 59% are accepted as good.

By far the most important predictor is relative advantage. This variable is also crucial in predicting buying interest. The second most important variable in predicting usefulness is communicability, but

PREDICTORS:

DEPENDENT VARIABLE:	Relative Advantage	Communic-ability	Compati-ibility	Complex-ity	Trial-ability	R^2
"Usefulness"						
all	.49	.25	.20	.09	.07	.45
early adopters	.46	.23	.22	.06	.05	.47
others	.47	.24	.18	.09	.07	.44
francophones	.47	.24	.18	.08	.10	.43
anglophones	.46	.23	.20	.09	.06	.42
"Buying Interest"						
all	.64	.18	.20	.09	.06	.48
early adopters	.58	.14	.14	ns	ns	.51
others	.55	.16	.17	.09	.05	.47
francophones	.59	.17	.14	.08	.07	.44
anglophones	.55	.16	.18	.06	.04	.46

TABLE 8.6: PRODUCT EVALUATIONS AND PRODUCT PERCEPTIONS: REGRESSION COEFFICIENTS

in predicting buying interest this slips into third place. The third most important predictor of usefulness is compatibility, which narrowly outperforms communicability in predicting buying interest. The final two Roger's attributes, complexity and trialability, are much less important. As in the discriminant analysis the coefficient on complexity has the wrong sign but is very close to zero. In fact the first three variables above, Relative Advantage, Communicability and Compatibility, can explain 44% of the variation in usefulness ratings and 47% of the variation in buying intent, the final variables add scarcely anything to predictive power. All coefficients shown in Table 8.6 are significant at the 1% level.

Regressions were also estimated for early adopters separately from the rest of the sample (Table 8.6). Explanatory power is a little better for early adopters (47% of the variation in usefulness and 51% of the variation in buying interest) but the relative size of the coefficients are very similar. FOR BOTH EARLY ADOPTERS AND OTHERS RELATIVE ADVANTAGE IS THE MOST IMPORTANT PRODUCT CHARACTERISTIC FOLLOWED BY COMMUNICABILITY AND COMPATIBILITY. EARLY ADOPTERS DO NOT HAVE A DISTINCTIVE PRODUCT EVALUATION EQUATION.

8.3 COMPONENTS OF RELATIVE ADVANTAGE

Given the importance of relative advantage in predicting respondents' favourability ratings, it is useful to decompose the relative advantage scale into its component items and attempt to estimate the contribution of each component to overall favourability assessment. Five items make up this relative advantage scale (see Table 6.1 above): "The

price of this device is too high for me to consider purchasing it", "This device would soon pay for itself", "I doubt this device could save the amount of energy claimed", "compared to other ways of saving energy, this one is superior", "It would be hard to determine how much energy this device saves". Within product maniuplations of relative advantage focussed on price ($10 light bulb vs. $20 light bulb) and payback period (1 year payback energy monitor vs. 2 year payback energy monitor). Between product manipulations also used a range of prices (from $10 or $20 for a light bulk to $465 for a solar economiser) and payback periods (from 3 months for a shower flow restrictor to 3 years for a solar economiser).

The immediate problems of disaggregating the relative advantage scale are reliability and multi-collinearity. The whole point of forming a scale from a set of individual items is to improve the reliability of our measures and effectively allow random errors to cancel out (see Section 5.2.1 above). Disaggregation leaves the individual items of untested reliability and with more random content than the scale as a whole. Also as the items are related (all measure relative advantage) they are by definition intercorrelated. Table 6.1 shows pairwise intercorrelations. The largest absolute value is -.54, the correlation between responses to "This device would soon pay for itself" and "I doubt this device could save the amount of energy claimed". Correlations of this magnitude reduce the efficiency of least squares estimates (standard errors of the coefficients will tend to be high) and affect our ability truly to discern the relative effects of individual predictors. If two predictors always vary together the data contains insufficient information to allow their individual effects to be estimated. The way we constructed

several of the product concepts manipulated price and payback period separately (the light bulbs differed in price while having a constant payback period; the energy monitor changed payback period while maintaining a constant price) nonetheless the correlation between perceived payback period and perceived price, over all product concepts, is -.50. All comments on the individual effects of the dimensions of relative advantage have to be interpreted in the light of significant intercorrelations.

Table 8.7 shows the coefficients obtained from regressing product evaluations on the relative advantage items. Regression was performed for each language group and early adopter classification. All predictors were standardized so coefficients can be interpreted as indicators of the predictor's relative importance (remembering the potentially disruptive effects of multicollinearity). As expected price perceptions have no significant effect on product usefulness evaluations. This is reassuring both as to the validity of the survey as a whole and to the limited impacts of multicollinearity. Were multicollinearity severe, price could have appeared to have a spurious effect on usefulness ratings. That price does not have such an effect provided some reassurance in interpreting the coefficients of the other regressions.

In assessing "usefulness" the most important predictor for all groups is payback period (agreement with the item "This device could soon pay for iself"). This is especially important in the usefulness perceptions of francophone early adopters. The second most important predictor of usefulness is a general superiority (agreement with the item "compared" to other ways of saving energy this one is superior").

In assessing "buying interest" there are some differences between

DEPENDENT VARIABLE:		PREDICTORS: "The price of this device is too high for me to consider purchasing it"	"This device would soon pay for itself"	"I doubt this device could save the amount of energy claimed"	"Compared to other ways of saving energy these are superior"	"It would be hard to determine how much energy this device saves"	R^2
"USEFULNESS							
early adopters:	anglophones	-.04	.29**	-.10*	.26**	-.10**	37
	francophones	.06	.52**	-.28**	.30**	.17**	.64
others:	anglophones	.03	.34**	-.11**	.30**	-.06**	.40
	francophones	-.00	.34**	-.20**	.31**	.04	.44
"BUYING INTEREST"							
early adopters:	anglophones	-.21**	.20**	-.20**	.22**	-.07	.46
	francophones	-.22**	.46**	-.15*	.21**	.08	.60
others:	anglophones	-.20**	.31**	-.10**	.24**	-.02	.43
	francophones	-.14**	.36**	-.23**	.25**	.05*	.53

*Indicates significant at 5% level. **Indicates significant at 1% level.

TABLE 8.7 PRODUCT EVALUATIONS AND RELATIVE ADVANTAGE ITEMS: REGRESSION COEFFICIENTS

anglophones and francophones. As the pattern of inter-item correlations are highly similar between francophones and anglophones (see Table 6.1 above) these differences are probably not the result of multi-collinearity but are probably genuine differences. For anglophones (particularly for anglophone early adopters) all predictors are of approximately equal importance. Anglophone non-early adopters show payback period as rather more important than other variables.

On the other hand francophones show payback period as the most important predictor, by at least a 44% margin. Particularly for non-early adopters, price is of little importance beside payback period. Unfortunately for francophones the predictor "It would be hard to determine how much energy this device saves" has the wrong sign, and for francophone non-early adopters is significant, suggesting that multicollinearity may be having an impact here.

At present we can only make the suggestion that payback period appears to be more important than price in predicting "buying interest" and "usefulness" particularly amongst francophones. This result is however speculative being open to the influence of multicollinearity and specific to the range of values tested here. Further research could profitably focus on experimentation designed to manipulate the components of relative advantage according to an orthogonal design, using a wider range of replicated measurement than attempted here.

9.0 CONCLUSIONS AND POLICY IMPLICATIONS

This study was designed to gain a general understanding of early adopters of energy conservation products. It was not directed towards any specific energy conservation program or policy. Consequently, this research is intended to provide the groundwork for later policy specific analyses. Conclusions are presented in two parts. The first part deals with methodological conclusions, relevant for planning and executing future projects in this area. The second part looks at policy implications, by design involving overall marketing strategy rather than the specific tactics for marketing any particular program.

9.1 METHODOLOGICAL CONCLUSIONS

First, a mail survey intentionally appealing to a self-selected, rare, sub-group of the population was very effective. Ownership of energy conservation products in our sample was two to four times higher than in the Canadian population as a whole. Sampling a rare group is always difficult, particularly when group membership is not readily visible and the group is geographically dispersed. The mail questionnaire procedure appears to work well and is extremely cost-effective.

However, it is important to remember that our respondents are definitely self-selected and may not be typical of the total population of early adopters. Response to the French questionnaire was particularly low. Future research should aim to improve francophone response. The only way to generate a more certainly random sample of early adopters would be to use a high response rate interviewing method (e.g. phone or personal interviews) and rely on screening to identify early adopters.

The cost of the large number of contacts required to generate sufficient early adopters would be very high.

More specialized sampling frames could be useful for future studies (e.g. mailing lists of energy conservation oriented magazines, subscription lists of conservation pressure groups or recipients of government grants or information). Compared to the procedure used here such frames should increase response rates, but would probably produce samples with less claim to represent all early adopters.

Second, this study finds that measures of innovativeness do overlap. Individuals that are identified as early adopters in a cross-sectional sense (i.e. by the number of energy conservation products owned) also tend to score highly on self-reported innovativeness scales. Similarly correlations between numbers of products owned at different points in time are high, suggesting that time of adoption is related to number of products adopted.

The cross-sectional adoption measure was used here as it spreads early adopter definition over several products, inherently reducing the impact of chance events and of non-conservation reasons for product adoption. However a detailed assessment of each product's adoption date has not yet been performed. Such an analysis could indicate specific products whose adoption is not well predicted by our cross-sectional measure. The data is available for this analysis. The measures of generalized innovativeness were not reliable and were not related to other early adopter definitions.

The third point concerning methodology is this study's careful concern to estimate the reliability of its measures. Measurement is only

meaningful to the extent that it measures systematically. If a scale contains a high proportion of random response, or error, it is unreliable. Such unreliable scales will be unlikely to explain individuals' behaviours and the chance, or error, component in the scale will reduce its correlations with other scales and behaviours. Previous energy conservation research has tended to find little relationship between attitudes and energy consumption. Instead physical household characteristics have offered the best explanation of domestic energy use. These results could be explained by the unreliability of the attitude measures used, in contrast to the highly reliable easily quantified physical household characteristics. Much of the previous research, both in energy conservation and early adoption, fails to report or even to test reliability. If research is to be programmatic, building on past successes, development of reliable measures should be given a high priority.

In this study we obtained highly reliable measures of opinion leadership, social integration and product relative advantage. Fairly reliable measures of product compatibility and product complexity were developed, although these did not include all the items expected to measure these constructs. Product observability/communicability and product trialability could be measured only by single items. It is surprising that more reliable measures of Rogers product attributes are not available. The measures adopted had all been used in previous research (with usually unreported reliability). The four energy conservation attitude items did not relate to one another and measured four distinct constructs (and/or random error).

It is hoped that future energy conservation research will estimate and report scale reliabilities. It would be useful to examine the research currently available to identify sets of reliable items. Those items of proven reliability could then constitute a test bank for use in future projects.

9.2 ENERGY CONSERVATION POLICY CONCLUSIONS

9.2.1 Francophones/Anglophones

A recurring theme throughout this research is the contrast between anglophones and francophones: from survey reponse to product perception and evaluation, anglophones and francophones are distinct.

Response rates were much lower for French questionnaires (14.2%) than for English questionnaires (23.6%). We can only guess at the reason for the lower French questionnaire response rate. Perhaps it is an indication from the outset that francophones have a lower level of interest in energy conservation. Alternatively francophones may simply be less likely to respond to survey questionnaires (or to survey questionnaires originating in Ontario). Other energy conservation research has faced similar problems in representing francophone households. A future research priority should be to gain greater co-operation from francophone respondents.

Looking only at respondents from Montreal, francophones tended to be less well-educated, less likely to be in professional or managerial occupations, and reported median incomes $15,000 below anglophones. Francophones were also much less likely to live in single, detached homes

(70% of Montreal francophones lived in single family homes vs 94% of Montreal anglophones). All statements made here with respect to "francophones" are based on the particular sample of francophones responding, a sample which as we see differs from the anglophone sample in more than language. Clearly it is difficult under these circumstances to isolate cultural differences from differences in demographic composition.

The francophones in our sample are less likely to own energy conservation products and as a result are less likely to be classified as early adopters. 18% of anglophones are classified as early adopters vs only 13% of francophones. The markedly lower penetration of energy conservation products amongst the francophone sample is potentially of policy concern. Not only are francophones less likely to own conservation products, they are also less likely to have heard of the energy conservation products features in the product concept part of the questionnaire. Over all the product concepts used francophones are significantly less aware than anglophones. The gap in awareness is greatest for the showerflow restrictor, a product currently on the Canadian market. That francophones tend to be unaware of this product is particularly disappointing as they actually give the concept a more favourable evaluation than do anglophones. The implication is that awareness, not unfavourable product perceptions or evaluations, may be the major stumbling block to greater francophone ownership of this product.

The francophone potential for conservation appears high. On average francophones reported spending $844 p.a. on heating, compared to $676 p.a. for anglophones.

However, there is evidence that francophones do view some

product attributes differently from anglophones. In particular although more likely to give high relative advantage and trialability ratings, francophones were more sensitive to the compatibility of products with their life-styles. This is especially obvious when considering those product concepts which explicitly manipulated compatibility. The "self-installed" solar economiser and the showerflow restrictor that "reduces shower quality" were rated as much less compatible by francophones than by anglophones. Compatibility of energy conservation products with existing lifestyles is an important consideration in the buying decisions of anglophones and francophones. The difference is one of degree of importance. The impact of compatibility for francophones is well demonstrated for the showerflow restrictor. The "reduces shower quality" version was rated very significantly lower on usefulness and buying interest. The gap in buying interest between the "reduces shower quality" version and the "quality unaffected" version is twice as wide for francophones as for anglophones. If current energy conservation products are to increase their penetration of the francophone market it seems that they need to be positioned as having less impact on users' life-styles, as more compatible products. It may be that at present energy conservation products are viewed as requiring too much sacrifice and dislocation to be adopted by francophones.

As discussed below, compatibility is not the only factor affecting the evaluation of energy conservation products. Even for francophones, relative advantage is more important. The problem is that at the levels of relative advantage now offered, francophones perceive the costs of incompatibility as just too great. This research suggests that franco-

phones' relative advantage perceptions are in fact already higher than those of anglophones and that the best chance of improving adoption is in boosting francophones' perceptions of compatibility and/or increasing francophone awareness of the products available.

A further barrier to the adoption and diffusion of energy conservation products among francophones is suggested by the characteristics of francophone early adopters. In contrast to anglophone early adopters, francophone early adopters were no more socially integrated than the average francophone. So francophone early adopters do not tend to play the social role of their anglophone counterparts; they are not more likely to be involved in voluntary work or to go to social gatherings, etc. As a result francophone early adopters may be less effective opinion leaders simply because they operate in a more restricted social milieu than their anglophone counterparts. Such interpretations, although attractive, are clearly speculative at the moment.

Finally, francophones show a tendency to see energy conservation as difficult. 42% of francophones agree that "It would be hard for me to cut down on the use of energy in the home"; only 23% of anglophones believe this (see Table 5.11). Given that anglophones tend to own more energy conservation products and therefore are likely to have reduced their energy consumption already, this is a particularly startling result. Moreover both anglophones and francophones overwhelmingly disagree with the statement "There is not much the average citizen can do to save energy" (88% of anglophones disagree with this statement vs 81% of francophones). Some francophone respondents clearly acknowledge that while energy conservation is possible for others, it would be hard for them.

This effect may reflect demographic as well as cultural factors. However, even if we restrict the analysis to owners of single, detached homes (Table 5.11a) the effect remains.

Overall these francophone/anglophone comparisons suggest:

i) there is considerable potential for energy conservation by increased penetration of energy conserving products within the francophone segment of the population

ii) information about energy conservation products is not getting through even to francophone early adopters

iii) marketing programs to francophones should use different appeals from those to anglophones in particular stressing compatibility

iv) government communication programs should be aimed at getting francophones to take a personal view of the possibilities of energy conservation.

v) future energy conservation research should make a major effort to obtain francophone response.

9.2.2 Early Adopters

Early adopters (defined by the number of energy conservation products owned) are definitely upscale of the population as a whole, but only slightly upscale of our sample. Although we find early adopters tend to be older, higher income and better educated, these characteristics are not sufficient to define the group. Many in our sample were upscale, but were not early adopters. From the marketing perspective this suggests that communications intended for early adopters should use vehicles with an upscale audience, but will need to use self-selection to target early adopters specifically. It seems to be impossible to define early adopters more tightly in demographic terms.

Early adopters and opinion leaders do overlap. Those most likely to own many energy conservation products are also likely to be involved in

energy conservation discussions and to be looked to for advice, etc. This overlap is not perfect: opinion leaders as a group are not identical to early adopters. But they are close. This means that the product experience of early adopters will be diffused throughout their communities rather quickly. This should encourage rapid diffusion of energy conservation products provided early adopters product experience is positive. If early adopters find that energy conservation products do not live up to expectations, (e.g. are faulty, or provide less relative advantage, or greater incompatibility than expected) they will disseminate adverse product reports and curtail diffusion. Indeed, one of the few differences in perception between early adopters and others is a tendency for early adopters to be more discerning in their judgements of relative advantage. Early adopters may judge a product's claimed energy savings particularly critically. All this makes any early product failures extremely damaging. Early adopters are gate-keepers to wider product acceptance; if the product fails to perform for them it may not get the chance to perform for others. In this light the impact, say, of the adverse publicity concerning urea-formaldehyde foam insulation can be seen as a major barrier to diffusion of the CHIP program. Early problems even when corrected will have major effects on diffusion.

Apart from a more critical assessment of each products' relative advantage, early adopters are not distinctive in their product perceptions. Although they tend to see all products as "more useful" and "more compatible", the major difference between early adopters and other respondents is awareness. Overall, early adopters are significantly more likely to have heard of the product concepts. This difference is particularly

marked for the solar economiser and the showerflow restrictor, both products which are on the market in one form or another and have received publicity. Unfortunately we cannot determine whether awareness is the cause or effect of early adoption. Do early adopters own energy conservation products because they are more aware of the available products? Or are they inherently more sensitive to messages about energy conservation? The latter explanation is a possibility although this study could not find distinctive early adopter attitudes or opinions.

Early adopters did report that they are driving less. This suggests that energy conservation activities may be linked over different energy uses. Indeed the fact that early adopters, owning a number of energy conservation products, even exist suggests the opportunity for cross-marketing of energy conservation. Individuals who buy one energy conserving product appear to be good prospects for other conserving products, and for energy conservation activities. In practical terms, individuals requesting automobile gas usage reports, or applying for CHIP grants could form a useful mailing list for ENERSAVE or other conservation programs.

9.2.3 Product Perceptions and Evaluations

Our manipulations of the product concepts showed that price, payback period and compatibility (both in the sense of ease of installation and ease of use) all affect perceived relative advantage. There is some evidence that compared to other respondents early adopters may form their relative advantage assessments based on payback period rather than price. Also, surprisingly, expert-installation boosted relative advantage for non-early-adopters although as expected it reduced relative advantage for

early adopters. This is consistent with a lack of confidence amongst those who are not early adopters; they find the reassurance of expert installation valuable in reducing product risk. In policy terms this risk could be reduced in other ways -- e.g. product endorsements (by respected figures or organizations) or guarantees or government standards.

For all respondents there is a gap between acknowledging the usefulness of a product and stating a buying interest. This gap widens as the product's price increases. The big ticket solar-economiser-expert-installed shows the largest drop off from usefulness to buying intention. Clearly energy conservation products have to be more than merely "useful", they have to be useful in relation to their price.

The manipulation which produced the largest effect on buying interest involved the showerflow restrictor. The "reduces shower quality" version led to significantly lower buying interest (particularly for francophones). The big effect of this manipulation is the result of its affecting both relative advantage <u>and</u> compatibility.

Discriminant analysis allows us to examine the effects of all aspects of product perception simultaneously. Product perceptions are found to be very good indicators of the direction of individuals' product evaluations. In the vast majority (84%) of cases we can predict whether individuals' evaluations of a product will be favourable or unfavourable based only on their perceptions of the product. In fact only three perceptual variables are important: relative advantage, communicability and compatibility. The other two of Rogers product attributes (trialability and complexity) provide very little additional predictive power. Furthermore relative advantage is by far the most important variable. In

explaining judgements of product "usefulness" its effects are greater than the total effect of communicability and compatibility put together. In explaining "buying interest" perceived relative advantage is even more important -- having 4 times the effect of communicability and 3 times the effect of compatibility. For early adopters relative advantage is an even more dominant determinant of buying interest.

This means that despite the comments above on the need to position energy conserving products as compatible (particularly when marketing to francophones), incompatible products can get a favourable evaluation if they are perceived to offer sufficient relative advantage. Indeed, as relative advantage is given so much weight, it is quite possible for fairly modest gains in relative advantage to outweigh considerable incompatibility, provided those relative advantage gains are perceived correctly (and believed).

A key to the role of early adopters of energy conservation products is the increased weight given to relative advantage by early adopters. Early adopters are more likely to let relative advantage gains outweigh product incompatibility, as a result they buy products when relative advantage is lower (i.e. at lower levels of energy prices and higher product prices) and/or compatibility lower (i.e. products which are not totally perfected, or which are more intrusive than they could be). The major role assigned to relative advantage highlights the problems of mis-perceived, and/or artifically restrained, energy prices. The relative advantage of all energy conservation is crucially tied to the market price of energy. As energy costs rise, conservation products' relative advantage is automatically increased. If, for wider policy reasons,

energy prices are restrained those marketing energy conservation products can manipulate perceived relative advantage by i) ensuring consumers perceive current prices correctly, (ii) that consumers have realistic expectations of future energy prices, (iii) improving the operating efficiency of conservation products (and ensuring that improvements are perceived) or (iv) reducing the price of energy conservation products. Alternatively marketing must concentrate on the other important product attributes, communicability and compatibility.

Some caution is necessary in interpreting these results. In particular, the individual elements of product perception are slightly correlated. Relative advantage and compatibility are correlated with r=.31, i.e. 9% of their variation is common. So the estimates of individual coefficients are not perfect. As relative advantage and compatibility to some extent vary together their coefficients are to some extent intertwined. This level of multicollinearity is not usually considered a major problem.

Also this analysis involves respondents' evaluations of written concept descriptions. Such descriptions may give quantitative (usually relative advantage) data greater weight in the respondent's mind than it would have in a "real" buying situation. A more realistic research design would provide respondents with longer product descriptions, including artwork or promotional literature (naturally this would increase the cost of fieldwork). Nonetheless we have seen that respondents recognize differences between concepts on other than relative advantage, but that those differences are only weakly related to evaluations.

Breaking relative advantage down into its components provides

additional insights, and additional problems. Multicollinearity does now become more severe. The individual elements of relative advantage ("The price of this device is too high for me to consider purchasing it", "This device would soon pay for itself", "I doubt this device could save the energy claimed", "Compared to other ways of saving energy, this one is superior", "It would be hard to determine how much energy this device saves") are correlated. By manipulating individual elements of relative advantage (i.e. price and payback period) we have attempted to keep item intercorrelations down. Nonetheless perceptions of "price ... too high" and "soon pay for itself" are correlated, r=.5, i.e. 25% of their variance is shared. As a result it will be impossible to completely disentangle their individual effects using this data. However the analysis suggests that perception of "This device would soon pay for itself" is the most important individual predictor of buying interest, this effect being particularly strong for francophones.

Interestingly, looking at the specific product for which payback period was varied (the energy monitor), moving from a 2 year payback to 1 year payback did <u>not</u> have a significant impact on buying interest. The manipulation did change perceptions of "This device would soon pay for itself" significantly, but this change had only a small, insignificant, effect on evaluations. The result obtained in regression pools data across all 8 product concepts and so measures the effects of payback period over the whole range from 3 months (for the showerflow restrictor) to 3 years (for the solar economiser). It appears that big variations in payback period (going from 3 months to 3 years) may have a major impact on evaluations while small changes in payback (going from 1 year to 2 years)

leave evaluations unaffected.

Future research should systematically manipulate individual elements of relative advantage over a wider range of values than attempted here. Such manipulations should be administered across subjects, as here (i.e. each respondent evaluates only one version of a product). Data collection could probably be accomplished by buying space on an existing omnibus survey. Certainly this research points strongly to relative advantage as the major determinant of buying interest (particularly amongst early adopters) and suggests that individual elements of relative advantage may have differing impacts on product evaluation.