

**"AN INTEGRATED AND CROSS-CULTURAL  
STUDY OF DIFFUSION THEORY"**

by

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# **An Integrated and Cross-Cultural Study of Diffusion Theory**

## **Abstract**

Motivated by the comprehensive review in Gatignon and Robertson (1985), this paper simultaneously tests various prevailing consumer theories of new product adoption. It puts special emphasis on the impact of culture on adoption, a topic that has been largely neglected in previous research. We study ten home-office and high-end consumer electronics innovations using a sample of some 900 individuals from over 30 countries. In addition to uncovering new aspects of consumer innovativeness, this paper represents a first attempt to gauge the relative importance of all relevant forces driving individual adoption timing for new products, as hypothesized in the extant literature.

# An Integrated and Cross-Cultural Study of Diffusion Theory

## INTRODUCTION

Since the 1960s, the consumer behavior literature has considered various aspects of new product adoption and diffusion (Arndt 1967, and Robertson 1967, 1971). Gatignon and Robertson (1985) have summarized this literature within an integrated framework, which positions various research streams into numerous propositions concerning key aspects of new product adoption timing and diffusion. Figure 1 shows the basic framework from which most consumer studies on the diffusion of innovations can be positioned (adapted from Gatignon and Robertson, p. 850). Previous studies have focused on three basic forces: (1) personal variables, related to the person who adopts the innovation (demographics and psychographics), (2) product variables (related to the innovation's perceived attributes), and (3) social system variables that describe the environment in which diffusion occurs (typically the country, geographic, or cultural setting).

This paper represents a first attempt to simultaneously estimate the relative importance of the various forces which are likely to affect consumer adoption timing (innovativeness) of discontinuous innovations (Robertson 1967). Table 1 lists consumer studies for each of the three basic forces, the general constructs considered, and each study's findings. The literature reviews in Gatignon and Robertson (1985) and Holak and Lehmann (1986) have noted, as shown in Table 1, that existing studies fail to compare *all* relevant variables (hypotheses) and basic forces in a single model. While a number of studies compare the relative importance of subsets of the variables within each of the three forces (see, for example, Robertson and Kennedy 1968, Ostlund 1974, or Hirschman 1980) or the relative importance across two forces (Ostlund 1973; Holak 1985, 1988), none to our knowledge simultaneously considers the various factors within each force, while also measuring the relative importance of the three forces themselves as shown in Figure 1. Previous studies find, for example, that product dimensions (e.g. perceived relative advantage or compatibility) dominate other variables (e.g. consumer risk aversion) in explaining innovativeness, but fail to consider how these effects depend on culture (e.g. one's nationality).

[Insert Figure 1 and Table 1 About Here]

The consideration of culture is lacking in most consumer behavior studies of new product adoption (Douglas and Craig 1992) and diffusion studies in general (Rogers 1983). This is mostly the consequence of the literature generally focusing on diffusion within a given country,

market potential or cultural group. Exceptions include early diffusion models (Mahajan and Peterson 1978; Peterson and Mahajan 1978) which have incorporated environmental variables that determined the size of the potential market, but these variables have been criticized to be "limited in scope" (Gatignon and Robertson 1985). Heeler and Hustad (1980) suggest introducing more general environmental characteristics describing communication patterns and economic conditions across countries. Along this line, in a comparative study including six European countries and the United States, Lindberg (1982) considers several macroeconomic variables (e.g. size of population, income, inflation rate, etc.) to forecast the relative demand in lagging countries (where the product was launched later) based on data from leading countries. In a more recent study on 14 European countries Gatignon, Eliashberg and Robertson (1989) propose a cross-national diffusion model where they classify countries by three primary dimensions: cosmopolitanism, mobility and sex roles. Consistent with this literature having very little, or inconsistent cross-country emphasis in the past, Douglas and Craig (1992, p. 298) note that "relatively little attention has been paid to examining the diffusion of innovations across countries nor the determinants or degree of innovativeness in different cultural contexts."

Our paper is a direct response to the call made by Gatignon and Robertson (1985, p. 864), among others, who suggest that "the entire framework should be considered" and "estimated through an analysis of covariance structure".<sup>1</sup> In doing so, our study represents a first step in providing insights into the following research questions:

RQ1: Do the variables (hypotheses) suggested in the extant literature reflect independent constructs or are they manifestations of fewer underlying constructs?

RQ2: Are there mediation effects among the variable categories or do the basic forces affect innovativeness independently?

RQ3: To what extent does culture contribute to adoption timing as a direct force, or as mediated by personal or product forces?

RQ4: Is the basic model (personal and product variables affecting innovativeness) consistent or robust across cultures (social systems)?

RQ5: Across the various forces including culture, which appear to be most relevant in predicting one's proneness to innovate (adopt early)?

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<sup>1</sup> Throughout the text we will refer to certain propositions, given by number, suggested in Gatignon and Robertson (1985).

Finally, our paper addresses, in a brief discussion outside of the studies undertaken, the following research question:

**RQ6:** Does an understanding of consumer-level innovativeness within the primary segment across cultures (e.g. the paradigm in Figure 1) provide useful information in understanding aggregate adoption rates (diffusion patterns) across these cultures?

In the conclusions of our paper, we will discuss whether it is possible to explain the wide variances seen in cross-country diffusion patterns based on consumer-level models of innovativeness (Gatignon, Eliashberg and Robertson 1989). This discussion is germane to the management science literature which has recently suggested using consumer survey research to calibrate aggregate diffusion models (see the review in Mahajan, Muller and Bass 1990, p. 20).

Our paper is organized as follows: the next sections summarize the general model, justify the survey methodology and describe the data collection procedure. Two studies are then reported. Study #1 estimates the core model, and tests prevailing hypotheses using an aggregate sample. Study #2 evaluates the impact of variances in cultural characteristics on the core model, and possible mediation effects. Study #2 also evaluates whether the core model is applicable across cultures (i.e. has structural equivalence across cultures). Within each study, care is made to highlight the incremental insights gained in relation to the existing literature. The paper ends with concluding remarks, caveats and suggestions for further research.

## THE MODEL

### The Core Model

As the primary goal of this research is to integrate existing theories of diffusion within a single study, we explicitly assume the general model (Figure 1) as our working hypothesis based on a systematic review of the literature published since the early 1960s (the key papers included are summarized in Table 1). Most of the factors in the model, therefore, are not original to this research and have been previously motivated in Rogers (1983), Gatignon and Robertson (1985) and Holak (1988). From our review a *master list* of constructs or variables was created. In most cases, work in this area has relied on single-item measures of basic constructs, and these measures have been re-used across studies, leading to a number of redundant constructs. The *core model* consists of two forces affecting innovativeness, or adoption timing: (1) personal characteristics, and (2) product characteristics (which are perceived). Personal characteristics can be further classified into two separate groups: (1) demographics (e.g. age, wealth), and (2) psychographics (e.g. attitudes toward various forms of risk). Perceived product characteristics

are typically classified in the literature as six independent constructs which follow the acronym ACCORD (see Rogers 1983, p. 15 and Angelmar 1990): (A) relative advantage over alternative innovations, (C) complexity, (C) compatibility with social (cultural) norms, (O) observability of innovation benefits, (R) social, financial or other risks, and (D) divisibility or pre-use triability. Most authors have treated these first two forces in isolation, or independently with the exception of Holak (1988) who considers interactions between certain personal and product variables. In general, perceptions are considered to be generated from independent, yet unidentified sources.

### Model Extensions

In addition to replicating previous constructs, our core model augments the previous literature in line with suggestions made in Gatignon and Robertson (1985). First, the authors conclude (p. 864) that the core model is basically the same paradigm as developed in rural sociology and that "consumer research has made little progress in advancing diffusion theory". Our study responds to this observation by exploring two behavioral areas: (1) consumer responsiveness to change agent actions, and (2) reliance on immediate, family-based interpersonal influence. Gatignon and Robertson (p. 864) note that most diffusion studies fail to investigate the potential variances in consumer's propensities to respond to change agent (the firm's) actions. To consider these, we have added a class of variables, labelled *Consumer Behavior*, which measure (1) the extent to which consumers use certain marketing actions as signals of quality (see, for example, Rao and Monroe 1988), (2) consumer information search and shopping behavior, and (3) consumer proneness to using various media and information sources prior to adoption. Rogers (1983) hypothesizes that earliest adopters are most affected by change agent communications. Gatignon and Robertson (1985, p. 862) further propose that "the greater the individual's propensity to use mass media or from sources external to the immediate social system (relative to interpersonal contacts within the social system), the earlier the adoption". Similarly, the normative marketing literature has modelled advertising so as to mostly affect earliest adoptions (Horsky and Simon 1983). We also consider the role of interpersonal influences generated from immediate family members (children, spouses, and parents), which has been considered in consumer research on non-innovation consumption behavior for high-involvement products (see Dubois and Marchetti 1993). We conjecture that such influences can play a role in innovation adoption for three reasons: (1) many household innovations are consumed by multiple family members, (2) these represent major focal points for family discussion, and (3) Robertson (1967) notes that discontinuous innovations result in substantial behavioral change which makes their adoption high involvement purchases and subject to multiple decision-makers.

The second area where our study augments the core model responds to Gatignon and

Robertson's (p. 864) recommendation that tests of diffusion theory include "multiple measures of these constructs". By integrating the inventory of existing measures and grouping these by construct, we have subsequently incorporated multiple measures for each (as the same construct has been studied using different single-item measures across studies); for the categories studied, discussed below, this resulted in a battery of over 200 questions. Relying on these extant measures allows us to uncover statistically interdependent or "underlying" constructs which may have been assumed independent in previous studies (RQ1).

Third, our study is unique in specifically integrating culture, which is also investigated using multiple measures, into the core diffusion model. The term *social system* is frequently used in the diffusion literature as being applicable to any population, market potential or cultural group. Here, we use the term culture to imply international differences in social systems (e.g. nationalities, trading areas, or other international distinctions). As our study draws from a sample representing numerous nationalities (which is a common definition for social system in diffusion research), we consider multiple aspects of social system on the model, including socio-economic development, within-country homogeneity, marketing orientation, and geo-political proximity/orientation. For the remainder of our discussion, therefore, we refer to culture, understanding that this reflects one form of social system.

Finally, Gatignon and Robertson (p. 864) note that "the literature has been largely concerned with direct relationships or main effects". The model in Figure 1 explicitly allows mediation effects, as defined by Baron and Kenny (1986), between personal variables and innovativeness, via perceptions, and culture and innovativeness, via personal and/or product variables. The consumer behavior literature commonly finds, for example, that perceptions may, in fact, be partially generated by personal factors (e.g. that certain demographic groups perceive the value of certain products more than others). Furthermore, cross-cultural studies have found that culture can be mediated by either personal or perceptual constructs (e.g. the Japanese culture generates low levels of personal risk aversion, and, therefore, lower perceptions of product risk; see, for example, Dawar and Parker 1994, p. 84).

## SAMPLING ISSUES

### Sample Matching Requirements

The sampling and general survey procedures used to evaluate the model directly follows recommendations on cross-cultural studies provided in Dawar and Parker (1994), Douglas and Craig (1983), Irvine and Carroll (1980), Kale and Sudharshan (1987), Levitt (1983), Sheth (1986) and Simmonds (1985). Contrary to casual intuition these studies demonstrate the

necessity of using matched samples, as opposed to random samples, in multi-cultural studies, and strongly argue that student samples serve this purpose provided that certain conditions be met (Durvasula et al. 1993). The key advantage of student samples, beyond convenience, is the de facto matching process that university admissions procedures impose (Lynch 1982). Extraneous unmeasurable covariates that might pollute analyses of variance are minimized by using students who have relatively similar socio-economic backgrounds than populations sampled at large. Dawar and Parker (1994, p. 82) caution, however, with respect to cross-cultural studies:

"Which matching criteria are used will depend on the category studied, but will most likely include economic criteria (wealth, professional status) and/or demographic criteria (age, marital status, lifestyle, family size) that characterize specific segments (Anderson and Engledow 1977; Engledow, Thorelli and Becker 1975; Katona, Strumpel and Zahn 1973). For example, we would sample doctors for medical products, engineers for technical industrial products, and farmers for agricultural products; samples drawn should be representative of the segments targeted by the marketer, and not of the overall population of each culture or country."

The authors conclude that student samples are effective in cross-cultural contexts provided that the respondents actually represent a qualified or target segment for the categories under study and are actual consumers (as opposed to hypothetical consumers) of the products in question (or high potential users in the case of as yet unlaunched innovations). Whereas one might fear biases generated by sample homogeneity, a number of cross-cultural consumer studies have found significant cross-cultural effects while using student admissions procedures as a sample matching mechanism; see, for example, Durvasula et al. (1993).

### **Diffusion Relevance Requirements**

In addition to handling concerns over sample matching and product-respondent relevance, we must also consider two shortcomings of random-sample-based diffusion research which some authors argue lead to little, if not biased, insights into the forces driving individual adoption timing (Rogers 1983). The first is that random samples will likely pick up an insufficient proportion of "innovators", as these represent, for most products, a very small percent of the general population; typical sample sizes, therefore, are generally insufficient to capture a sufficient number of highly innovative, opinion leading consumers. The second criticism is based on early studies relying on random samples finding, for example, that innovators are young, cosmopolitan, educated and economically affluent. In addition to finding that these characteristics reflect interdependent constructs when a whole population is considered (e.g. only the affluent can be cosmopolitan), the innovations studied in this context are purchased almost exclusively, for example, by incomes above a certain threshold, and that within that

particular population segment (or social class), the results are no longer valid (e.g. higher incomes, cosmopolitanism, etc., may not lead to greater innovativeness). For most products consumer surveys are best conducted within the segment of consumers likely to have a higher than average concentration of innovators (e.g. the highly educated, upwardly mobile, and cosmopolitan consumers in the case of high-priced consumer goods). This social stratum is a primary market for many consumer product innovations. The study of innovativeness within this affluent segment is, therefore, of greater academic interest than studies using a given population in general. This allows us to test, for example, whether affluent and cosmopolitan consumers are earlier adopters than equally affluent less-cosmopolitan consumers (or that the more affluent consumers among the cosmopolitan are more prone to early adoption). The practical importance of limiting diffusion studies to such qualified segments is readily apparent from Figure 2 which shows diffusion curves of mobile telephones across some 70 countries using two different definitions of "qualified segment". The top figure calculates diffusion rates (penetration) based on dividing mobile telephone users (subscribers) by the entire population (men, women and children). The bottom figure divides subscribers by the more relevant matching criteria: "the literate population who can at a minimum afford basic telephone service". Clearly, the hypothesis of income affecting diffusion is supported in the first case, yet somewhat contradicted in the second when the data is restricted to the population of relevant potential adopters. The need to correctly match samples at the individual level across cultures carries, therefore, into tests of hypotheses concerning the impact of country-level characteristics on innovativeness which might ultimately be reflected in aggregate diffusion patterns.

[Insert Figure 2 About Here]

## SURVEY METHODOLOGY

### The Respondents

Based on the methodological concerns stated above and in keeping with the general research questions raised in the introduction, data on ten home-office and high-end consumer electronics innovations have been collected from more than 900 graduate students from a business school in Europe. The respondents come from 38 countries; eleven industrialized countries in Asia, North America, and Europe (members of the OECD) are sufficiently represented for within country analyses. These eleven countries, in the aggregate, are responsible for over 70 percent of the worldwide sales of the products used in the questionnaire, discussed below, and are the key countries for multinational product launches, and cross-cultural studies in consumer behavior (see, respectively, Levitt 1983 and Douglas and Craig 1992). Respondents are matched, in part, by the admissions procedure on the basis of age, education, professional

experience (3 to 5 years and above), academic potential, and, indirectly, absolute income levels. It must be stressed that sample matching on average characteristics does not eliminate variances required for hypothesis tests; i.e. there are both wealthy and middle-class respondents within the sample, though the mean level of income across cultures is similar. For aggregate cultural groupings (clusters defined by Hofstede 1980, discussed below), Table 2 shows the proportions, means, and standard deviations for various individual measures. As the statistics in Table 2 indicate, the sample is well-matched on several individual-level criteria such that the subsample from any culture cluster is comparable to the subsample from any other cluster on several demographic variables (age, marital status, education). Within each culture, however, there is sufficiently wide variation to test research hypotheses across individuals. Satisfying the criteria that the sample be appropriate for the categories concerned, the respondents are, on average, highly educated, mobile, young (28 years on average), and mostly single professionals, many of whom own a house/apartment. These individuals represent, therefore, a leading segment for products targeted to young households with some affluence (especially in Europe where home ownership is uncommon for this age group). Indeed, the average respondent fits closely with the generic description of innovators and early adopters: "higher income, higher education, younger, greater social mobility" (Gatignon and Robertson 1985, p. 861). With respect to measures of innovativeness, discussed below, we find that within this affluent segment there are clearly "innovators" and "laggards" (i.e. a large proportion of the respondents are neither innovative, nor opinion leaders, despite these having the average generic "innovator" profile of being young, mobile, cosmopolitan and affluent).

[Insert Table 2 About Here]

## The Innovations

Based on interviews with three European electronics manufacturers who asserted the sample relevance of the products in question, the following ten categories were ultimately chosen for our study: cellular telephones, pocket pagers, personal computers, video cameras, high definition television, cable television (a recent innovation in Europe), satellite reception dishes, digital audio tape recorders, video cassette recorders, and microwave ovens.<sup>2</sup> Among the possible alternatives, these products were chosen with certain design issues in mind. First, all of the categories are readily recognized by a multi-cultural sample which would be drawn from the lead segment (the young, affluent, cosmopolitan class). Second, previous diffusion research has successfully used such products to test theories of diffusion, with some using student samples allowing for direct comparison (Holak 1988; Holak and Lehman 1986). Third, most of

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<sup>2</sup> These included a white goods manufacturer, Calor SA, a home electronics and computer manufacturer, Thompson SA, and a telecommunications firm, Ericsson Radio Systems.

the products studied are discontinuous innovations (Robertson 1967) and likely to be subject to diffusion processes. Fourth, in order to avoid obtaining similar responses across the categories, three are home-office oriented (personal computer, cellular phone, pocket pager), five are visual entertainment oriented with wide variances in prices (high definition television, video cameras, cable television, video cassette recorder and satellite television), one is audio entertainment oriented (digital audio tape recorder), and one is cooking/time efficacy oriented (microwave oven).

Finally, five products are "existing innovations" which had substantial differences in cross-country diffusion patterns, though the percent penetration of these was typically less than 10 percent for most of the countries represented in the sample when the data were collected (1990-1992): personal computers, cable television, video cameras, video cassette recorders, and microwave ovens. As existing data show wide variances in diffusion across countries for these products, we investigate whether these differences are likely to be generated by, for example, general differences in product perceptions, or more idiosyncratic phenomena. The other five innovations are classified as "recent innovations" in that these had less than one percent penetration across all countries, or were as yet to be sold to the public (but were well publicized in the popular press -- digital audio tape recorders, and high definition television). With respect to category relevance, for the existing innovations respondents show a higher than average adoption level (compared to total population statistics) within their age groups, by country, for personal computers (averaging 65 percent), video cassette recorders (22 percent) and microwave ovens (32 percent).<sup>3</sup> This supports our assumption and management assertions that the respondents are actual consumers of the products in question, and are a leading segment.

### **Cohort Innovativeness**

By having included existing innovations, we are offered the opportunity to evaluate "cohort innovativeness" which we define as the degree to which individuals, within a social strata, are prone to adopt non-contemporary innovations. Parker (1992) notes that upwards from 40 percent of the sales of many consumer innovations remain first purchases, or initial adoptions, even after the category is several decades old. Every year, new consumers enter the market (due to family life cycles or the natural aging process) and that within cohort diffusion results in certain consumers being more prone to adopt innovations than others ("cohort innovators"); each cohort always faces innovations, though many of these innovations will have been launched prior to when the cohort (or age group) belong to the lead segment. Our study, to our

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<sup>3</sup> Aggregate adoption data for these categories, across countries are available from Euromonitor, Ltd.

knowledge, is the first designed to evaluate whether the profile of cohort innovators is radically different from traditional innovators (the first generation innovators who were the lead segment when the innovations were initially launched).

### **Implementation and Pre-Tests**

A self-administered questionnaire assessing intentions, behaviors and perceptions towards the ten product categories was completed by 941 respondents. Approximately 900 responses were complete and usable for the analysis. The Appendix provides details on the sample sizes per country or culture clusters used. Some 25 to 30 minutes were required to complete the questionnaire. Since language differences have been found to be an important inhibitor of cross-national consumer research (Douglas and Craig 1983), the questionnaire was uniformly administered in English (all respondents were conversant in English). Since this was generally the first questionnaire administered to students following their arrival on campus and they were instructed that responses were to be incorporated into future class discussion, there was virtually ubiquitous response. In order to avoid possible campus acclimation biases, or "MBA-oriented" responses, the questionnaire was administered during the first weeks of the academic year.

Despite these precautions, concerns might be raised whether the respondents are representative of the affluent segment of consumers from their cultures of origin, or that the respondents are themselves members of a "cosmopolitan culture" which is reflective of none but derived from all, or especially Western, cultures. Should this be the case, we are left with an intriguing academic dilemma: if innovators are "cosmopolites", as Rogers (p. 248) contends, then how can there be cultural differences across innovators (if we define a cosmopolite as someone being devoid of culture, or as coming from an amalgamous culture)? While we will return to this dilemma in a later section, Hall (1966) strongly argues that such a "cosmopolitan culture" is unlikely to exist (except, perhaps, for children of diplomats) because individuals, despite years of effort to do so, are generally unable to shed themselves of their cultures of origin. Cultural effects are found to be strong and deeply rooted.

Confirming this belief, four tests conducted during a pre-test phase (and on the general sample after tabulation), and related studies, confirm the relevance and the representativeness of the respondents. The first involved evaluating possible contamination effects due to local campus environment. Questionnaire pre-tests revealed that responses are not affected by whether the questionnaire is administered during their first days or early weeks on campus. The second tested for differences across respondents who had lived in or travelled to foreign countries prior to arriving on campus and those who had not. Likewise, no significant differences in responses

to the independent variables (other than measures of mobility) were detected. Furthermore, should respondents have shed their cultural origins, one would expect little differences in most behaviors that may be affected by culture. The third test simply looks at structural variables which should be reflected by cultural differences (e.g. the readership of consumer magazines which are more, or less, available across cultures). Here again, significant differences were detected. Finally, as reported in Table 2, the dependent variables, purchase intentions, ownership and general proneness to innovate, shows significant differences across cultural groups. For example, Japanese respondents show a far higher proclivity to innovate for a number of the products studied (similar findings have been published in the diffusion modelling literature; see Takada and Jain 1989). Overall, these tests, and previous cross-cultural studies using student samples, permit us to be assured that differences found to be culture-based are not spurious. Likewise, any lack of significance can be confidently attributed to low, or non-existent cultural effects (as opposed to sample homogenization biases).

### The Questionnaire

The instrument design closely follows the work of Holak (1988) and Holak and Lehmann (1986). The questionnaire consisted of three parts. Part 1 obtained purchase intentions and ownership levels for the 10 product categories. Intentions ("how likely is it that you will personally own these items within one year after graduation") were measured on a 10-point Juster (1966) scale and were used as surrogate measures for innovativeness. This scale has been widely used in the literature (Jamieson 1986; Urban and Hauser 1980; Holak 1988). To assess innovativeness towards electronics in general, another variable was measured, in a different part of the questionnaire, using a 7-point likert scale: "How likely are you to buy the latest home electronics gadget or innovation?"

The second part of the questionnaire assessed general psychographics (venturesomeness, self confidence, risk aversion, cosmopolitanism), demographics (age, income, personal wealth, number of children, education) as well as various consumer behaviors (information search habits, information seeking and giving behavior, marketing signal use levels and media proneness). The questionnaire recorded the nationality of each respondent which allows the measurement of various cultural dimensions (discussed in Study #2). To assess family influence on adoption, data were collected on marital status, number of dependents, likelihood to make decisions with spouses, and parent ownership of innovations. Questions - except for the demographic variables, parent ownership and media exposure - were asked on a 7-point likert-scale (1 = behavior not very likely, 7 = very likely); more detailed discussions of the scales used are given in the next section. Most constructs were based on adapted single-item measures used in the extant literature. As multiple measures were used here, these were

randomly dispersed within the questionnaire in order to avoid order biases likely to be generated by having within construct questions follow each other in order. Where possible, various measures (education, income, family structure, nationality, etc.) were cross-validated using statistics generated from the business school admission process: in all cases, the responses to the instrument were validated by these external sources.

The third part of the questionnaire asked the subjects to evaluate the products on various characteristics (compatibility, relative advantage, complexity, triability, perceived risk and communicability) on a 7-point scale. Again, in contrast to most published diffusion surveys, constructs which are multidimensional in nature (e.g. perceived risk, relative advantage) are explored using multiple items. For example, besides directly asking the overall relative advantage of the product compared to alternatives, the construct "relative advantage" is also measured in terms of the product's potential in reducing physical labor, saving time and providing enjoyment/pleasure. Question ordering was randomized to avoid order biases. Product perception questions were followed by media usage measures across seven items: "When deciding to purchase home electronics, which sources of information do you often rely on?" Answers were grouped based on whether the information source was change agent (firm) originated (television advertising, radio advertising, print media advertising, sales persons) or generated from independent sources (personal friends, consumer magazines, expert opinions).

### **STUDY #1: THE CORE MODEL**

Our first study consists of an aggregate analysis of the data and the core model (without cultural influences). We treat the sample as if it were representative of the international community of young, affluent consumers (see, for example, Becker's 1976 study on "Cosmopolitan Information Seekers"). With this in mind, we turn to the first two research questions: (RQ1) do the variables (hypotheses) suggested in the extant literature reflect independent constructs or are they manifestations of fewer underlying constructs?, and (RQ2) are there mediation effects among the variable categories or do the basic (non-cultural) forces affect innovativeness independently? To answer the first, we apply factor analysis (principal components with varimax rotation) to each of the three conceptually independent variable categories: personal variables, consumer behavior variables, and product variables. In the case of personal variables, both demographic and psychographics were simultaneously considered in a single factor analysis. In all of the subsequent analyses, categorical variables and variables that did not load on any of the factors were considered separately.

## Personal Variables: Demographics, Psychographics and Consumer Behavior

Six and four factors were retained (eigen-value,  $\lambda \geq 1$ ) for the personal and consumer behaviour analyses, respectively. The personal variables clearly split into demographic and psychographic factors, allowing us to conclude their independence within this analysis. Table 3 reports the factors and their member variables' loadings. Each personal factor shows strong face validity and, together, represent important concepts that have previously been used to describe individuals on the innovator-laggard continuum. Table 4 shows the explained variance by factor and pairwise correlations of the retained factors with innovativeness for each variable category.

{Insert Tables 3 and 4 About Here}

Beginning with demographics, the correlations in Table 4 provide no evidence that income and education and mixed evidence that age and cosmopolitanism affect innovativeness. It is important to draw attention to the fact that the sample has been matched on these dimensions so limited insight is given by our analysis on their impact within general populations. However, as these respondents are drawn from a lead, or qualified, segment, the analysis indicates that these demographics are not worthwhile as "within" segment constructs. In contrast to traditional demographics, the factor "Family Life Cycle" is important for non-home-office innovations whether recent or existing. The dummy variable, Parent Ownership, also has a consistent and significant effect across products. According to Hirschman (1980) greater product knowledge leads to innovativeness since less cognitive effort is needed for the adoption. Parent ownership leads to more product knowledge and may reduce perceived risk related to adoption.

With respect to psychographics, (Proposition #23 of Gatignon and Robertson), the data indicate that innovators tend to be venturesome and favourable toward risk. As for consumer behavior constructs, signal usage (factor Signal-usage) and media proneness are highly correlated with innovativeness especially for recent innovations (much more so than the factor Opinion Leadership). Some of the innovators, therefore, may come from a population that tends to rely on these signals rather than on independent information sources or his/her own judgement.

According to Figure 1 demographics, psychographics and consumer behavior factors enter the model independently. This has been confirmed by regressions that showed only insignificant relationships between these two categories (adjusted R-squared less than 0.01 and insignificant t-statistics for each variable). In our subsequent terminology we will thus call these two categories personal factors and conceptually we refer to dimensions related to the person who is

a potential adopter of the innovation.

## **Product Perceptions**

From the product variables, only three factors were retained. This fulfilled the " $\lambda \geq 1$ " criterion for most of the products in the analysis. The first factor, Relative Advantage, explained a significant part of the variance ( $\lambda=2.21$ ) and was very coherent across products. Three variables (relative advantage, enjoyment/pleasure and lifestyle compatibility) loaded consistently and significantly ( $\geq 0.70$ ) on the factor. In the case of four products (Cable TV, Microwave oven, Pocket pager and Mobile phone) two variables, both related to the concept of Advantage (reduces physical labor, time saved) also loaded on this first factor with somewhat smaller loadings (0.60). In the case of High Definition Television (HDTV) communicability also had a significant loading (0.54). The next two factors had a much less consistent factor pattern across products. The second one essentially represents Complexity (the variable loads for each of the products with the exception of Mobile Phone). "How easy to repair" and "triability" are also important for this factor (they load for seven products). Finally "obsolescence", "time saved" and "enjoyment/pleasure" also load for two products. The most important variables loading on Factor 3 are "time saved" and "reduces physical labor". Less important (loading for only three products) are "triability" and "communicability".

Returning to RQ1, it is important to see that the perceived product attributes, introduced by Rogers (1983) and summarized by the ACCORD acronym are not statistically independent constructs. They rather seem to represent three underlying factors two of which (Relative advantage and Complexity) are consistent across the product categories studied. It is important to recognize that the variables compatibility and relative advantage may represent different dimensions of the same construct. This interpretation is intuitively appealing since compatibility may be seen as an advantage over other alternatives.

Correlations of the product factors with innovativeness confirm Proposition #27 of Gatignon and Robertson with the exception of complexity. The Complexity factor as well as the variable "complexity" are positively related to innovativeness although the factor contains variables that were found to be positively related to innovativeness previously. It is possible that innovators find complexity desirable for such innovations, therefore, perceived complexity does not affect negatively this segment's purchase timing.

## Mediation Effects

We now investigate the second research question (RQ2) concerning the interdependence of factors. Figure 1 suggests that the above defined personal factors affect innovativeness directly and indirectly through perceptions. Perceptions are thus influenced by personal factors but are not determined by the later. To test for the mediation effect of perceptions we use a method proposed by Baron and Kenny (1986, p. 1177):

"To test for mediation, one should estimate the three following regression equations: first, regressing the mediator on the independent variable; second, regressing the dependent variable on the independent variable; and third, regressing the dependent variable on both the independent variable and on the mediator. ... To establish mediation the following conditions must hold: first, the independent variable must affect the mediator in the first equation; second, the independent variable must be shown to affect the dependent variable in the second equation; and third, the mediator must effect the dependent variable in the third equation. If these conditions all hold in the predicted direction, then the effect of the independent variable on the dependent variable must be less in the third equation than in the second. Perfect mediation holds if the independent variable has no effect when the mediator is controlled."

The above test was used to assess mediation effects for each product. Table 5 summarizes the results.<sup>4</sup> The first perception factor, Relative Advantage, was found to be a mediator of some personal factors for each of the products with the exception of Pocket pager. Factor 2, Complexity, was found to have a mediating effect in the case of Cable TV, DAT and HDTV and finally the third factor was found to be a mediator only for DAT. In most cases the mediation was not "perfect" in the sense defined above. The only personal factor that was mediated by perception factor(s) consistently across products is Parent Ownership. For recent innovations, Signal-usage was also somewhat consistent; the significance level in the second regression was much less ( $p\text{-value} < 0.05$ , not reported in the table) for DAT and Pocket pager. Cosmopolitanism was mediated in two cases (for Video camera and Satellite TV) as well as Venturesomeness (for PC and Mobile phone). These findings show that family influence has a major role in forming perceptions about a product. It reduces perceived adoption risk substantially through increased knowledge and trial. Another interesting conclusion is that people heavily relying on marketing signals are prone to adopt new innovations and these signals (physical appearance, price and brand) also seem to affect innovativeness through perceptions. Perceptions, therefore, are partly explained by personal factors. Additional origins of perceptions clearly require further investigation. Finally, it is interesting to look at the impact of those few personal factors that were not found to be mediated by perceptions. Among these, Family Life Cycle was found to have some effect in the case of PC, VCR and Microwave, all of which are existing innovations. Age had a direct positive effect in two cases (DAT and

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<sup>4</sup> In Table 5 only the mediation effect of the first product factor is shown because of space limitations and its dominant influence on innovativeness.

Mobile phone) and Media proneness and Cosmopolitanism had direct positive effects in the case of HDTV and Mobile phone respectively. The rest of the personal factors that had a significant correlation with innovativeness in Table 4 (Venturesomeness for instance) were not found significant once the product factors were included in the model. As in previous research, we, therefore, conclude that product factors dominate personal variables (RQ5).

[Insert Table 5 About Here]

## Summary of Study #1

The substantive findings from our first study can be summarized as follows:

- *Psychographic factors:* Venturesomeness and Financial risk proneness have a significant positive effect on innovativeness (Proposition #23 of Gatignon and Robertson). The effect of the later is more accented for recent innovations.
- *Demographic factors:* In the present sample Age, Education and Income are unrelated or marginally related to innovativeness. Family Life Cycle positively affects "cohort" innovativeness for existing innovations. Parent Ownership has a significant positive effect on innovativeness.
- *Consumer Behavior factors:* Opinion leaders and people relying heavily on marketing signals are likely to adopt earlier.
- *Product factors:* Perceived product attributes used in diffusion research are components of three orthogonal factors. The first factor is clearly related to Relative Advantage and Compatibility whereas the second factor is related to Complexity (RQ1). Product factors were found to dominate personal and consumer behavior factors when explaining innovativeness (supporting previous research). The direction of their effects partly supports Proposition #27 of Gatignon and Robertson. For the sample used in this study Complexity was positively related to innovativeness contradicting previous research.
- *Mediation effects:* Parent Ownership and (marketing) Signal-usage were found to be mediated by Product factors; the later only in the case of recent innovations. Family Life Cycle was found to have significant direct effect on innovativeness for non-home-office innovations. Given the weak link between personal and product factors, perceptions still remain mostly unexplained (RQ2).

## STUDY #2: CULTURE AND INNOVATIVENESS

Our second study investigates the impact of culture on the core model: (RQ3) to what extent does culture contribute to innovation timing as a direct force, or as mediated by personal or product forces, and (RQ4) is the basic model consistent or robust across cultures? Our approach to the former research question (RQ3) assumes, as Rogers (1983) claims, that diffusion theory is a valid model within all social systems. Study #2 ends with tests of this assumption (RQ4). Before presenting these, it is important to clearly define culture.

### Defining Culture

A number of methods have been suggested to measure the effects of culture in consumer behavior research. Here we will implement two broadly defined methods proposed by Clark (1990): (1) cross-cultural approaches, and (2) national characteristics approaches. The first estimates the impact of culture using dummy variable models in order to identify idiosyncratic effects under different definitions of culture. One limitation of this approach is that any significant difference found can only be attributed to the definition of the dummy variables (e.g. the Germans are more innovative than the Italians because the Germans are Germans, and the Italians are Italians; see Dawar and Parker 1994). The second involves the estimation of models including explanatory variables which vary across cultures (sociological variables, cultural diversity measures and country demographics). Using the later approach we are afforded the opportunity to directly test a variety of culturally-driven behavioral hypotheses. In both approaches we are interested in how these variables affect the core model. Do they affect innovativeness directly, through personal constructs or through perceptions? Since the countries are not represented equally in the sample, a weighted least-squares approach will be used both for the dummy variable models and the "explanatory variable" models.

First, culture will be defined in an idiosyncratic sense. Dawar and Parker (1994) suggest that in order to derive meaningful conclusions in cross-cultural studies using the dummy variable approach, multiple definitions of culture are desirable. Culture will thus be defined according to three different criteria which focus on either national boundaries, behavioral dispositions, or change agent relevant dimensions. In the first approach - as in most cross-cultural studies - countries will serve as definitions of culture. The questionnaire recorded the nationality of each respondent that allows the creation of country dummy variables. This operationalization of culture allows us to perform the analysis for the 11 countries that are sufficiently represented in the sample (sample size equal or above 20). Despite its practicality this approach has many drawbacks. First, it gives little theoretic insight beyond describing the data. Second, as mentioned before, political borders may not coincide with cultural boundaries for products

(especially for products such as satellite reception dishes, in the case of Europe). To overcome these problems, in the second approach we will use Hofstede's cultural clusters (Hofstede 1980). Adopting Hofstede's cultural categorization, countries are grouped in the following five clusters: Anglo, Germanic, Latin, Nordic and Asian. These clusters are differentiated with respect to four underlying factors: masculinity, aversion to risk, perceived distance to decision makers and individualism. While these clusters appear culturally intuitive, they were generated based on management styles and not consumer behavior. We use them as they are the only clusters we are aware of with sufficient cross-country representation while also considering behavioral dispositions. In Proposition #13 of their paper, Gatignon and Robertson note: "The diffusion rate and the maximum penetration level are positively related to the innovation's compatibility with social system values". Hofstede's clusters implicitly group countries with similar values and we hope to get insight on this dimension of culture. This approach hopes to overcome some of the drawbacks of the previous one. Dawar and Parker (1994) note that "grouping nations along behavioral dispositions allows the researcher to attribute observed group differences to causal factors and thus extrapolate the conclusions beyond the countries represented in the sample to similar populations in other countries which have a common psychological orientation". The last, change-agent motivated, approach will use trade areas as definitions of culture. From the point of view of innovation sellers (change agents), geographical trade areas also constitute an important definition of culture in a diffusion framework. One would expect physical distance and trade agreements to facilitate the diffusion of innovations (Gatignon and Robertson 1985, Proposition #17). Countries will be grouped in four categories, North America (the United States and Canada), the European Community (EC), and Non-EC European countries; the Appendix summarizes the above definitions and shows sample sizes by culture.

To overcome the limitation of dummy variable approaches, we will also consider culture using explanatory variables motivated by the diffusion literature. These include macroeconomic variables such as GNP per capita and electricity consumption per capita as well as country demographics (population density, age distribution, literacy rate, urbanisation, housing) and variables explicitly used in prior empirical diffusion research: cosmopolitanism, mobility (Gatignon, Eliasberg and Robertson 1989) and social homogeneity (Gatignon and Robertson 1985, Proposition #15). Variables similar to the ones used by Gatignon et al. (1989) are used as proxies to measure cosmopolitanism (tourist receipts per capita) and mobility (% spent on transport and telecommunication, telephone calls per capita, number of cars per households), whereas for cultural homogeneity we use number of languages, ethnic groups and religious groups, percent of population in the biggest language group, ethnic group and religious group. Finally, marketing development was also considered to be important in the diffusion of innovations context. This concept was measured by two proxies: the countries' advertising

expenditures per capita and the number of scanning stores per capita.

Factor analysis for the explanatory cultural variables was carried out on the countries rather than the original observations. Since the number of countries (58) included in the analysis is quite small compared to the number variables, including all the variables in the factor analysis simultaneously was intractable. By grouping the highly correlated variables first and then carrying out the factor analysis on each group separately we extracted 4 factors describing the wide array of cultures represented in the sample; see Table 6. We call these "Socio-economic Development", "Marketing Development" and two homogeneity measures: "Ethnic Homogeneity" and "Religious Homogeneity". Though generated separately, these factors are independent from one another as the correlation between any pair of two is not significant ( $p\text{-value}>0.1$ ); the variables within a factor are highly correlated as they load on a single factor when Principal Components Analysis is performed on them alone. The factor structure has reasonable face validity and it is consistent in many respects with results reported previously in the diffusion literature.

[Insert Table 6 About Here]

These cultural factors demonstrate that many of the presumably independent variables used in previous studies are highly correlated (RQ1). In particular cosmopolitanism and mobility are confounded with general economic development (especially GNP per capita) and are represented, in our study, in the Socio-economic Development factor. It is interesting that the Marketing development factor is not correlated at all ( $\rho=0.16$ ,  $p\text{-value}>0.5$ ) to socio-economic development.

### Direct and Mediated Effects of Culture

Cultural variables were allowed to affect the model in two different ways: mediated by Personal factors (including consumer behaviors) and/or Product perception factors, or affecting innovativeness directly.<sup>5</sup> Table 7 summarizes the results of Study #2. The last column of Table 7 shows the products for which cultural variables (in the rows) had a significant ( $p\text{-value}>0.01$ ) direct effect on innovativeness. The other columns show mediated effects by the factor indicated above each column. The signs refer to the direction of the effects. In general, cultural variables seem to have more impact (either through mediation or directly) for audio-visual products like Video camera, VCR, DAT, SAT TV, HDTV, than for others, such as Microwave, Mobile Phone or Pocket Pager. Relative Advantage from the perception factors

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<sup>5</sup> As mentioned before we used weighted least squares in this study to account for differences in sample sizes across nationalities, or culture clusters.

is the mediator in many more cases than Personal factors. Given their large number and the relatively few mediation effects identified, we can conclude that cultural factors generally do not affect innovativeness through Personal factors. As mentioned earlier, one has to be cautious when drawing conclusions on demographic factors, since the sample has been matched on demographics (i.e. cultural factors should not affect demographics). Besides mediated effects, social system has a significant direct effect in many more cases. Direct effects seem to exist for all products of the category, not only for audio-visual products. In the case of Microwave ovens, practically no cultural effect was found. It is also interesting that mediated effects in general are mostly negative, but there is no such tendency in the case of direct effects.

Next, we look at differences in the results across different definitions of culture. To define culture by nationality we used the 11 countries with sufficiently large sample sizes. These included countries from the European Community (except Scandinavian countries) and the US, Canada and Japan. From these Italy and France did not have significant effects at all and only Holland and Japan had important effects in at least 5 cases. The dummy variable corresponding to Holland was mediated in most of the cases by Relative Advantage and its effect was negative (VCR, DAT, SAT, HDTV) except for one case (Cable TV). Being Japanese had a positive direct effect on innovativeness in all the cases (Video camera, Pocket Pager, SAT, DAT and Mobile phone). Switzerland and Belgium had positive effects in three cases. Next, culture is defined by Hofstede's clusters. Out of the 5 clusters Nordic, Latin and Asian had significant effects in at least 4 cases. All effects were negative except that of Asian. There were no direct effects corresponding to the cluster Anglo, whereas only direct effects were found for Germanic. The last dummy variable model defines culture by trade area (eco-geographic proximity). Being European had a significant negative effect in all the cases (15 cases out of which 10 were attributed to Non-EEC countries). No direct effects were found for North-America. Finally, the explanatory variables had very little effect (they were significant in only 9 cases altogether). Homogeneity in particular was not found to affect innovativeness at all (only one effect, in the case of Mobile phone, for the two variables).

[Insert Table 7 About Here]

Summarizing, we considered whether culture affects the core model represented on Figure 1 in two different ways: mediated by perception factors or directly affecting innovativeness. The mediating role of personal factors was not found significant, although, as noted above we can not safely reach such conclusions for demographic factors that we controlled for during the study. Culture did not have an important and consistent impact on innovativeness in either way for the segment in question (RQ3). This supports the view of some authors about the development of a cosmopolitan segment for globally marketed products (Becker 1976). From

all three idiosyncratic definitions of culture (dummy variable models) Japanese, Nordic and European had important influence on innovativeness across many different products and among these only Japanese had a positive effect. While dummy variable models are useful to detect the existence and direction of differences across social systems, they give limited explanation on why these differences occur. Explanatory variables are needed to detect causal relationships between culture and innovativeness. In this study we have used similar variables to those utilised in other studies in the field. These - mostly macroeconomic - variables seem to be insufficient in explaining why differences in innovativeness exist across cultures. This is important since we know that diffusion patterns are strikingly different across social systems (see Figure 2). Gatignon and Robertson (1985) suggest to use other variables describing competitive structures and consumption patterns in different countries: we leave this for further research.

It is important to recognise, however that our study is limited to only one segment of the society. It is possible that social system has a bigger impact when results are summarized across segments rather than on the core model within a single segment (GDP per capita for instance can be correlated with the size or proportion of wealthy segments; richer countries will be more apt to adopt faster even if innovativeness within segments is the same for rich and poor countries).

#### **Follow-up Tests (structural equivalence studies)**

As stated earlier, we have assumed that the theory of diffusion, as shown in Figure 1, is applicable in all cultures (as the many studies conducted in numerous countries summarized by Rogers would suggest). To formally evaluate this assumption (RQ4), we follow tests suggested in Bond (1988) and Durvasula et al. (1993). Given the number of statistics generated from these tests only the general outcomes of the tests are reported here. The first test evaluates whether systematic mean differences across cultures "pollute" the aggregate model, i.e. cause some variables to be significant. We do so using a method recently proposed by Bond (1988) to check cross-national applicability of consumer behavior models. The method involves "deculturing" the data (standardizing the variables by subgroups - in our case cultures) to remove culturally idiosyncratic patterns before estimation of the model on the pooled sample. In this way, we test for "culture-constant equivalence" between the core model and one in which culture is included, but where the latter does not fundamentally change the basic model outcomes. Before we re-analyzed the pooled sample, we first standardised the variables by countries. Once standardized by culture (defined as nationality, Hofstede's cluster or trade area), the identical analyses to those in Study #1 were performed. This test revealed that the factor structure for each category of variables as well as the qualitative behavior of the model

were practically identical to that reported in Study #1.

Given that mean cultural differences across respondents did not affect the findings in Study #1, we further checked whether the core model holds qualitatively across different cultures under multiple definitions of culture (Durvasula et al. 1993). This involves two tests. The first test determines if the factor structure estimated on the aggregate sample holds for different cultures. The second test verifies that similar relationships amongst the variable categories hold across cultures. These tests are only operational in cases where there is a sufficiently large sample within each of the cultural groups in question. Given the large number of variables under consideration, this test is constrained to 3 definitions of culture which had sufficiently large sample sizes, excluding missing values (292, 326, 585 observations respectively): Latin and Anglo from Hofstede's clusters, and the EC from the trade areas. We find that the personal factors have the least stability when factor analysis is performed for sub-samples. This is understandable since this analysis contained the most (16) variables. In general the factor structure has converged to the structure of the pooled data with increasing sample sizes of the subgroups. In the case of the EC sample, the factor structure is equivalent with that of the pooled sample. Age was found to emerge as the first factor in each subgroup (in the Latin cluster "years at university" also loaded on Age). Income, Family Life Cycle and Venturesomeness also emerged as distinct factors, but the order of their explained variance changed from subgroup to subgroup. Cosmopolitanism and Education were not found to be very consistent across subgroups except in the case of the EC sample. The consumer behavior factors were much more stable for different sub-samples which is not surprising in view of the fact that fewer variables were included in the analysis (11 variables). Again, for the EC sample the factor structure was practically identical to the full sample. The product factors show the greatest stability across subgroups (only 10 variables in the factor analysis) with Relative Advantage and Complexity always emerging as in the case of the aggregate analysis. Summarizing, we can conclude that the sample sizes in the subgroups were not large enough to test the invariance of factor structures across all definitions of culture. Nevertheless, for those definitions of culture with sufficient representation, there is clear indication that the factor structure is similar across these definitions, and converges to the one reported in Table 3 for the subgroups with larger samples.

The final test considers the equivalence of linkages across the core model constructs and uses the same subgroups as the previous validity test. The EC sample was again found to reflect the same qualitative model structure as the aggregate sample although the mediated variables were less significant. Analysis on the clusters gives somewhat less clear evidence, especially in the case of the Latin sample. As in the previous test, we can note that perceptions seem to mediate some of the personal and consumer behavior factors (especially Parent Ownership). For

definitions of culture having larger samples, the relationships found are similar to those found in the aggregate model. Given the lack of strong evidence to the contrary, these tests support the basic assumption that diffusion theory, as modelled in Figure 1 is a generally applicable model across cultures.

## Summary of Study #2

We summarize the results of Study #2 as follows:

- *Cultural factors*: Certain explanatory variables used in previous studies to describe culture (e.g. Telephone calls per capita, Tourist receipts per capita, Number of cars per capita, Telecommunication and Transport expenditures per capita) are highly correlated and mainly reflect socio-economic development (RQ1). Cultural factors (e.g. Socio-economic development, Marketing development, Homogeneity) have little impact on the core model (RQ3, RQ5). Strong consistent effects were found only in the dummy variable models: being Japanese had a consistent positive impact on innovativeness, whereas being European had a negative impact.
- *Mediation effects*: Culture seems to affect innovativeness either mediated by perceptions or - in more cases - directly (RQ2).
- *Cultural invariance*: In a preliminary analysis the present study found that the "core model", presented on Figure 1 is qualitatively invariant across cultures, i.e. the factor structure is similar and the links between the factors (mediation effect of product factors) have the same direction across cultures for different definitions of this concept (RQ4).

Combining the results from both Study #1 and Study #2, we can address the final research question (RQ6), discussed next.

## CONCLUSIONS

### Summary Remarks

Inspired by the comprehensive review of Gatignon and Robertson (1985), this paper reports an integrated study of diffusion theory. Across the various studies, Table 8 provides a comprehensive summary to the fifth research question (RQ5): among the various forces including culture, which appear to be most relevant in predicting one's proneness to innovate

(adopt early)? Table 8 classifies the various relationships on a spectrum from "none" to "strong", based on the statistical tests presented across the two studies (i.e. no entry signifies no relationship found, whereas "strong" indicates highest explanatory power). As pointed out earlier and confirming previous research, product perceptions are strong predictors of innovativeness but variables currently used in diffusion research as well as cultural factors are not sufficient to explain these perceptions. This holds true for all types of innovations and the two types of innovators considered: cohort and non-cohort. Culture, per se, has little affect on innovativeness. Family Life Cycle has some influence on both "cohort" and non-cohort innovativeness provided that the products be family oriented. Parent Ownership and Product signal usage are shown to have some influence on innovativeness, personal traits as yet studied in the literature. Most other personal factors (age, income, education, cosmopolitanism, risk aversion, information seeking and media proneness) hypothesized in the literature have negligible influence on innovativeness for the categories studied (e.g. variances in cosmopolitanism among the lead segment has no affect on innovativeness; likewise, greater wealth among the affluent has no effect on innovativeness).

[Insert Table 8 About Here]

Finally, research question RQ6 asks: does an understanding of consumer-level innovativeness within the primary segment across cultures (e.g. the paradigm in Figure 1) provide useful information in understanding aggregate adoption rates (diffusion patterns) across these cultures? The answer is "no". Previous research has demonstrated that for cross-cultural studies it is essential to match samples on absolute socio-economic status so that differences in psychographics and perceptions can not be attributed to socio-economic factors. If the researcher wants to draw macro-level conclusions from micro-level (survey) data, however, he or she has to survey all possible strata for each culture and also take into account the size of each strata within the social system. Figure 2 clearly demonstrates that controlling for the size of the relevant segment or social system (i.e. persons having a minimum income level) is critical in evaluating aggregate diffusion patterns. It is possible that within a matched segment innovativeness is higher for a poorer country than for a richer country but diffusion will be faster in the later because the importance of the segment in question is much larger. This suggests that lead-segment surveys alone are not sufficient to fully comprehend long-run diffusion dynamics. Rather, macro-level analyses of segments or social system structures becomes critical.

The present study suggests that estimation of diffusion model parameters from consumer surveys should involve two steps. First, target segments have to be identified. These segments have to transcend cultures, i.e. have to be matched on economics or demographics. This allows

the evaluation of the effect of culture on each individual segment: note that this would not be possible for a representative sample from the culture because socio-economic and demographic factors would be confounded with cultural factors. In the next stage, survey results across segments have to be summarized. Summarising results across segments is not trivial and future research should develop methods for such aggregation procedures.

### **Limitations and Extensions**

Gatignon and Robertson suggest to approach new product adoption research in an integrated framework. The disadvantage of having such a large scope comes from the trade-off between scope and depth. In most of the cases we had to content ourselves with existing scales given the length of the questionnaire. Also, although we argued before that the sample was appropriate for research across social systems, additional samples across multiple social strata should be evaluated in order to get full insight on cultural effects. Considering these limitations, our study suggests that further research is needed. In particular greater emphasis should be made on developing causal models which can explain individual-level variances in product perceptions (i.e. why one individual perceives a tangible product to be highly advantageous or complex, while another does not). Three domains may prove useful in this regard. First, additional cultural variables should be considered; in the present study we limited ourselves to commonly suggested measures. Presumably these variables might be able to describe the competitive, social or physical environment of the diffusion process and factors affecting general consumption patterns of the population within the culture. Second, even if perceptions are explained to some extent by cultural variables, market-driven (change agent) factors should also be considered by future research. Such variables could describe the relevant marketing environment specific to the product category under study. Finally, perceptions can be seen as manifestations of causal mechanisms generated at the individual level. The mechanisms as yet considered in the diffusion literature fall short in explaining variances in perceptions. Further work in this regard appears warranted.

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**Figure 1**

**Social and Cross-Cultural Influences on Innovativeness**

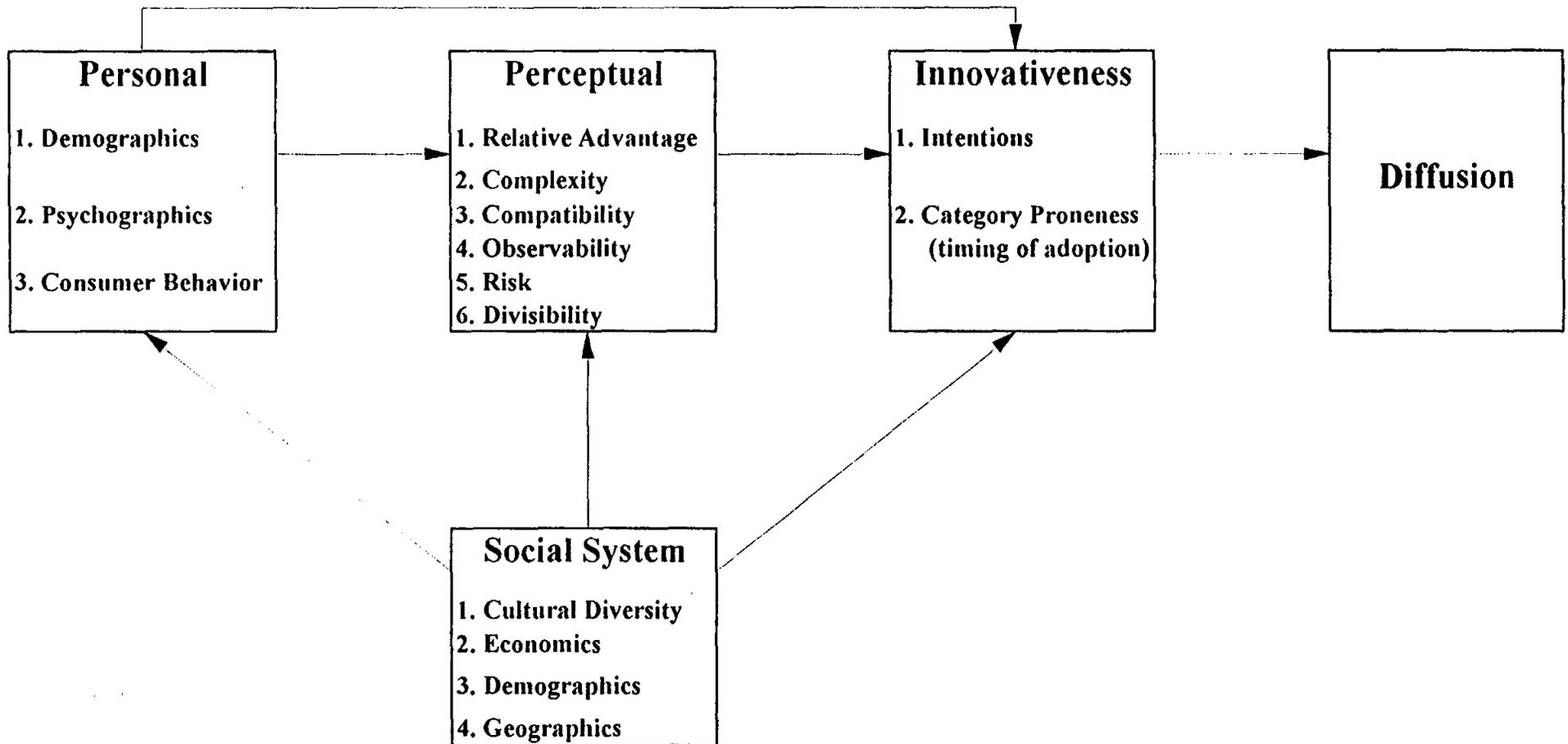
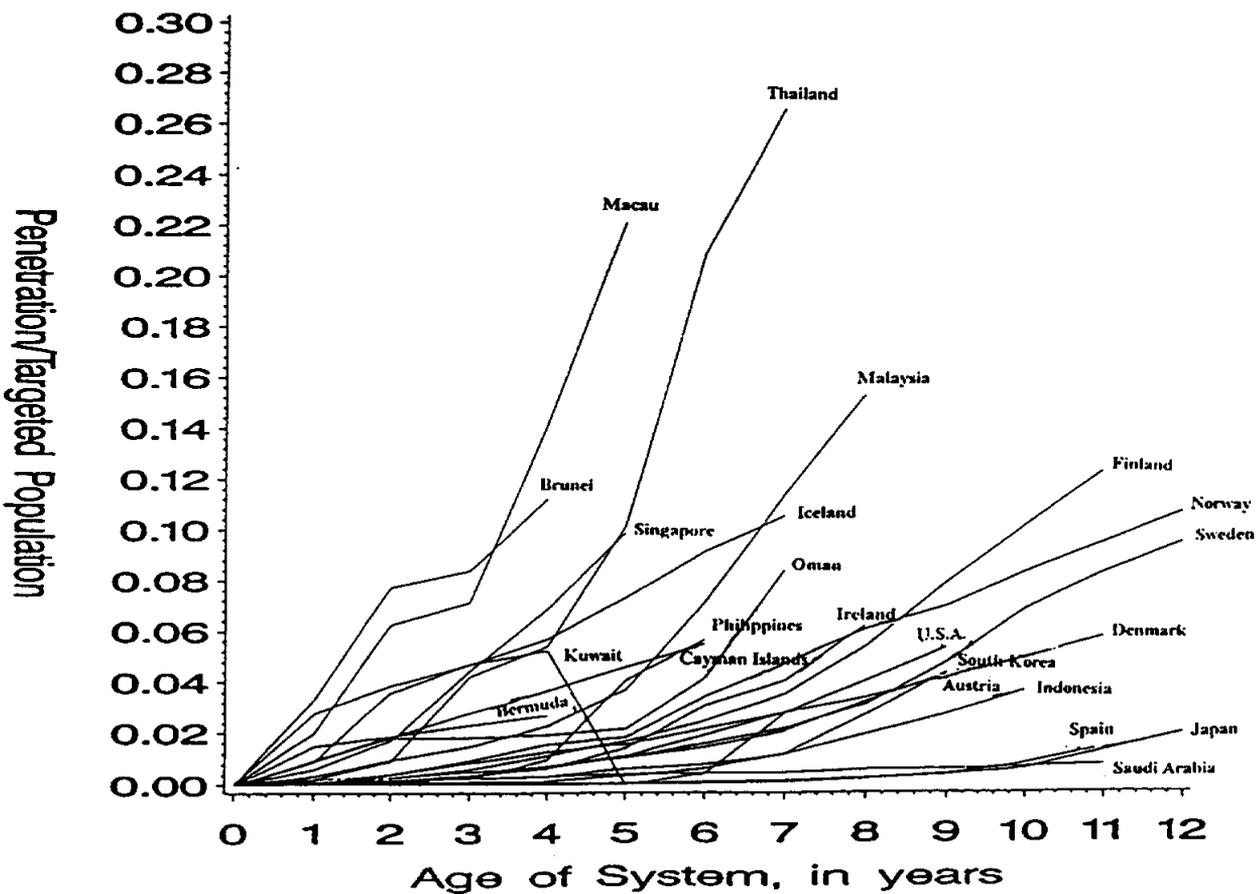
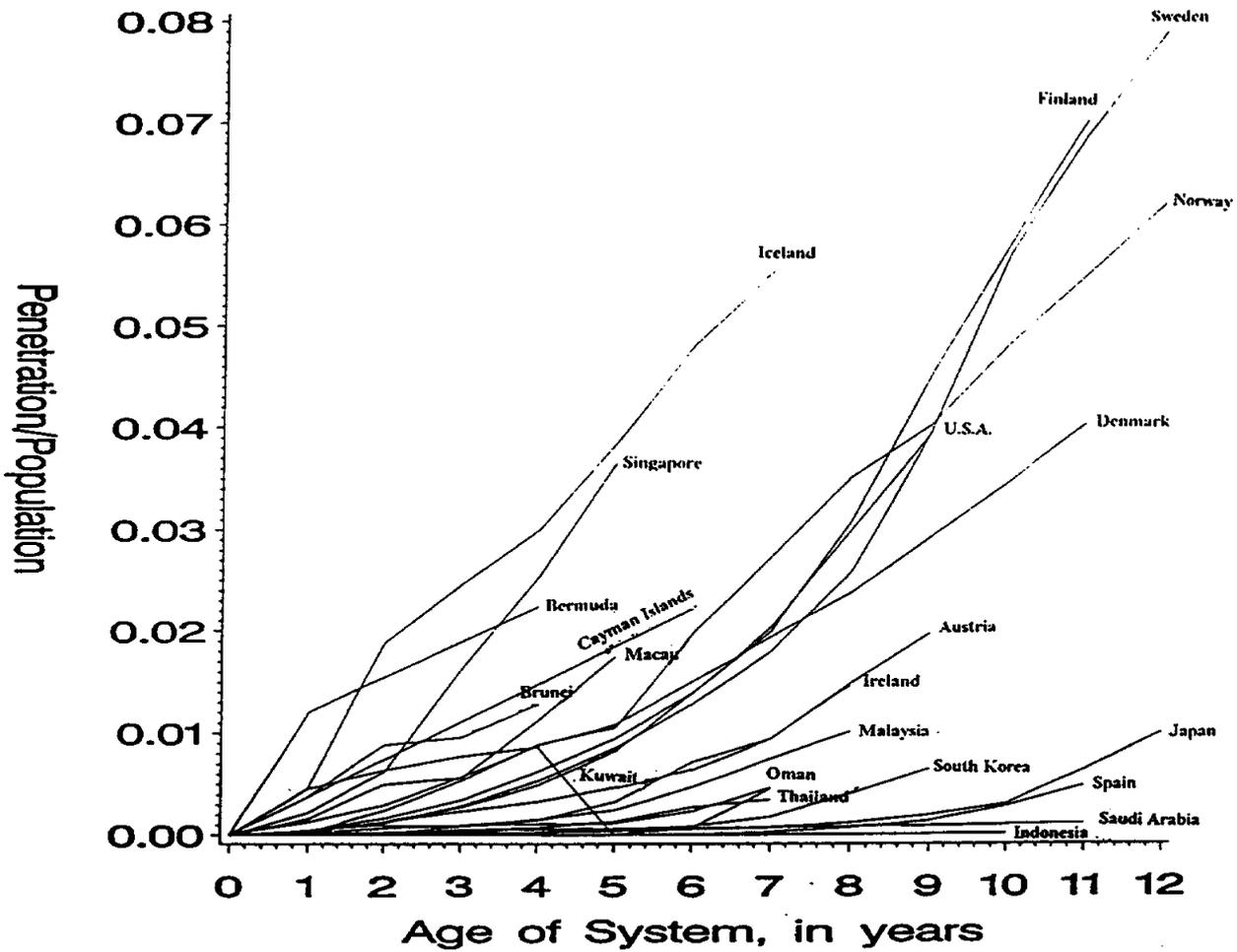


Figure 2. Penetration of Cellular Services, Across Countries



**Table 1: Literature review**

**PERSONAL VARIABLES:**

Rogers (1983)	Describes innovators as "venturesome", early adopters as "respectable", the early majority "deliberate", the late majority "skeptical", and the laggards "traditional".
Robertson (1971); Danko, and McLachlan (1983); Dickerson, and Gentry (1983); Peters, and Venkatesan (1973)	Innovators will be drawn from the heavy users of the product category.
Hirschman (1980)	Greater knowledge about the product leads to innovativeness, since less cognitive effort is required for the adoption.
Bass (1969); Midgley, and Dowling (1978)	Innovativeness is the degree to which an individual is receptive to new ideas and makes innovation decisions independently of the communicated experience of the others.
Green, Langeard, and Favell (1974); Summers (1972)	Innovators are more exposed to mass media.
Yapa, and Mayfield (1978)	Innovators are more cosmopolitan.

**PRODUCT VARIABLES:**

Rogers (1983); Ostlund (1974)	Relative advantage, compatibility, triability, and observability are positively related to the speed of diffusion. Complexity and perceived risk are negatively related.
Ostlund (1974); Labay and Kinnear (1981)	Perceived innovation characteristics are more effective predictors of innovativeness than personal variables.
Holak (1985); Holak and Lehmann (1986)	Among the six important product attributes, compatibility, relative advantage, and perceived risk have a consistent (direct) effect on purchase intentions and the other three variables have an indirect effect.

**Table 1: Literature review (continued)**

**SOCIAL SYSTEM VARIABLES:**

Mahajan, and Peterson (1978); Peterson and Mahajan (1978)	Environmental variables (such as new housing starts for instance) affect the size of the potential market.
Lindberg (1982)	Using variables such as size of the population, GNP, inflation rate, a model is developed to predict relative demande in "lagging countries" (where the product was introduced later). Data originated from 6 Europcan countries and the US.
Gatignon, and Robertson (1985); Brown, Malceky, and Spector (1976)	Propose that diffusion rates and penetration levels are positively related to the innovation's compatibility with social system values, but expect these parameters to change as these values evolve over time. They also expect a positive relation between these parameters and social system homogeneity.
Hirschman (1984)	Consumers of English descent and Jewish nationality tend to be sensation seekers, Chinese tend to avoid sensation seeking and the Irish are cognitive seekers.
Becker (1976)	"Cosmopolitan Infromation Seekers", far higher in education, income, and social prestige than average consumers, represent a growing nucleus of "professional" consumers in the industrially advanced countries.
Gatignon, Eliasberg and Robertson (1989)	The society's level of "cosmopolitanism" is positively related to the population's innovativeness.

**Table 2: Sample characteristics**  
Means, Proportions and Standard deviations (in parentheses)

<b>MATCHED VARIABLES:</b>	<b>LATIN</b>	<b>GERMANI</b>	<b>ANGLO</b>	<b>NORDIC</b>	<b>ASIAN</b>	<b>OTHER</b>	<b>TOTAL SAMPLE</b>
<b>Age</b>	<b>28.6</b> (2.65)	<b>28.4</b> (2.37)	<b>27.8</b> (2.26)	<b>28.4</b> (2.6)	<b>28.75</b> (2.09)	<b>28.6</b> (2.3)	<b>28.3</b> (2.45)
<b>Years at university</b>	<b>6.4</b> (1.14)	<b>5.9</b> (1.2)	<b>5.1</b> (1.43)	<b>6.4</b> (1.45)	<b>5.61</b> (1.26)	<b>6.2</b> (1.92)	<b>5.9</b> (1.46)
<b>Years work experience</b>	<b>4.6</b> (1.98)	<b>4.1</b> (1.93)	<b>5</b> (2.08)	<b>4</b> (1.85)	<b>5</b> (1.56)	<b>4.8</b> (2.35)	<b>4.7</b> (2.03)
<b>% owning house</b>	<b>44</b>	<b>39</b>	<b>51</b>	<b>44</b>	<b>32</b>	<b>64</b>	<b>47</b>
<b>% owning car</b>	<b>100</b>	<b>100</b>	<b>94</b>	<b>100</b>	<b>93</b>	<b>88</b>	<b>100</b>
<b>PURCHASE INTENTIONS:</b>							
<b>1. PC</b>	<b>7.69</b> (2.85)	<b>8.55</b> (2.61)	<b>8.37</b> (2.42)	<b>7.89</b> (2.93)	<b>8.46</b> (2.44)	<b>8.1</b> (3.03)	<b>8.12</b> (2.69)
<b>2. Cable TV</b>	<b>4.6</b> (2.87)	<b>5.57</b> (3.26)	<b>4.51</b> (3.05)	<b>6.18</b> (2.94)	<b>5.22</b> (3.05)	<b>5.04</b> (3.11)	<b>4.89</b> (3.06)
<b>3. Video camera</b>	<b>4.57</b> (3.17)	<b>3.6</b> (2.75)	<b>3.32</b> (2.51)	<b>2.87</b> (2.24)	<b>5.6</b> (3.27)	<b>4.61</b> (3.19)	<b>3.91</b> (2.92)
<b>4. DAT recorder</b>	<b>3.57</b> (2.59)	<b>3.07</b> (2.31)	<b>2.99</b> (2.35)	<b>2.61</b> (1.98)	<b>4.58</b> (2.98)	<b>3.6</b> (2.82)	<b>3.26</b> (2.49)
<b>5. Sat. TV dish</b>	<b>3.41</b> (2.47)	<b>2.36</b> (1.93)	<b>2.59</b> (2.03)	<b>2.37</b> (1.79)	<b>4.57</b> (3.23)	<b>3.54</b> (2.52)	<b>2.97</b> (2.32)
<b>6. VCR</b>	<b>7.01</b> (3.14)	<b>6.22</b> (3.33)	<b>7.55</b> (2.89)	<b>6.1</b> (3.11)	<b>8.08</b> (2.36)	<b>7.08</b> (3.11)	<b>7.08</b> (3.08)
<b>7. HDTV set</b>	<b>3.48</b> (2.57)	<b>2.73</b> (2.12)	<b>3.8</b> (2.69)	<b>2.94</b> (2.38)	<b>3.77</b> (2.46)	<b>4.22</b> (2.92)	<b>3.52</b> (2.6)
<b>8. Pocket pager</b>	<b>2.75</b> (2.04)	<b>3.16</b> (2.39)	<b>2.81</b> (2.03)	<b>3.31</b> (2.59)	<b>3.4</b> (2.7)	<b>2.85</b> (2.17)	<b>2.91</b> (2.18)
<b>9. Mobile phone</b>	<b>4.04</b> (2.63)	<b>4.81</b> (2.86)	<b>4.45</b> (2.67)	<b>4.91</b> (2.75)	<b>4.62</b> (2.69)	<b>5.1</b> (3.16)	<b>4.46</b> (2.74)
<b>10. Microwave oven</b>	<b>7.94</b> (2.7)	<b>7.39</b> (3.13)	<b>7.65</b> (2.81)	<b>7.47</b> (3.03)	<b>7.97</b> (2.73)	<b>7.08</b> (2.92)	<b>7.66</b> (2.85)

**Table 3: Personal factors**

<b>Variable Category</b>	<b>Rotated Factors</b>	<b>Variables</b>	<b>Loading</b>	
<b>1. Demographics:</b>	Age	Age	0.9	
		Years of work experience	0.8	
	Income	Income before the programme	0.9	
		Expected income after programme	0.9	
	Family Life Cycle	Number of houses owned	0.7	
		Number of cars owned	0.7	
		Number of children	0.5	
	Education	Number of non-native languages spoken	0.7	
		Number of years at university	0.7	
	Parent Ownership	(dummy variable)	N/A	
	<b>2. Psychographics:</b>	Venturesomeness	Likely to start a company within one year	0.6
			"How venturesome are you?"	0.8
			"How self confident are you?"	0.5
Cosmopolitanism		Number of continents visited	0.8	
		"Number of clubs you are member of"	0.7	
Physical Risk aversion		Likely to play life-threatening sport	N/A	
Financial Risk aversion		Likely to bet on horses or in casino	N/A	
<b>3. Consumer Behavior:</b>		Signal- usage	Likely to use price as a signal of quality	0.8
	Likely to use brand name as signal of quality		0.8	
	Likely to use physical appearance as signal of quality		0.6	
	Opinion leadership	Number of shops visited before buying	0.6	
		Likely to research before buying	0.8	
		Likely to give advice to others	0.7	
	Information seeking	Likely to jointly decide on purchase	0.5	
		Likely to seek advice from others	0.6	
		Price sensitivity	0.7	
	Media proneness	Exposure to firm sent information	0.8	
Exposure to independent information sources		0.7		

TABLE 4: PAIRWISE CORRELATION OF FACTORS WITH INNOVATIVENESS

Factor Name:	lambda:	Existing innovations					Recent innovations					Latest
		PC	Cable TV	Video Camera	VCR	Micro Wave	DAT	Sat. TV	HDTV	Pocket Pager	Mobile Phone	Electric Gadget
<b>PERSONAL FACTORS</b>												
<b>1. Demographics</b>												
Age	1.88		-0.08*	.17***			.08*					
Income	1.52											
Family Life-Cycle	1.46			.19***	.09*	.13***					.09*	
Education	1.26		.09*		-.11*							
Parent Ownership	N/A		.39***		.21***	.21***	.36***	.24***	.33***		.15***	N/A
<b>2. Psychographics</b>												
Venturesomeness	1.66	.17***	.10**				.12***	.09*	.13***	.13***	.25***	.18***
Cosmopolitanism	1.39			-.18***				-.08*			.08*	
Physical risk aversion	N/A		-.06*								.08*	
Financial Risk aversion	N/A		.07*		.10**			.10**	.09**	.08*	.10**	.14***
<b>3. Consumer behavior</b>												
Signal-usage	1.78		.11***	.08*	.08*	.08*		.12***	.11***		.16***	.20***
Opinion leadership	1.77	.13***				.07*				.10**		.28***
Information seeking	1.22					.07*				.08*		-.08*
Media proneness	1.16	.09**	.12***					.08*	.11***	.08*	.07*	
<b>PRODUCT FACTORS</b>												
F 1: Advantage	2.21 b	.43***	.53***	.60***	.54***	.43***	.43***	.53***	.29***	.43***	.45***	N/A
F 2: Complexity	1.61 b		.25***	.15***		.11**	.15***	.09*	.16***		.09**	N/A
F 3: Other	1.38 b		.07*	.14***	.08**		.17***	.19***	.16***	.13***		N/A

a.) \*: < .05, \*\*: < .01, \*\*\*: < .001

b.) average across products

TABLE 5 : ADVANTAGE AS MEDIATOR BETWEEN PERSONALITY AND INTENTIONS

Regression type:		Existing Innovations					Recent Innovations				
		PC	Cable TV	Video Camera	VCR	Micro Wave	DAT	Sat. TV	HDTV	Pocket Pager	Mobile Phone
<b>Regress. 1:</b>	<b>R-squared:</b>	0.08	0.07	0.09	0.08	0.09	0.08	0.08	0.06	0.04	0.08
Dep. var.:	Age	-.14***		.12**							
Advantage	Family Life Cycle			.14***							
	Parent Ownership		.40***	.37***	.44***	.32***	.76***	.57***	.40*	.57***	.39***
Indep. var.:	Venturesomeness	-.14***									.16***
Personal factors	Cosmopolitanism		-.15***	-.13***	-.10*			-.12**			
	Signal-usage		.13***	.17***	.15***	.14**	.15***	.17***	.20***	.13**	.18***
	Opinion leadership	.20***					.15***				-.14***
	Information Seeking					.19***					
	Media proneness							.14***			
<b>Regress. 2:</b>	<b>R-squared:</b>	0.05	0.19	0.12	0.06	0.08	0.17	0.1	0.16	0.03	0.13
Dep. var.:	Age			.54***			.28**				
Intention	Family Life Cycle	.23*		.60***		.39***					.25*
	Parent Ownership		2.65***	.62*	1.32***	1.32***	3.65***	1.97***	3.13***		1.22***
Indep. var.:	Venturesomeness	.48***						.30**	.24**		.69***
Personal factors	Cosmopolitanism			-.57***				-.26**			
	Signal-usage							.37***	.35***		.51***
	Opinion leadership	.27*									
	Information seeking					.28*					
	Media proneness	.25*	.30**	.27*							
<b>Regress. 3:</b>	<b>R-squared:</b>	0.19	0.45	0.45	0.31	0.27	0.33	0.38	0.23	0.22	0.31
Dep. var.:	F 1: Advantage	1.03***	1.47***	1.65***	1.56***	1.02***	.90***	1.16***	.63***	.96***	1.16***
Intention	F 2: Complexity		.74***	.38***			.27**	.27***	.30**		.27**
	F 3: Other			.44***			.25**	.46***	.31***	.24**	
Indep. var.:	Age			.36***			.25**				.52***
Personal factors and Advantage	Family Life Cycle	.25*		.46***	.27*	.38***					
	Parent Ownership		1.94***		.73**	1.27***	2.60***	1.46***	2.27***		
	Venturesomeness	.35***									
	Cosmopolitanism			-.36***							.34***
	Signal-usage							.30**			.87**
	Opinion leadership										
	Information Seeking							.32***			
	Media proneness										
<b>Mediated variables:</b> (by Relative Advantage)		Venture Oplead	Parent Parent	Parent Family Ic	Parent Cosmop.	Parent Age	Parent Seeking	Parent Cosmop Signal U.	Parent O. Signal U.	Parent O. Venture Signal U.	

a.) \*: <.05, \*\*: <.01, \*\*\*: <.001

**Table 6: Cultural factors**

<b>Variable Category</b>	<b>Non-independent Factors</b>	<b>Variables</b>	<b>Loading</b>
<b>Cultural factors</b>	Socio-economic development	GNP/capita	0.9
		% urban population	0.7
		Literacy rate	0.8
		Telephone calls/capita	0.6
		Tourist receipts/capita	0.4
		% spent on transport and communication	0.7
		Number of cars/capita	0.9
	Marketing development	Advertisement expenditures/capita	0.8
		Number of scanner stores/capita	0.8
	Ethnic homogeneity	% of biggest language group	0.9
		Number of language groups	-0.7
		% of biggest ethnic group	0.9
		Number of ethnic groups	-0.8
	Religious homogeneity	% of biggest religious group	0.9
Number of religious groups		-0.9	

TABLE 7: EFFECT OF CULTURE ON INNOVATIVENESS

Mediated Factors	Mediator Factors								Direct effects of Social system
	Sign. user	Media p.	Age	Venture	Family Ic	Cosmop.	Parent O.	Relative Advantage	
<b>Countries</b>									
United Kingdom								Cbl TV-	
Holland								VCR- DAT- SAT- HDTV-	Cbl TV+
Canada					Vid-				SAT-
Germany									HDTV-
Japan								VCR+	Vid+ P.Pager+ SAT+ DAT+ M.Phone+
Belgium					Micro w. +			Cbl TV+	P.Pager+
Switzerland									Cbl TV+ P.Pager+ M.Phone+
Spain								M.Phone-	
US								Cbl TV+	
<b>Hofstede's Clusters</b>									
Latin					M. Phone-			M.Phone-	PC- Cbl TV- VCR-
Germanic									VCR- SAT- HDTV-
Nordic		Cbl TV+				Vid- SAT-		DAT- SAT-	PC- VCR- HDTV-
Asian	SAT+							VCR+	DAT+ P.Pager+
Anglo						Vid- SAT-		SAT-	
<b>Trade Clusters</b>									
North-America		Cbl TV+	Vid- DAT-				Cbl TV+	SAT-	
EEC								Cbl TV- VCR- SAT-	Vid- DAT-
Non-EEC			Vid- DAT-			Vid- SAT-		Vid- VCR- DAT- SAT-	PC- HDTV-
<b>Explanatory variables</b>									
Development			Vid-					VCR-	Cbl TV+ P.Pager+ M.Phone+
Marketing development								PC-	Cbl TV- SAT+
Ethnic homogeneity								M.Phone+	

Note: "Cbl TV-" in the column Relative Advantage and row United Kingdom means that the dummy variable United Kingdom has a negative effect on Cable TV purchase intention and this effect is mediated by Relative Advantage.

**TABLE 8: RELATIVE IMPORTANCE OF FACTORS ACROSS PRODUCTS**

<b>Factor Name:</b>	<b>Direct effects</b>	<b>Mediated effects</b>
<b>PERSONAL FACTORS</b>		
<b>1. Demographics</b>		
Age		
Income		
Family Life-Cycle	weak	
Education		
Parent Ownership	medium	medium
<b>2. Psychographics</b>		
Venturesomeness	medium	medium
Cosmopolitanism		
Physical risk aversion		
Financial Risk aversion	weak	
<b>3. Consumer behavior</b>		
Signal-usage	weak	medium
Opinion leadership	weak	
Information seeking		
Media proneness	weak	
<b>PRODUCT FACTORS</b>		
F 1: Advantage	strong	N/A
F 2: Complexity	medium	N/A
F 3: Other	medium	N/A
<b>CULTURAL FACTORS</b>		
Development	weak	
Marketing development		
Ethnic homogeneity		
Religious homogeneity		
Idiosyncratic factors	weak	weak

**APPENDIX:**  
Membership of countries by clusters and sample sizes

COUNTRIES	HOFSTEDE'S CULTURE CLUSTERS	TRADE - AREA CLUSTERS
Belgium (21)	<b>1. LATIN (292)</b>	<b>1. North-America (127)</b>
Canada (47)	Argentina	Canada
France (175)	Belgium	United States
Germany (59)	Brazil	
Italy (36)	Italy	<b>2. EEC (585)</b>
Japan (31)	France	Belgium
Netherlands (36)	Spain	Denmark
Spain (31)	Portugal	France
Switzerland (24)		Germany
UK (174)	<b>2. GERMANIC(111)</b>	Greece
US (80)	Austria	Ireland
	Germany	Italy
	Israel	Luxembourg
	Switzerland	Netherlands
		Portugal
	<b>3. ANGLO (326)</b>	Spain
	Australia	United Kingdom
	Canada	
	Ireland	<b>3. Non-EEC-EUROPE(68)</b>
	New Zealand	Austria
	United Kingdom	Finland
	United States	Hungary
		Iceland
	<b>4. NORDIC (85)</b>	Norway
	Denmark	Poland
	Finland	Russia
	Iceland	Sweden
	Netherlands	Switzerland
	Norway	
	Sweden	<b>4. OTHER (117)</b>
		Argentina
	<b>5. ASIAN (45)</b>	Australia
	China	Brazil
	Hong Kong	China
	India	Egypt
	Japan	Hong Kong
	Singapore	India
		Israel
	<b>6. OTHER (68)</b>	Japan
	Chile	Lebanon
	Greece	Mexico
	Hungary	New Zealand
	Lebanon	Singapore
	Luxembourg	South Africa
	Mexico	Syria
	South Africa	Venezuela
	Syria	Zimbabwe
	Venezuela	
	Zimbabwe	