

**Consumers in demand:  
The relationship between innovativeness and use of  
information sources**

ISBN 978-90-8891-150-7

Cover design:  
Uitgeverij BOXPress, Oisterwijk

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Printed by: Proefschriftmaken.nl || Printyourthesis.com  
Published by: Uitgeverij BOXPress, Oisterwijk

# **Consumers in demand: The relationship between innovativeness and use of information sources**

Vragende consumenten: De relatie tussen innovativiteit en het gebruik van  
informatiebronnen

(met een samenvatting in het Nederlands)

Proefschrift

Ter verkrijging van de graad van doctor aan de Universiteit Utrecht op gezag van  
de rector magnificus, prof.dr. J.C. Stoof, ingevolge het besluit van het college voor  
promoties in het openbaar te verdedigen op vrijdag 26 februari 2010 des middags te  
4.15 uur

door

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geboren op 26 februari 1981 te Leerdam

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# 1 Introduction

## Background

Innovation is seen as an important driver for the growth of modern capitalist economies. The European Union initiated the Lisbon Strategy in 2000 (see EU High Level Group 2004; European Commission 2006). According to the European Lisbon Strategy, the EU was to become the most competitive and dynamic knowledge economy in the world (EU High Level Group 2004). The Dutch Government followed in 2003 with launching her own innovation platform (see Innovation Platform 2006). The Dutch aim was to be ranked among the top 5 countries with regard to higher education, research and innovation. These initiatives show that innovation has become a focal point in EU and Dutch policy. In 2004 the EU spent a total of 201 billion Euros on research and development for innovation (Eurostat 2008), this is 1.84% of the EU GDP<sup>1</sup>. In the Netherlands, 8.7 billion Euros were spent on R&D, which was close to the EU percentage.

However, not all these investments result into successful innovations (Tidd, Bessant et al. 2001; Hekkert, Suurs et al. 2007). Given the importance of innovation from a policy perspective, a considerable amount of scientific research has been dedicated to understanding the innovation process, and how investments in innovation can be utilized in an optimal manner. This stream of research can broadly be designated as the field of innovation studies, it includes contributions from the perspective of different actors that are involved in the innovation process, such as firms (Cyert and March 1963; Nelson and Winter 1982; Poole and Van de Ven 2004), users (Von Hippel 1977; Lundvall 1985), scientists (Laursen and Salter 2004; Meeus, Oerlemans et al. 2004; Van Rijnsoever, Hessels et al. 2008), governments (Shaffer 1995) or intermediary organizations (Boon, Moors et al. 2008). Other authors have looked at the innovation process from a so-called systemic perspective (Edquist 1997; Smits and Kuhlmann 2004; Hekkert, Suurs et al. 2007), instead of investigating each actor separately, the joint actions of the actors are analysed to understand innovation processes.

The field of innovation studies has traditionally been dominated by studies that attempt to understand the supply side of innovation (e.g. firms) (Consoli 2008). However, those who use many of the innovative products, and those who eventually experience the consequences of many technological innovations are consumers. Further, due to a more systemic view on innovation development (Smits 2002), consumers as end-users are increasingly involved in the development of new innovations (Lüthje 2004; Von Hippel 2005). Therefore, scholars argue increasingly that in order to fully understand the

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1 The aim was to achieve 3% in 2010.

innovation process, it is also important to look at the demand side of innovation (Aversi, Dosi et al. 1999; Devetag 1999; Witt 2001; Consoli 2008). Examples of topics in the field of innovations studies that are related to the demand side are: the evolution of consumer preferences (Aversi, Dosi et al. 1999; Consoli 2008) and the study of innovation adoption and diffusion (Dickerson and Gentry 1983; Im, Bayus et al. 2003; Rogers 2003). The focus of this thesis is on the adoption of product innovations by consumers.

For consumers, the adoption of innovations is a process that entails strong uncertainties and risk. Consumers can be characterized as bounded rational agents (Simon 1955; Wilde 1980; Tversky and Kahneman 1986; Bettman, Luce et al. 1998). They are constrained in terms of cognitive and computational resources they can exploit to absorb information, solve problems and take decisions (Simon 1955). As a result, consumers are unfamiliar with many features of innovations and cannot always foresee whether adopting an innovation will enhance future utility or not. To reduce these uncertainties the adoption of innovations nearly always involves a search for information (Dosi 1988; Dowling and Staelin 1994; Blackwell, Miniard et al. 2001). A textbook definition of search is: “the motivational activation of knowledge in memory or acquisition of information from the environment (Blackwell, Miniard et al. 2001, p. 106)”. This can be information about the functions and performance of the product, but also about other relevant attributes of the product, such as its environmental impact, other risks involved or its design. Searching can enhance the quality of the outcome of the adoption process. Since the diffusion and establishment of an innovation depends upon its adoption by consumers, a better understanding of the consumer search process can aid producers of innovations and policy makers in the formulation of strategies that facilitate the diffusion and the development of innovations.

In the innovation literature theories have been formulated about the demand for knowledge by agents (Nelson and Winter 1982; Cohen and Levinthal 1990; Nooteboom 2000), but empirical work in this field has mostly focused on explaining the demand for knowledge by firms. The demand for knowledge about innovations by consumers has always been left to be explained by scholars in the field of marketing. In this discipline consumer search in general has been researched widely (see Ratchford 1982; Johnson and Russo 1984; GreganPaxton and John 1997; Moorthy, Ratchford et al. 1997). However, a dimension of search that has been somewhat neglected in the search literature (Klein and Ford 2003) relates to the sources of information consulted<sup>2</sup> (see Kiel and Layton 1981), in particular the choice to search a particular channel out of a broader set of channels has not been studied extensively. Many studies focus on explaining the use of a particular source, such as the Internet (see Peterson and Merino 2003; Mathwick and Rigdon 2004; Ratchford, Talukdar et al. 2007) or interpersonal channels (see Gilly, Graham et al. 1998). Every source has its own risks attached, because the content and the quality of information differ. Only a limited number of studies do consider the choice among multiple sources, all these studies focus on specific product domains: Kerstetter and Cho (2004) on the domain of tourism, Klein and Ford (2003) on the domain of

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2 In this thesis information sources and information search channels are used interchangeably.

automobiles, and Mattila and Wirtz (2002) on credence services. Each product domain has a different level of risk related to adoption, because the prices and the quality of the products vary, therefore it can be assumed that information search patterns differ per product domain.

The varying levels of risk attached to the adoption of innovation in different product domains and to search, attract different types of consumers who are more or less willing to adopt certain products. A specific characteristic that is related to risk taking is consumer innovativeness (Kirton 1994), which is the consumers' degree of inherent novelty seeking behavior (Hirschman 1980). Innovators play an important role in the innovation diffusion process. First, people with a high degree of innovativeness are often the first consumers who take the risk to adopt new products on which much is still unknown (Midgley and Dowling 1978; Rogers 2003; Roehrich 2004). Further, they partly test the product's functionality and can even contribute to further improvement of the product (Von Hippel 2005; Van Rijnsoever, Faber et al. Forthcoming). They also familiarize a broader audience with the characteristics and functionality of the innovation. This is because early adopters can serve as opinion leaders who introduce new norms and ideas into a social system (Rogers and Cartano 1962; Katz and Lazarsfeld 1964). Further, in the case of interdependent innovations, the early adoption of products by innovators enables the build-up of what is called 'critical mass', the point after which the diffusion of the innovation becomes self-sustaining (Rogers 2003). The reason for this is that some innovations are only useful if there is a certain amount of users (a fax for example would be useless if there is only one in the world). Having a sufficient number of innovative individuals in a population is thus a critical component in the diffusion process. Without innovative individuals, successful innovation diffusion is less likely. Since innovative individuals are the ones who first take the risk of innovating it is crucial to understand how their information search patterns differ from other individuals and what their preferred information search channels are. Formulating strategies to provide information directly to early adopters can enhance the rate of adoption of innovations. Further, some of these search channels can also serve as a channel for feedback to producers of innovations. This enables them to repair faults and use the innovative consumer as lead user to improve the product further after market introduction (Lüthje 2004; Von Hippel 2005).

This thesis adds to the consumer search literature a series of papers that investigate the relationship between consumer innovativeness and the use of information sources in different product domains. It combines theoretical arguments from the marketing literature with insights from the diffusion of innovations literature.

This thesis both contributes to theories that explain consumer information search and adds to a further understanding of the role of innovators in innovation diffusion and demand oriented innovation development processes.

The remainder of this introductory chapter is organized as follows. First a conceptual model with a short literature review of the most important concepts and relationships is provided. Next the research questions of the thesis are posed, after which the data used in the thesis is discussed. Finally, an overview of the thesis chapters follows.

## Conceptual framework

This thesis explores the conceptual model represented in Figure 1.1. Two related measures of innovativeness are assumed to influence the use of different information search channels during different phases of the search process. The relationships can be explained from both a utilitarian or hedonic perspective. The relationships are moderated by the product domain. Further variables that might influence the main relations are added. All concepts and explanatory mechanisms are explained in this section.

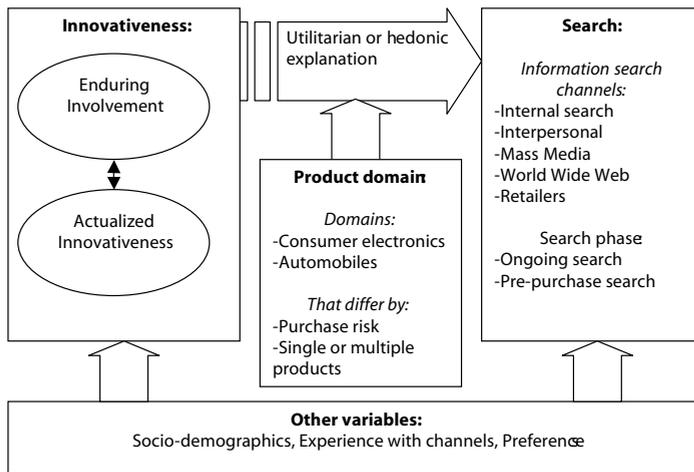


Figure 1.1: The conceptual framework of the thesis.

## Search

### Information Search channels

When searching for information, consumers can engage in an *internal* or an *external search* (Blackwell, Miniard et al. 2001), as captured in the two elements of the definition quoted above.

An internal search is nothing more than an internal memory scan by the consumer for decision-relevant knowledge that can be used in the purchase process. The effectiveness of an internal search to a purchase is dependent on the consumers' relevant prior knowledge and experience with the product under investigation (Moore and Lehmann 1980; Srinivasan and Ratchford 1991; Kerstetter and Cho 2004). If there is enough prior knowledge, consumers can make inference about the new product to be purchased. Otherwise consumers will have to resort to other sources.

Kiel and Layton (1981) discern three main categories of external sources: interpersonal channels, mass media and retailers. Interpersonal channels (also called word-of-mouth) are defined as "informal communications directed at other consumers about ownership, usage, or characteristics of particular goods and services and/or their sellers" (De Matos

and Rossi 2008 p. 578). Mass media channels are the impersonal information sources that target a broad audience, e.g. radio, TV and newspapers. Finally, retailers advise consumers as part of their service offer to consumers. More recently consumer information search is also heavily influenced by the World Wide Web (Alba, Lynch et al. 1997; Bakos 1997; Biswas 2004). Compared to other external channels, such as retailers or specialized media, the World Wide Web provides a wealth of information against relatively low costs (Biswas 2004). As a result, the Web competes with other channels in the search process (Ratchford, Talukdar et al. 2007). On the other hand, the Web is not necessarily a more efficient search channel, because it provides an overload of information that the consumer cannot always comprehend (Biswas 2004). It is therefore worthwhile to consider the WWW separately from the other external search channels.

### **Search phase**

Another dimension of search scholars agree on is that there are two different phases of consumer information search: *pre-purchase search* and *ongoing search* (Bloch, Sherrell et al. 1986). During pre-purchase information search, the consumer gathers information to enhance the quality of a specific purchase outcome (Punj and Staelin 1983), its most important distinguishing feature is that it is goal directed by nature (Janiszewski 1998). Ongoing search on the other hand is exploratory by nature. The search patterns are less focused and do not necessarily have a purchase outcome (Moe 2003). The most important motivations for engaging in ongoing search are either recreational or related to acquiring a bank of product information for future purchase decisions (Bloch, Sherrell et al. 1986; Moe 2003). Ongoing search is largely driven by hedonistic motives, while pre-purchase search is more utility driven (Babin, Darden et al. 1994). In practice however, the two phases are difficult to separate (Bloch, Sherrell et al. 1986). In empirical consumer research, it is often implicit that pre-purchase search is being studied; ongoing search is often ignored in the literature. In this thesis attention is devoted to both phases of search.

### **Innovativeness**

In consumer research the concept of innovativeness has been defined and analyzed at multiple levels (Garcia and Calantone 2002) ranging from a personality trait to the result of actual (purchasing) behaviour. Midgley and Dowling (1978) defined innovativeness as the degree to which an individual is receptive to new ideas and makes innovation decisions independently of the communicated experience of others. Hirschman (1980) defined innovativeness as a form of inherent novelty seeking behaviour, while Rogers (2003) uses it as a concrete measure for the adoption of new products. Steenkamp, Ter Hofstede et al. (1999) have taken an intermediate position by stating that innovativeness is the tendency to be attracted by new products.

Three different levels of innovativeness are usually distinguished (Goldsmith, Freiden et al. 1995; Roehrich 2004): global innovativeness as a personality trait; domain-specific innovativeness which refers to the adoption within a category of products; and product-specific innovativeness which refers to the adoption of a single product. The latter two

reflect actual displayed innovative behaviour (or actualized innovativeness), while the first level views innovativeness as a personality trait.

Another potential level of analysis that has received much less attention in research is that of technology clusters (Larose and Atkin 1992; Rogers 2003; Vishwanath and Chen 2006). Innovations are often perceived to be related and are adopted in combination with each other. These perceived related innovations are called technology clusters and can be viewed as a part of the domain-specific level.

In this thesis two concepts are used as approximations for innovativeness. These are actualized innovativeness, and enduring product involvement, both are domain specific measures. Consumers are not considered to be innovative with all types of products, but rather in a limited number of domains (Goldsmith and Hofacker 1991).

### **Actualized innovativeness and enduring product involvement**

Actualized innovativeness is a term that originates from the diffusion of innovation literature. It is defined as the time of adoption of an innovation compared to other potential adopters (Midgley and Dowling 1978; Rogers 2003).

There are two types of involvement: enduring (or ego) and purchase involvement (Beatty, Kahle et al. 1988). However, some scholars argue that these two forms of involvement are antecedents of the consumers level of felt involvement, and they are not separate types (Celsi and Olson 1988). In this thesis only enduring involvement is used..

Enduring involvement captures a consumer's involvement with a product class (Mittal and Lee 1989). Enduring involvement is: "independent of purchase situations and is motivated by the degree to which the product relates to the self and/or the hedonic pleasure received from the product" (Richins and Bloch 1986,p. 280). The concept reflects the perceived personal relevance of a product to the consumer in terms of needs, values, goals and interests (Zaichkowsky 1985; Celsi and Olson 1988; Mittal and Lee 1989). Enduring involvement with a product has been indentified as an important antecedent of search (Beatty and Smith 1987; Schmidt and Spreng 1996; Gursoy and McCleary 2004).

Actualized innovativeness and enduring involvement are strongly positively related to each other for two reasons. First the former is a behavioural expression of innovativeness, while the latter is an attitudinal expression of innovativeness. Past research has shown that attitude and behaviour are positively related to each other, but that not all attitudes are directly translated into behaviour (Ajzen 2005). Second, both concepts are related to a third underlying concept: prior knowledge (Sujan 1985; Celsi and Olson 1988; Rogers 2003). Prior knowledge is the knowledge a consumer has about a specific product class (Johnson and Russo 1984).

### **Explanatory mechanisms**

A prominent view to explain search in economics (see Stiglitz 2000) and in consumer behavior studies (see Wilde 1980; Moorthy, Ratchford et al. 1997) is the economics of information (EI) perspective, pioneered by Stigler (1961). The EI perspective offers a

utilitarian based explanation for actor search behavior. This view argues that actors will search as long as the marginal costs of searching are lower than the marginal gains. In the consumer behavior literature, the two most important elements of search costs are the resources invested in search and the efficiency of the search (Goldman and Johansson 1978; Blackwell, Miniard et al. 2001). For consumers resources can be time, money, cognitive effort, reputation (Borgatti and Cross 2003). The efficiency of the search is the amount of knowledge retrieved during the search per unit of invested resource. From the EI perspective it follows that if the search efficiency becomes smaller than one, the search will cease.

There are many empirical consumer studies that have used the EI perspective (see for instance Beatty and Smith 1987; Moorthy, Ratchford et al. 1997; Jones, Mothersbaugh et al. 2000). However, this view has also been criticized by scholars that claim that consumers not only have utilitarian motives for searching, but also other, more hedonistic reasons (see for instance Bloch, Sherrell et al. 1986; Babin, Darden et al. 1994; Sands, Oppewal et al. 2008), it can actually be fun!

Looking from an utilitarian perspective, a higher innovativeness implies a larger amount of prior knowledge. In consumer studies there are at least three ways in which prior knowledge influences search (see Johnson and Russo 1984; Moorthy, Ratchford et al. 1997). First of all, consumers with a larger amount of prior knowledge, have less need for additional search, therefore a negative relationship is implied. Second, a higher amount of prior knowledge allows consumers to better interpret the knowledge gathered during the search, as a result they are able to search more efficiently; each resource invested in search facilitates future search efforts (Johnson and Russo 1984). The third argument is a combination of the former two; the consumer is better able to search as the amount of prior knowledge increases, until the point where the consumer does not find it worthwhile to search any further. After this turning point the amount of search decreases, so that the overall relationship is an inverted U-shape. This inverted U-shape implies that there is some point after which the consumer does not find it worthwhile to continue to search, from the EI perspective it follows that this point is when the costs of searching exceed the expected gains.

From a hedonic perspective, search channels can have certain characteristics that make them more attractive to use for high involved consumers, than other channels. For example, certain channels can provide additional hedonic value during the search (Babin, Darden et al. 1994), so consumers may enjoy searching a particular channel. A higher degree of involvement motivates consumers to search more through these channels (Schmidt and Spreng 1996).

Next to the cost-benefit approach and motivational arguments, the amount of search effort is also related to the amount of perceived risk associated with the product (Srinivasan and Ratchford 1991; Schmidt and Spreng 1996; Conchar, Zinkhan et al. 2004). This perceived risk is determined by expected (monetary) losses of purchasing, perceived benefits and personal perceptions about risk (Dowling and Staelin 1994). If more risk is associated with the purchase of a product, then consumers gear up their search efforts to reduce uncertainty (Taylor 1974; Dowling and Staelin 1994). In this thesis the role of risk for the use of information search channels is explored further.

## **Moderator: Product domains**

Different relationships between innovativeness and search are expected for different product domains. In this thesis two empirical product domains are considered: the domain of consumer electronics and the domain of automobiles. These domains are chosen for three reasons.

First, different risks are associated with the adoption of products in the two domains; this has implications for the amount of search. The higher the degree of perceived risk, the higher the search effort is (Dowling and Staelin 1994). For low risk products, different channels of information search can be thought to compete with each other based on their relative costs. Consumers rely on the channel that provides the required information against the lowest search costs. The increased use of one channel leads to another channel being used less. This assumption might hold for low risk type of products such as groceries and this thesis explores whether it also holds for consumer electronics.

Automobiles are relatively expensive compared to consumer electronics. Also, consumers generally use cars for a long time and have sporadic experience with purchasing the product. Therefore, we consider this product category as a relatively high risk type. Due to the high risk involved, there is usually a considerable time lag between the start of information search and the actual moment of purchase (Srinivasan and Ratchford 1991). The length typically varies from a few weeks to several months (Putsis and Srinivasan 1994). This results in increased use of each search channel as well as increased dependence on multiple search channels in order to increase the reliability of acquired information. In this case, the channels do not compete with each other, but rather they complement each other. This means that an increased use of one channel does not necessarily lead to another channel being used less.

Second, in both domains new products are introduced on a regular basis. Either as a functional enhancement of a previous product generation or to add new functionalities to the product domain (Kim, Srivastava et al. 2001; Van Rijnsoever and Oppewal 2009). The product domains differ in two important manners. First, the domain of consumer electronics encompasses a set of products, whereas the automobile domain consists of only one type of product. It is therefore important to determine whether these differences in categorization can have implications for how consumers perceive the two domains and their adoption patterns.

Third, both domains are of economic importance. With regard to consumer electronics: in the Netherlands in 2006 a total of 98.5% of all households owned a colour television while 80.6% own a personal computer. In the European Union television ownership is in all countries higher than 94% of all households. European computer household ownership varies between 35.1% (Greece) and 80.6% (the Netherlands) (Eurostat 2009). With regard to the automobile domain: in the Netherlands a total of about 7.5 million automobiles are registered (CBS 2009). In 2007, of all households 55.2% owned one car, while 21.8% owned two cars (CBS 2009). In the European Union in 2006 household car ownership varied between 41.7% (Latvia) and 87.2% (Luxemburg) among the different member states (Eurostat 2009).

These numbers also indicate that most consumers in the Netherlands, but also across Europe are to some extent familiar with the products in these domains. Consumers often

have purchased or used one of the products themselves. This familiarity enhances the chances of obtaining valid results.

## **Other variables**

In the different studies different sets of control variables are used to further explain the relationship between innovativeness and search. In particular, socio-demographic variables, experience with communication channels and preferences are taken into account. Adding control variables to the models allows establishing to what extent the relationships found are explained by the independent variables and not by other variables. Ultimately, control variables are added to the models to see what the 'net' effect is of innovativeness, all other things being equal (Lewis-Beck, Bryman et al. 2004).

### **Socio-demographics**

Past studies have revealed that socio-demographic characteristics are associated with search behaviour (e.g. Kiel and Layton 1981; 2003; Gursoy and McCleary 2004; Ratchford, Talukdar et al. 2007) and innovativeness (Dickerson and Gentry 1983; Vishwanath 2005). Since socio-demographic characteristics of innovators are domain specific (Goldsmith and Hofacker 1991), they can provide valuable information for marketers in the product domains considered. The following socio-demographic variables used as control variables: age, sex, education level, income and the amount of inhabitants in the town of residence.

### **Experience with other channels**

This second set of control variables is used, because experience with a specific external search channel can reduce information search costs (Moorthy, Ratchford et al. 1997). Such experience makes it easier for consumers to acquire and process new information (Brucks 1985; Biswas 2004), which increases the efficiency of the search (Goldman and Johansson 1978). This in turn will lead to an increased use of the channel for information search (Blackwell, Miniard et al. 2001). Therefore the following experience variables are controlled for: (1) telephoning, (2) being with family and friends, (3) emailing, (4) watching TV, (5) listening to the radio, (6) newspapers and magazines, (7) car magazines (8) surfing the Internet, and (9) shopping.

### **Preferences**

A final set of variables that are of interest here are the consumers' preferences of certain aspects for technologies. The preferences of innovative consumers are important, because they can influence both the adoption of new products and technological development in demand oriented innovation processes (Von Hippel 1986; Windrum, Ciarli et al. 2009). Following Blackwell et al. (2001, p289): "preferences represent attitudes to one object in relation another". According to Ajzen (2005, p3) an attitude is defined as "a disposition to respond favourably or unfavourably to an object, person, institution or event. [...] The main characteristic of attitude is its evaluative nature."

Two types of attitudes can be distinguished: attitudes towards the object and attitudes towards the behaviour (Ajzen and Fishbein 1980). Not all attitudes are always translated

into behaviour, this is called the attitude behaviour gap (Acock and DeFleur 1972; Owens 2000; Bartiaux 2008). This thesis also explores how preferences towards certain aspects of a product are related to use of information sources. Using specific information sources by policy makers can influence the formation of consumer preferences and can help bridge the gap between attitude and behaviour.

## Research questions

Based on the conceptual model the following research question (RQ) is formulated to guide the research in this thesis:

*RQ: What is the relationship between innovativeness and the use of different information search channels by consumers in the domains of consumer electronics and automobiles?*

Also a number of sub questions (SQ) are formulated. The first question addresses the comparability of the product domains. The domain of automobiles consists of a single product, while the domain of consumer electronics consists of multiple products. In order to compare product domains it is important to verify the extent to which consumer electronics can be regarded as a single product domain. Therefore the first sub question is:

*SQ1: To what extent can the domain of consumer electronics be considered as a single product domain?*

In the conceptual framework, it is claimed that the two approximations of innovativeness are related to each other. The second question tests the assumed relation between actualized innovativeness and enduring product involvement empirically.

*SQ2: What is the relationship between the different approximations of innovativeness?*

Having established the relationship between the approximations of innovativeness, the third research question addresses the relationship between innovativeness and use of information search channels for the different product domains:

*SQ3: What is the relationship between innovativeness and the use of different information search channels by consumers in the two product domains?*

Having established the main relationship in the conceptual model, the fourth sub question considers other variables that can play a role:

*SQ4: What is the influence of other variables, such as socio demographics, experience with communication channels and consumer preferences, on innovativeness and search?*

Finally to answer our main research question, the relationships between the two product domains are compared:

*SQ5: How do the relationships between innovativeness and the use of information search channels by consumers differ between the two product domains?*

## **Outline of the thesis**

The remainder of the thesis consists of five studies and a concluding chapter aimed at answering the research questions proposed. Each study develops a coherent theoretical framework, that is empirically tested. Chapters 2, 3 and 4 are on the domain of consumer electronics, chapters five and six are on the automobile domain. In chapter 2 SQ 1 is answered, chapter 3 deals with SQ 1, SQ2 and SQ4, chapter 4 answers SQ 2 and SQ 3, chapters 5, and 6 answer SQ3 and SQ4. Chapter 7 answers SQ5. The purpose of each chapter in the thesis is shortly explained below.

### **Chapter 2: Perceived technology clusters and ownership of related technologies: the case of consumer electronics**

In chapter two the relationship between perceived clustering of consumer electronics (which is a self reported measure) and patterns of combined ownership of these products (which is a behavioural measure) is studied. Within the product domain, typical patterns of combined ownership are identified. It is found that consumers first tend to adopt a set of stand-alone 'base technologies', before they start adopting technologies that are complementary to any of the base technologies. This sheds light on whether the products in the domain of consumer electronics are part of a single domain or whether they are part of multiple sub-domains.

### **Chapter 3: The Effect of Innovativeness on Different Levels of Technology Adoption**

In this chapter variables ranging from personality traits, enduring involvement and socio-demographics are used to predict different measures of actualized innovativeness. Also actualized innovativeness is predicted on the product specific level, the cluster-specific level and the domain specific level. Based on this chapter and chapter 2 it is concluded that the product domain of consumer electronics can be regarded as a valid domain of analysis, rather than that the clusters can be seen as separate sub-domains.

### **Chapter 4: The relationship between Innovativeness and use of Information Sources in Ongoing Search**

This chapter explains, for the consumer electronics domain, the use of information search channels during ongoing search with the two approximations for innovativeness: It is shown that both independent variables are related to the different channels in the form of an inverted U-shape, with different turning points. This suggests that the channels compete for use. Also the difference in relationships between the two measures of innovativeness is discussed.

## **Chapter 5: Involvement and use of multiple Search Channels in the Automobile Purchase Process**

This chapter is on the use of information search channels during the pre-purchase phase in the automobile domain. Enduring involvement is used as main explanatory variable, socio-demographics and experience with communication channels are used as control variables. Since the domain consists of only one product, and only car owners were surveyed, no measure of actualized innovativeness was used. It is found that enduring involvement is positively related to the use of all channels, but that this relationship is stronger for mass media and the World Wide Web, than for the other external search channels. Also the channels do not appear to compete with each other for use, but rather are complementary.

## **Chapter 6: Consumer Car Preferences and Information Search Channels**

This chapter extends the model in the previous chapter, by adding indicators for both stated and revealed preferences. With the use of a cluster analysis, consumers are categorized based on their stated and revealed preferences. It is shown that a large gap exists between attitudes and behaviour on various aspects with regard to automobiles. Enduring involvement partly explains this gap. Policy recommendations are made on how to bridge the attitude-behaviour gap using communication strategies.

## **Chapter 7: Conclusion and implications**

In the concluding chapter the results from the studies are used to answer the research questions. Further, implications are discussed for the demand side of innovation and for theory of search.

## **Data**

To answer the research questions five survey datasets are used. One dataset consists of qualitative data about consumer electronics; four are of a quantitative nature. Three of the quantitative datasets are on the domain of consumer electronics; one is on the domain of automobiles. Two of these are representative for the Dutch population, the other two are not. Each dataset is described below in more detail.

The qualitative dataset (Qual1) consists of a sample of 47 consumers that were interviewed in June 2007 about how they perceived the relation between 16 different consumer electronic products. Quota by age and sex were used to ensure a broad sample. Respondents varied in age between 16 and 86 years old, with a mean of 48.55. The sample consisted of 23 men and 24 women. All interviews were held in the respondents own houses. The interviews were recorded on audio and written out literally afterwards. This dataset is used in chapter 2.

The first quantitative dataset (Quan1) is also on the domain of consumer electronics and consists of a sample of undergraduate students of a first-year research methodology class surveyed in November 2005 and students of a second-year bachelor course on innovation

and organization theory surveyed in February 2006. The sample size was 138 respondents, varying in age between 19 and 28 years; among these, 112 were male and 26 female. This sample is not likely to be representative, but its results can be used in an explorative research strategy to provide theoretical indications for future research (Bryman 2008). The questionnaire measured different indicators of innovativeness. These measures are related to each other in chapter 3.

The second quantitative dataset (Quan2) is related to the first one. Each of the 101 students of a first-year bachelor course on research methodology was asked to distribute a questionnaire to 6 individuals he or she knew. Two of these individuals were to be the parents of the students, if possible; two were to be brothers or sisters, if possible, and two other persons were to be from his or her social environment. If a person did not have a certain relative, a brother for example, he or she was obliged to substitute that relative with an individual from his or her own social environment. This resulted in a sample of 450 respondents (not all students did complete the assignment). The sample consisted of 266 men and 184 women; age varied between 13 and 80 years. Because of the approach by which the questionnaires were distributed, the respondents tended to be young. Over 50% of them were younger than 30 years of age. The method of sampling resulted in two distinct age groups in the sample. Therefore, the sample was split into two subsamples: one subsample containing all the respondents that were 27 years of age or younger ( $n=271$ ) and the second subsample with respondents older than 27 years ( $n=179$ ). The splitting of the sample into two groups allowed comparing the results between the older and the younger age groups. This form of snowball sampling is not likely to give a representative sample, but the results are used to give theoretical indications that can be tested on representative samples (Bryman 2008). The questionnaire measured different indicators of innovativeness. These measures are also related to each other in chapter 3.

The third quantitative dataset (Quan3) consists of a survey among Dutch consumers. The survey was administered in a time span of three weeks in December 2006 by students of a research methodology course. Respondents were approached in public places all over the Netherlands and asked whether they would fill in a questionnaire. They told the respondents that they could win 20 Euros if they participated. Filling in the questionnaire took about ten minutes. While quotas by age groups and sex were used to ensure a representative sample of the Dutch population, the sample did contain an overrepresentation of people with higher education. The final sample consisted of 2094 consumers, varying in age between 16 and 88 years (mean = 44.3); 1046 respondents were male, 1048 were female. The written questionnaire enquired, among other things, whether the consumers owned the previously mentioned technologies and the consumers use of information search channels. This dataset is used in chapter 2 and 4.

The fourth quantitative dataset (Quan4) is on the domain of automobiles. A total of 1392 households owning a car were surveyed in The Netherlands. This sample was obtained by personally delivering questionnaires to households all over the Netherlands. Households were screened for the presence of a car and the willingness of the person that had been most involved in the purchase process to fill in the questionnaire. Households unwilling

to participate were replaced with other households until 1500 questionnaires had been distributed. The filled-in questionnaires were collected a few days after delivery. Quota were set by gender and age to be representative for the Dutch population. Verification with data from the Dutch Central Statistical Office (CBS 2007) confirmed the data to represent these population statistics of Dutch households owning a car well. Only the education level of the respondents was higher than observed for the total population.

Table 1.1 provides an overview of the thesis chapters, the product domains, the sub questions and the data used. In the following chapters each of the sub questions are dealt with. In the final chapter an answer to the research question is given.

<b>Chapter:</b>	<b>Product domain:</b>	<b>Sub questions addressed:</b>	<b>Data:</b>
Chapter 1	-	-	-
Chapter 2	Consumer electronics	SQ1	Qual1, Quan3
Chapter 3	Consumer electronics	SQ1, SQ2, SQ4	Quan1, Quan2
Chapter 4	Consumer electronics	SQ2, SQ3	Quan3
Chapter 5	Automobiles	SQ3, SQ4	Quan4
Chapter 6	Automobiles	SQ3, SQ4	Quan4
Chapter 7	-	SQ5	-

*Table 1.1: An overview of the thesis*

## **Other publications**

The empirical chapters in this thesis have been selected out of a broader set of research papers that were all written during the same period. Other papers written by the same author that have not been selected for this thesis are:

- Van Rijnsoever, F. J., Hessels, L. K., & Vandeberg, R. L. J. (2008). A resource-based view on the interactions of university researchers. *Research Policy*, 37(8), 1255-1266.
- Van Rijnsoever, F. J., Van Hameren, D., Walraven, P. F. G., & Dijk, V. (2009). Interdependent technology attributes and the diffusion of consumer electronics. *Telematics and Informatics*, 26, 410-420.
- Van Rijnsoever, F. J., & Oppewal, H. (2009). Successive early adoption of technology generations: the case of video players *ANZMAC 2009*
- Van Rijnsoever, F. J., Faber, J., Brinkman, M. L. J., & Van Weele, M. A. (Forthcoming). User-producer interaction in website development: motives, modes and misfits. *Journal of the American Society for Information Science & Technology*.

## 2 Perceived technology clusters and ownership of related technologies: the case of consumer electronics<sup>3</sup>

### Abstract

We contribute to the understanding of how technologies may be perceived to be part of technology clusters. The value added of the paper is both at a theoretical and empirical level. We add to the theoretical understanding of technology clusters by distinguishing between clusters in perceptions and clusters in ownership and by proposing a mechanism to explain the existence of clusters. Our empirical analysis combines qualitative and quantitative methods to investigate clusters of consumer electronics for a sample of Dutch consumers. We find that perceived clusters in consumer electronics are mostly determined by functional linkages and that perceived technology clusters are good predictors of ownership clusters, but only for less widely diffused products.

### Introduction

In his famous book on the diffusion of innovations Rogers (2003, p.249) states that: “Innovations are often not viewed singularly by individuals, but they may be perceived as an interrelated bundle of new ideas. The adoption of one idea may trigger the adoption of others.” This intuition has been taken up by a few researchers that have further developed the seminal idea of perceived related technologies to the concept of *technology clusters* and have tested it in practice<sup>4</sup>. The word *technology* has been used to refer to technology-based innovations, and has most often been applied in the field of information technologies. While the claim in Rogers (2003) implicitly assumes that an innovation entails a new idea, technology clusters specifically refer to new ideas embodied in actual products. The motivation for an interest in technology clusters has been spurred by the empirical evidence that such clusters can be significant predictors of the adoption of innovations (see for instance Lin (1998); Busselle et al. (1999) and Vishwanath and Goldhaber (2003)).

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3 This chapter is published as: Van Rijnsoever, F.J. and C. Castaldi (2009). “Perceived technology clusters and ownership of related technologies: the case of consumer electronics.” *Journal of the American Society for Information Science and Technology* **60**(2): 381-392.

4 Some authors prefer the term *innovation clusters* (see Larose, R. and A. Hoag (1996). “Organizational adoptions of the internet and the clustering of innovations.” *Telematics and Informatics* **13**: 49-61. and Neundorff, K. A., D. Atkin and L. W. Jeffres (1998). “Understanding Adopters of Audio Information Innovations.” *Journal of Broadcasting & Electronic Media* **42**(1): 80-93.). Both terms are in fact also used in the literature on industrial clusters for clusters of technology/innovation-oriented firms.

They have, for example, been defined by shared infrastructures (Larose and Atkin 1992; Perse and Courtright 1993), or by brand (Warlop, Ratneshwar et al. 2005). Clusters have also been determined in relation to the lifestyle of the adopter (Ettema 1984), to some emotional attachment (Kwortnik and Ross 2007), or to the fulfilment of communication needs (Cowles 1989; Perse and Courtright 1993).

In this paper we propose that the literature on technology clusters can make further steps in two main directions. First, as discussed in Vishwanath and Chen (2006), technology clusters have been used and defined in *ad hoc* ways depending on the focus of the study. The definition proposed by Rogers implies that there is a relationship between two different types of clusters, namely that a perceived relationship between products (perceived clustering) is predictive of the combined ownership of these products (ownership clustering).

Perceived relationships among products are the focus of product categorization literature (see for instance: Nedungadi et al. (2001) and Rosa and Porac (2002)), while the combined ownership of technologies is discussed in the technology adoption literature (Leung and Wei 1999). Most studies consider technology clusters as exogenous, and imply that clusters reflect past behaviour. They do not aspire at formulating a theoretical mechanism that explains their existence.<sup>5</sup> Mechanisms on how clusters come to exist can be formulated both for perceived technology clusters and for the combined ownership of technologies. The theoretical mechanism behind both perceived and ownership clusters is bound to depend on the specific technologies considered. We propose a theoretical mechanism for both types of clusters and we relate them by testing whether perceived clusters are a good predictor of actual ownership. Continuing the line of most previous studies on this topic, we apply our theory on information related consumer electronic products.

Second, Vishwanath and Chen (2006) have suggested that different types of adopters may perceive technology clusters differently. They find that early-adopters perceive technologies to be related through functional interdependencies and a shared infrastructure, while non-adopters relate technologies based upon their functional merits. Their contribution is a first step towards a better understanding of the individual characteristics of adopters that shape technology clusters. In this paper we analyze the role of consumers' prior adoption on the likelihood of linking two technologies together.

In the next section we develop a theoretical framework for technology clusters in consumer electronics. Next, we test our hypotheses on a sample of Dutch consumers using a combination of qualitative and quantitative research methods. In the conclusions we discuss the implications of our results for the literature on technology clusters and suggest some implications for consumer behaviour scholars as well.

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<sup>5</sup> The studies by LaRose and Atkin (1992) and Vishwanath and Chen (2006) are the only two exceptions that we are aware of.

## Theoretical framework

### Technology clusters in consumer electronics

Following Rogers (2003) a technological innovation<sup>6</sup> can be defined as a technology/product that is perceived to be new by an individual. This innovation can be viewed as being stand-alone or as being part of a perceived larger whole, a technology cluster (Larose and Hoag 1996; Rogers 2003; Vishwanath and Chen 2006).

Figure 2.1 graphically displays 16 different technologies<sup>7</sup> that are considered in this study. The underlying *infrastructure* is also depicted. The lines that connect the technologies display possible physical connections, like cables or Bluetooth, between them. The hubs in the infrastructure can be considered “base technologies”: they are standalone equipments to which other devices can be linked so that the performance of either of the two devices increases. For consumer electronics two base technologies can be identified, the Personal Computer (PC) and the Television (TV)<sup>8,9</sup>. The PC is represented by the desktop and the notebook, which have similar functions and can be considered to a great extent as *functional substitutes*. Together with ordinary television, we consider two functional substitutes, High Definition Television (HDTV) and Flat Panel Television (FPTV). All other technologies are considered “peripheral”. Peripheral technologies are *functional complements* of the respective base technologies. This complementarity entails a strong linkage between peripheral and base technologies since the proper functioning of peripheral technologies is contingent upon the ownership of the corresponding base technology.

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6 In what follows we shall simply refer to *innovations* and use the term interchangeably with new products and new technologies.

7 The products chosen cover a wide range in terms of diffusion (from TV to PDA). We sought for a relatively complete list of consumer electronics while at the same time limiting the number of products to 16 in order to keep the response rate of our questionnaire high.

8 It can be argued whether the TV is actually a base technology, because it needs an input signal to function. Such a signal could also be viewed as a separate technology. In this study it is assumed that all TVs owned by the respondents have an input signal in the form of a cable, antenna or satellite. This assumption is reasonable for a country like the Netherlands, but it may be reconsidered for a country with a weaker infrastructure.

9 A cluster around the TV has previously been identified by Perse and Courtright (1993).

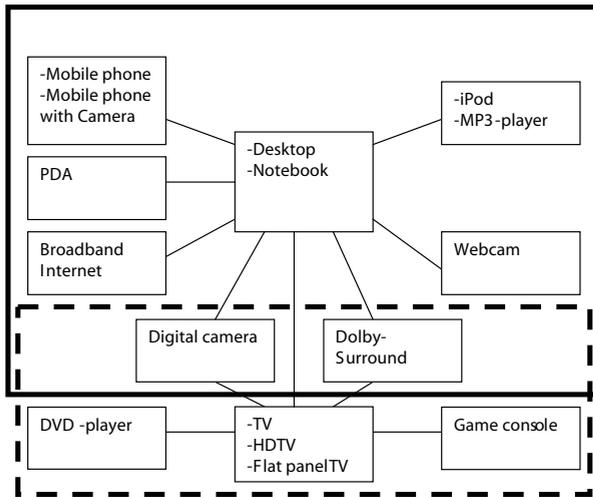


Figure 2.1: The 16 technologies and their shared infrastructure. PDA (Personal Digital Assistant) HDTV (High Definition TV, iPod, Flat panel TV, Game console, Webcam, MP3-player, Notebook (or laptop)), Dolby-surround, Mobile Phone with camera, Digital camera, Broadband Internet, Desktop, DVD-player, Mobile Phone, TV.

### Perceived clusters in consumer electronics

According to Rosa and Porac (2002) the categorization of products by individuals depends on how the products are experienced, which in turn largely depends on contextual factors. Yeh and Barsalou (2006) propose a general classification of properties on which cognitive categories for tangible objects can be based. Their classification can be used to understand which properties define categories of products in consumer electronics. They distinguish among categories based on *entity properties* (e.g. small phones, thin TVs), *situational properties* that describe the physical setting or event to which the product is associated (e.g. conversing, hearing ring tone and beeps for the mobile phone), *taxonomic properties* (neighbouring concepts in a cognitive taxonomy like music devices) and *introspective properties*, which describe agents subjective perspective on the target object (e.g. annoying devices, convenient products). Products sharing common properties fall into the same perceived category.

Following the representation in Figure 2.1, we consider categories of products based on linkages defined by 'basic functions', an example of categorization based on taxonomic properties. The basic function of a product is defined as the primary function for which the product is purchased. For example, the basic function of a television, which is to display video transmissions from several sources (e.g DVD-player, Cable-TV, Satellite, Game console etc.) We define four different categories of linkages and corresponding indicators of 'infrastructural distance' between technologies.

- Overlapping functions (OF): technologies perform the same basic function, in other words, they are largely functional substitutes. For example, a notebook basically does

the same as a desktop computer. The infrastructural distance between the technologies is zero.

- Functional interdependencies (FI): the technologies are directly connected to each other and the performance of either technology depends on this connection, they are functional complements. For example, broadband internet does not function without a computer. The infrastructural distance between the technologies is one.
- Shared base technology (SBT): the technologies are connected with each other through a base technology. A webcam for example is connected to the internet through a computer. The infrastructural distance between the technologies is two.
- Unknown (Unk): This category entails all other linkages, which cannot be related to a functional linkage, but relate instead to entity, situational or introspective properties (such as lifestyle- or brand-related properties). The distance between the technologies is three or greater. The word “Unknown” thus means that the type of link is unknown when clusters are viewed from a shared infrastructure perspective.

Appendix A shows how we classified each of the possible 120 links among the 16 technologies<sup>10</sup>. The classification stems directly from Figure 2.1 and from the four categories defined above: functional substitutes are classified as ‘OL’, while functional complements as ‘FI’.

Given the existence of clear base technologies in the case of consumer electronics, we suggest that linkages based on infrastructural distance will be significant predictors for perceived technology clusters. Specifically, we assume that a lower infrastructural distance is associated with a higher likelihood for perceiving technologies as part of the same cluster. This implies two main claims. First, products with overlapping functions (substitutes) are most likely to be perceived as being part of the same cluster. Second, factors different from functional linkages, falling in our ‘Unknown category’, matter the least for predicting clusters in consumer electronics. Our first hypothesis is then:

*Hypothesis 1: The larger the infrastructural distance between two technologies, the smaller the likelihood of perceived linking between them.*

### **Prior adoption and perceived technology clusters**

As discussed in the introduction, Viswanath and Chen (2006) found that adopters and non-adopters perceive relationships among technologies differently. Early adopters relate technologies based on their functional interdependence, while later adopters focus more on overlapping functions. These findings are in line with the Consumer Learning by Analogy model (CLA) (GreganPaxton and John 1997). The theory considers experts as individuals with a larger prior knowledge and claims that experts perceive technologies to be related based on actual relationships or “links”, like a shared infrastructure. Instead, non-experts perceive technologies to be related based on single attributes (like having overlapping functions). This also implies that non-experts use more entity properties and introspective properties than experts. Furthermore, Moreau, Markman, & Lehmann (2001) found that categorization for new products depends on external cues (situational properties, entity properties, but certainly not taxonomic concepts,) because there is no

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10  $(16^2 - 16)/2 = 120$

existing knowledge base to fit them in. The level of prior adoption determines the extent to which an individual makes use of taxonomic concepts in associating concepts. In assessing technology clusters the level of expertise and thus the level of prior adoption can play an important moderating role on the type of link used to relate technologies. We propose the following hypothesis:

*Hypothesis 2: Individuals with a high level of prior adoption about the products are more likely to perceive links based on functional interdependence, while individuals with a low level of prior adoption are more likely to perceive links based on overlapping functions.*

### **Perceived clusters and actual ownership clusters**

The relationship between perceived linking of technologies and actual ownership forms the basis of Rogers (2003) argument on technology clusters. His starting assumption is that perceived clustering can enhance the likelihood of adoption. Logically, consumers will only purchase technologies that they can actually put to use. If one does not possess or has no access to a television, it is of little value to purchase a DVD-player (for own use). This means that ownership patterns are expected to follow the patterns laid out by the shared infrastructure. In the case of functional interdependencies clustering does favour adoption, but this is most likely when the performance of the base technology gets enhanced by the peripheral technology. If two different products have the same basic function, a consumer does not need to aspire to own both products. An example is the case of the iPod and an ordinary MP3 player. Since both play digital media, there is little reason for an individual consumer to own both products, except for a replacement purchase or because there are additional functions that one of the two devices does not have, but that are perceived to be important by particular consumers. Finally, the likelihood of adoption as a result of clustering decreases if there is only a shared base technology, and the peripheral technology has no added value from the other technologies.

Based on the above considerations, we expect the type of link to explain the difference between perceived clusters and observed ownership patterns. From this it follows that:

*Hypothesis 3: The relationship between perceived technological clusters and actual technology ownership is moderated by the type of link in such a manner that links based on functional interdependencies and a shared base technology have a higher likelihood of being found in ownership clusters than links based on overlapping functions.*

We expect no effect of prior adoption in actual ownership patterns, because we view prior adoption as the combined ownership of technologies: this means that prior adoption is incorporated in our dependent variable.

We add a last but very important control factor to our model. In modelling perceived relationships we are only dependent on the preferences of the respondents. This is not the case for patterns in ownership; here diffusion of the technology through the population also plays a significant role. In testing our hypotheses we would like to test whether the actual patterns in ownership depart significantly from what we would expect to find on the basis of chance. However, in the case of two widely diffused technologies (the added percentages of ownership of both technologies is larger than 100 %) links will be formed

not only by chance, but also because it is certain that both technologies are owned by some consumers. The amount of diffusion thus heavily influences our results. In our methodology we discuss how we deal with this issue.

## **Empirical studies**

As concerns our empirical analysis, we will combine the results of oral interviews with survey data. Most contributions in this field come from survey data (e.g. LaRose and Atkin (1992), LaRose and Hoag (1996), Leung and Wei (1999), Vishwanath and Goldhaber (2003). A notable exception is the paper by Vishwanath and Chen (2006), who take an original approach by using multi-dimensional scaling techniques.

To test our hypotheses two studies were conducted.

- A study with semi-structured interviews combining a qualitative analysis to investigate how consumers perceive technology clusters and a statistical analysis to test hypotheses 1 and 2.
- A quantitative study to find out which technologies are actually owned in combination with each other and to compare them with the perceived clusters. This study seeks to confirm hypothesis 3.

## **Study one: A study into perceived clusters**

### **Methods**

#### **Sample and data collection**

A group of 21 university students of a research methodology course conducted a series of 47 interviews among a sample of consumers. Although the sample size is too small to form an adequate representation of the population, quota by age and sex were used to ensure a broad sample<sup>11</sup>. Respondents varied in age between 16 and 86 years old, with a mean of 48.55. The sample consisted of 23 men and 24 women. All interviews were held in the respondents own houses. The interviews were recorded on audio and written out literally afterwards. At the beginning of the interview, the interviewer laid out in front of the respondent a series of 16 cards with the names and pictures of the previously mentioned 16 technologies in figure 2.1. The cards were laid out in a predetermined format of two horizontal rows consisting of eight cards. The interviewer asked the respondents whether they would group the cards into, for them, logical clusters. To prevent influence through external cues (Moreau, Markman et al. 2001), no hint for the manner of clustering (such as hints for a category structure (Nedungadi, Chattopadhyay et al. 2001)) was given prior to this question. It was told that if respondents required a technology more than once to form a cluster, they could receive a spare card. After the respondent had finished laying

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11 The study by Vishwanath and Chen (2006) only addressed young consumers. Our sample includes consumers for all ages and thus deals with one of the further tests indicated by the two authors in their conclusions.

out the combinations, the interviewer wrote these down. Next the interviewer asked for each cluster, why the respondents had made this particular combination of technologies. After giving these reasons, the respondents were asked which of the technologies they actually owned.

### **Analysis**

Per respondent all cluster data was put into a 16 by 16 matrix, where the rows and columns stand for the 16 technologies; there were 120 different possible combinations. Each time two products were placed in the same group the value of the combination became 1, this represented a perceived link. If two products were not in the same group, then the combination received the value 0.

All relations were coded in the manner based on our theory (see appendix A): (1) the products have overlapping functions, (2) the products are functional interdependent, (3) the products share the same base technology, (4) unknown.

There are two levels at which we can analyse our data: we can analyse the aggregated matrices of the entire sample, or we can analyse the matrix of each respondent separately. This implies a two-level model (Snijders and Bosker 1999), with the possible combinations at the macro-level and each respondent at the micro-level. In this case we prefer a two-level approach, because it allows us to estimate the effect of the prior adoption variable, which is on the micro level. We measure prior adoption (PA) by the total number of products actually owned. On average the respondents owned 8.23 products, with a standard deviation of 3.41.

From the tables we constructed a vector with values zero and one for all possible combinations of technologies for all respondents: the vector consisted of 5640 observations.

First, to determine which combinations (if any) were perceived as clusters we fitted a binomial random effects model with an intercept dependent on the respondent, using the lme4 package (Bates and Sarkar 2006) of the R-program (R Development Core Team 2007). As dependent variable we used the dummy vector with the links made by all respondents, the independent variable was a factor variable, containing all 120 possible combinations.

Next, to test hypothesis 1, we estimated a binomial random effects model with an intercept dependent on the respondent. The model predicts the probability of each perceived link by the respondents. The independent variable is a nominal variable capturing the four types of functional linkages in order of increasing infrastructural distance (overlapping function is the reference category).

To estimate the moderating effect of hypothesis 2, we added interaction terms between the factor that captures functional linkages and the level of prior adoption of consumers (PA). In order to determine the effect of prior adoption for each type of link, we also inserted the prior adoption variable in four separate models where the dependent variable relates to perceived links based on the four types of links.

To find evidence for our theoretical arguments about perceived clusters, we analysed the interview question with respect to the motives used by respondents to form their clusters. This was done by interpreting and coding the text fragments of the answers with simple labels for each type of link. This is a way of testing whether our theoretical explanations about the reasons for clustering were correct. The coding was checked for inter-subjectivity

to ensure a correct interpretation of the text. We thus have four labels, one for each type of link. In analyzing the interviews we found however that the arguments for linking were often a mixture of the labels. In those cases all relevant labels were attached to the text fragment. The number of times a certain label was mentioned is an indicator for the validity of our results (Baarda, De Goede et al. 2005).

## Results

### Statistical analysis

In appendix B the results of the analysis aimed at identifying the clusters perceived by the respondents are presented. To ease interpretation, we show the actual number of times the respondents clustered the technologies together, but the asterisks indicate the p-values resulting from the analysis. The significant values indicate that the likelihood that the two technologies are perceived to be linked significantly departs from what is expected on the basis of chance alone. Establishing clusters has a high degree of arbitrariness. We have chosen to look at all links above a threshold value that gives a relatively coherent pattern, in this case this was 21 links. This has no further consequence for the rest of the analysis which will take into account all links at the individual level. The sole purpose here is to see whether technology clusters can actually be discovered. From appendix B we can distinguish relatively coherent patterns of clusters if we look at the links that are mentioned more than 21 times. The general result is that there are indeed two main clusters, one around the TV and one around the PC. A third cluster is built around smaller communication devices. A fourth cluster is built around music-players. Only the position of the PDA is somewhat ambiguous, because it ends up being in two clusters. These results resembles the ones in Perse and Courtright (1993) with regard to the TV cluster and the music cluster.

Cluster	Technologies
1	TV, HDTV, FPTV, DVD-player, Dolby surround
2	Desktop, Laptop, Broadband Internet, Webcam, Game console, PDA
3	Mobile Phone, Mobile Phone with Camera, Digital Camera, PDA
4	MP3-player, iPod

*Table 2.1:* The clusters that can be found from appendix 2 based on 21 perceived links or more.

Y=Prob (Perceived link)	All types	Interaction model	OF	FI	SBT	Unk
Intercept	0.158	-0.969**	-1.020**	-1.556***	-2.231***	-2.729***
OL						
FI	-0.673***	-0.601**				
SBT	-1.384***	-1.243***				
Unk	-2.630***	-1.735***				
PA		0.137***	0.145***	0.124***	0.115**	0.014
FI* PA		-0.010				
SBT * PA		-0.018				
Unk * PA		-0.104***				
AIC	5195	5180	907	1719	1035	1527
Number of respondents	47	47	47	47	47	47
Number of observations	5640	5640	705	1363	987	2585

Table 2.2: The results of the random effect models predicting the likelihood of perceived links.

\*\*\*:  $p < 0.01$ , \*\*:  $p < 0.05$ , \*  $p < 0.1$ .

Table 2.2 presents the estimates of the random effects models that test hypotheses 1 and 2. Overlapping functions is the reference category and has therefore no estimate.

The model predicting the effect of the type of link on the likelihood of linking shows that the larger the distance between the technologies becomes, the smaller the likelihood of linking is. In other words, compared to linking based on overlapping functions, linking on the basis of functional interdependencies has a smaller likelihood, followed by linking based on shared base technologies and thereafter followed by the unknown type of linking. This confirms hypothesis 1 and implies two corollary results that are in line with our expectations. First, overlapping functions is the most important factor for consumers to perceive two products as similar. Second, the unknown category is the least important factor for predicting clusters, indicating that considerations not based on functional linkages, such as lifestyle or product attributes like brand, matter the least for perceived clusters in consumer electronics. We will see how the latter result is also confirmed by the findings from the qualitative analysis.

The model that adds the level of prior adoption and its interaction with the type of link (Interaction model) shows that there is a moderating effect between the unknown types of links and the level of prior adoption. In the last four columns we explore this interaction further, by using prior adoption as a direct predictor for the probability of linking for each of the four linking categories. This enables us to determine to which type of linking prior adoption is significantly related. It turns out that prior adoption has a significant positive influence on the likelihood of linking on the basis of overlapping functions, functional interdependencies, and on the same base technology. There is no effect for the unknown types of linking. This indicates that whatever the level of prior adoption, consumers do

not differentiate much between types of links when clustering. What we can say is that people with a higher level of prior adoption make more links in general. This partly rejects hypothesis 2, as individuals with a higher level of prior adoption do perceive clusters more based on functional interdependencies, but non-experts do not perceive clusters more on the basis of overlapping functions. The partial rejection of hypothesis 2 implies that in our design we did not succeed in confirming the theories of GreganPaxton & John (1997), neither did we replicate the results of Vishwanath and Chen (2006). There can be several explanations for this. First, our sample size might have been too small; second, the way of relating the technologies may not sufficiently allowed to detect different types of linkages other than functional ones; third, the prior adoption of the respondents might not have been differentiated enough to detect any statistically significant differences.

The sample size limitation is probably not the main issue considering the fact that we had 120 observations for each respondent. The research design was focused at identifying clusters over all technologies, without any limitations to the size of the cluster. This is a difference with respect to Vishwanath and Chen (2006) who only researched pairs of technologies. Our study did not however instruct respondents on any number of possible linkages, neither on the types of linkages. Probably the respondents' desire for parsimony was stronger than their distinction between different types of links or other possible means to relate technologies. The range in prior adoption was large among the respondents. The set of technologies also contained some very new products next to more conventional products. The respondents were able to categorize these new products in a sensible way, based on the prior adoption they already had from other products.

These considerations lead us to believe that the theoretical arguments elaborated for hypothesis 2 are still correct, and might be confirmed in the controlled situation of a laboratory experiment such as Vishwanath and Chen (2006) did. However the effects may be too subtle to be confirmed when transferred to a real-life context (Campbell and Stanley 1966). If we had added an almost totally unknown product, a really new product or even a non-existing product to the set, we might have found different effects. This is however far from reality in our particular product domain, where most products are related functionally and therefore familiar to their users.

### Qualitative analysis

The great majority of the text fragments of the respondents explaining their grouping indeed point to clustering based on functionality and infrastructure. Some illustrative examples (all translated from Dutch) follow below. The first one is from a 50 year old woman with moderate experience with consumer electronics. She describes her motivation for grouping the desktop, the laptop, broadband internet, the webcam and the PDA.

Interviewer: *"Could you tell me why you have made these groups?"*

Respondent: *"Yes, the computer and the laptop are computers of course".*

Interviewer: *"Is that your first group?"*

Respondent: *"That is my first group indeed. Broadband internet also belongs to that group. I wouldn't know were else to put it than with a computer. A webcam is also connected to a computer. Then I also have the personal digital assistant, which is a sort of computerized agenda, I believe."*

This example shows that the respondent started reasoning from overlapping functions (the laptop and the desktop computer) and then added other technologies to the cluster that can be connected to the base technology. Another example comes from an inexperienced 76 year old male, who explains his motivation for clustering the desktop, the laptop, the game console and the webcam:

- Interviewer: *“Why did you put these items together into one group?”*  
Respondent: *“This is a kind of computer?”* [Referring to the notebook]  
Interviewer: *“Yes it is a kind of computer.”*  
Respondent: *“At least, I always see my son in law walking around with one. Well and this is a game computer. And a webcam, I don't know it, but you always hear that there is trouble with those things, with all of those dirty old men. You also connect those to a computer, don't you? So I thought, yes.”*

We see the same pattern here. The respondent starts reasoning from overlapping functions (the desktop, the game console and the laptop) and afterwards (via a step of irrelevant information) he also connects a device that is functionally dependent on a computer.

We have many more examples of this kind of reasoning. Most arguments for clustering contained a mixture of functional overlap and functional interdependencies. There were other sporadic arguments for clustering, like that it appealed to young people or because the items were gadgets. An example that illustrates this was given by a 19 year old woman:

- Interviewer: *“... what can you tell about this group?”* [Referring to a group consisting of the iPod, the MP3-player and the digital camera]  
Respondent: *“Yes... at first I had grouped the things that produce music together, but then I also added the camera. These are all playthings. It is not like you need to own them, but they are fun to have. Well, perhaps the camera can be an item that certain people need, of course. However, for me it is not necessary, but it is a nice toy”.*

In this excerpt the respondent started reasoning from an overlapping functions perspective, but she ended by concluding that the items in this group were playthings. This is an example of clustering on introspective properties, it describes the respondents subjective perspective on the object (Yeh and Barsalou 2006). Therefore this fragment was coded into the residual “Unknown” category.

In general however the arguments from the interviews confirm our findings in the models. Of the 193 text fragments that were analysed, 165 referred to a mixture of overlapping functions and functional interdependencies and a shared base technology. Only 28 fragments referred to other arguments.

The results of the qualitative study show that the infrastructural distance between technologies is the most important determinant for linking two technologies. This is in line with the claims of LaRose and Atkin (1992). Alternative explanations like lifestyle are less prominent, clustering starts from functionality. This result is in line with the estimated effects associated with the ‘Unknown’ category in the statistical analysis.

To summarize the findings from study 1:

- The type of link predicts the likelihood of perceived clustering. The larger the infrastructural distance between two technologies, the smaller the likelihood of perceived linking between technologies becomes.
- Technology clusters are perceived mostly based on functional linkages, while perceived similarities among products based on other considerations are only marginally used.
- The larger the level of prior adoption the larger the likelihood of linking technologies based on overlapping functions, functional interdependencies and a shared base technology.

Finally, we would like to make a note on methodology. We believe that the motivations behind perceived clustering are better analyzed with qualitative research methods, while evaluating ownership clusters is better done with quantitative research. In our qualitative research we have recovered our theoretical framework in the answers given in the interview. These answers supported our theory and the theory predicted the clusters correctly. This makes the findings of study 1 reliable and a valid predictor for study 2, although the authors do recognize that the sample size for study 1 is rather small.

## **Study 2: A quantitative survey about ownership clusters in consumer electronics**

### **Methods**

#### **Sample and data collection**

A survey was administered by students of an introductory research methodology course among consumers. Respondents were approached to fill in the questionnaires in streets and public places all over the Netherlands. The written questionnaire enquired, among other things, whether the consumers owned the previously mentioned technologies. Since the ordinary TV is owned by 98 % of all households in the Netherlands (CBS 2007)<sup>12</sup>, it was not included in the questionnaire. It would have too little discriminating value to be useful. Quota by age groups and sex were used to ensure a representative sample. This resulted in a response of 2094 consumers, varying in age between 16 and 88 years of age (mean = 44.3); 1046 respondents were male, 1048 were female.

#### **Analysis**

All questions regarding ownership of the products were recoded to dummies with value 0 = not owning the product, and value 1 = owning the product. The percentages of ownership are displayed in table 2.3. The mean number of products owned was 6.46 with a standard deviation of 2.99. Clearly, there is a wide spread in diffusion among the technologies.

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<sup>12</sup> This is a choice that is reasonable for the situation in the Netherlands. Studies concerned with countries or periods with lower diffusion rates for the TV should include this product in the analysis.

	Valid N	No	Yes
PDA	2084	88.7%	11.3%
HDTV	2074	88.5%	11.5%
iPod	2079	82.5%	17.5%
FlatPanel TV	2085	80.4%	19.6%
Game Console	2087	77.1%	22.9%
Webcam	2078	68.4%	31.6%
MP3-Player	2080	66.3%	33.8%
Notebook	2084	64.7%	35.3%
Dolby Surround	2078	61.5%	38.5%
Mobile Phone with Camera	2078	51.9%	48.1%
Digital Camera	2084	41.0%	59.0%
Broadband Internet	2073	26.0%	74.0%
Desktop Computer	2083	24.8%	75.2%
DVD-Player	2086	21.5%	78.5%
Mobile Phone	2084	9.3%	90.7%

Table 2.3: The ownership percentages of the 15 technologies

Since we have no micro-level variables that we want to test, there is no need to build a random-effects model similar to the previous study. Instead, we look for an appropriate binary association measure for a simple 2x2 matrix (figure 2.2) to indicate combined ownership. The rows represent technology 1 and the columns represent technology 2. A value of 0 means that the technology is not owned and a value 1 means that the technology is owned. The combined ownership is represented by cell d (the individual owns both items).

	0 ( $C_0$ )	1 ( $C_1$ )
0 ( $R_0$ )	a	b
1 ( $R_1$ )	c	d

Figure 2.2: A simple two by two matrix. Cell d represents the ownership links between two technologies.

Sneath and Sokal (1973) mention various binary association measures like the simple matching coefficient, the Yule coefficient and the asymmetric Jaccard coefficient. However, due to the large spread in the frequency distributions none of these measures is applicable. Two widely diffused technologies will automatically have a higher association, because many of the matches in cell d will not be based on chance. If we take, for example, two technologies that are both owned by 90 % of the population, then there is already a guaranteed match in 80 % of the cases. Further, the combined ownership of less widely

diffused technologies will be underestimated, because the maximum number of potential matches is lower than with widely diffused technologies. Measures such as the Jaccard coefficient tend to underestimate the low diffused relationships and tend to overestimate the high diffused technologies. Therefore we consider only the number of pairs based on chance. We use the following formula (1) to associate these pairs:

$$(1) \quad match = \frac{d - \min d}{\max d - \min d}$$

Where:

match = matching coefficient between 0 and 1  
d = value of cell d  
min d = the minimum value of cell d  
max d = maximum value of cell d

We calculate the association for each possible link between the 15 technologies; this results in 105 different observations. These observations can once again be written as a vector. We test the interaction of hypothesis 3 with the use of an analysis of covariance (ANCOVA). The dependent variable is the matching coefficient vector for each possible link. The two independent variables are the nominal variable indicating the four types of linking and a variable that represents the perceived links from study 1 (see appendix B). Furthermore, we consider an interaction term between the two independent variables. If the interaction term between perceived linkages and overlapping functions is significantly lower than the other interaction terms, then hypothesis 3 is considered to be confirmed. As control variables we added the diffusion percentages of both technologies. We indicate the most diffused technology as technology 1, and the other as technology 2.

## Results

Appendix C displays the results of the binary association procedure. The table forms the basis for identifying clusters in ownership. Each cell represents the matching coefficient between the technologies. The larger the matching coefficient, the larger the probability that two technologies are owned in combination with each other. The first thing we notice on the basis of this table is that there is a relatively strong triangular structure within data among the widely diffused technologies. This can be seen because the matching coefficients are higher for the widely diffused technologies than they are for the less widely diffused technologies.

Despite our correction for guaranteed matches, widely diffused technologies are related to most other technologies. This justifies our choice to use diffusion as a control variable in the models. Table 2.4 displays the results of the ANCOVA models.

	Base model	Model categories	Model perceived links	Interaction model	Base Model low diffusion	Base Model high diffusion	Model Perceived links low diffusion	Model Perceived high diffusion
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Intercept	.306	.270	0.281	.245***	.219***	.454***	.188***	.439***
OL		.054**		.109**				
FI		.050***		.045				
SBT		.058***		.079**				
Unk (reference category)		0		0				
Perceived links (from study 1)			.092***	.218***			.166***	.049
Diffusion technology 1 (most diffused technology)	.009***	.009***	.009***	.009***	.010***	.007***	.009***	.007***
Diffusion technology 2 (least diffused technology)	-.005***	-.005***	-.005***	-.005***	-.003	-.006***	-.003	-.006***
Perceived links * OL				-.272**				
Perceived links * FI				-.148				
Perceived links * SBT				-.206*				
Perceived links * Unk				0				
N	105	105	105	105	43	62	43	62
Adj. R <sup>2</sup>	0.839	0.855	0.854	0.863	0.825	0.812	0.866	0.817

Table 2.4: The results of the ANCOVA models predicting the aggregate amount of ownership linkages. \*\*\*, p < 0.01, \*\*, p < 0.05, \* p < 0.1.

The first model is the base model, which only contains the control variables; these variables already explain 83.9 percent of the variance. The diffusion of a technology is thus by far the most important factor in predicting ownership clusters, even after controlling for guaranteed matches. The second model predicts ownership clusters based only on the factor capturing the types of functional linkages. Compared to the reference category all types of links appear to be equally strong. The third model includes the perceived links and the control variables. There is a significant effect of perceived links on likelihood of ownership, but this is only a modest improvement in R-square compared to the base model. The fourth model includes an interaction term between the type of link and the perceived links. Overlapping functions in interaction with perceived links leads to a significantly lower chance of combined ownership: hypothesis 3 is thus confirmed.

To get more insights into the role of the diffusion of technologies we have also split the dataset into two subsets. One subset contains all relationships of the widely diffused technologies and the other contains the relationships of the less diffused technologies. To determine this we multiplied the diffusion percentage of technology 1 with the diffusion percentage of technology 2 (see table 2.3 for the percentages). One subset contains the relationships where the multiplication is  $< 1000$  (43 cases) and the other subset contains the other relations (62 cases). For both models we estimated again a base model (models (5) and (6) in the table) and a model with the perceived links variable (models (7) and (8)). Both base models perform well, although the diffusion of technology 2 does not play a significant role in likelihood of combined ownership for the less diffused technologies. In model 7, the perceived links are significant, but not in model 8. The main finding here is that perceived links from study 1 only play a significant role for the less diffused technologies, but not for the more diffused ones.

Study 2 shows first of all that, even after a correction for guaranteed linkages, the rate of diffusion is by far the most important predictor for ownership clusters. There is a relatively strong tendency to buy some technologies first, unrelated to their cluster, and then purchase other technologies, which happen to be part of a technology cluster. Base technologies still remain conditional for adopting peripheral technologies, but they explain relative little variance of the patterns in ownership. Perceived links do have a significant interaction with overlapping functions, as was predicted. However, compared to the base model the improvement in fit is negligible (only 0.024 in adjusted R-squared). Perceived links do play a stronger role in predicting the likelihood of combined ownership in case of lower diffused technologies.

Summarized findings of study 2:

- The diffusion of the technologies is by far the most important factor in predicting ownership clusters.
- Perceived clusters are significantly less predictive for ownership clusters, in case of overlapping functions, compared to other types of links.
- Perceived clusters are significantly predictive for ownership clusters when less diffused technologies are considered, but not in case of highly diffused technologies.

## Conclusions and discussion

This paper aimed to contribute to a better understanding of technology clusters in consumer electronics. In this final section we discuss our main findings and their theoretical and practical implications.

As discussed in the introduction, our aim was twofold. First, we aimed at proposing a theoretical mechanism that explains the formation of both perceived clusters and clusters in ownership, while at the same time testing whether perceived clusters are predictors of actual ownership patterns.

We have shown that perceived clusters in consumer electronics are significantly determined by functional linkages based on the underlying infrastructure of such products. This result stems both from a qualitative study uncovering motives behind consumers' categorizations and from a quantitative analysis of the effects of different types of product properties. Factors not related to functional linkages, such as lifestyle considerations, are not good predictors of perceived clusters in consumer electronics.

While perceived clusters are primarily based on functionality, ownership clusters are more likely to be based on the diffusion of the technologies. Ownership clustering starts from a broad base of technologies that most people own, after which consumers adopt additional parts of one or more clusters according to individual preferences and external circumstances. Starting to adopt a cluster itself may be based on lifestyle, but how the cluster is composed is based on the types of linkages.

The main implication of these results for the literature on technology clusters is that a clear conceptual distinction between perceived and ownership clusters is worthwhile to pursue if one wants to understand the composition of clusters and not take them as exogenous entities.

Our findings have also several implications for diffusion studies in general. First, when predicting the adoption of a certain innovation, many authors include the ownership of other technologies as predictor in their models (e.g. Leung and Wie (1999); Vishwanath & Goldhaber (2003)). Positive findings from these modelling efforts should not be always attributed to technology clustering. The existence of technology clusters cannot be entirely explained by such types of results. In fact, the underlying explanations for technology clustering can be rather complex and they depend on the type of links that connect the technologies. Moreover, positive results can also be the result of a high diffusion rate of one of the products, which will automatically give a large correlation. Future studies should thus be careful in adding ownership variables to their models. The method used to determine the clusters in study 2 can correct for the high diffusion rate of certain technologies, but even after the correction the diffusion rate has a large influence on the combined ownership of technologies. Our study indicates that for highly diffused technologies, the perceived relationship between technologies is a far less likely explanation for the combined ownership of technologies. This is a consideration that ought to be taken into account in future modelling efforts.

Our second aim in this paper was to investigate the role of prior adoption on technology clusters. We have found that consumers with a higher level of prior adoption perceive clusters based on functional linkages, but without a strong preference for one of the

types of linkages considered. Our theoretical prediction was that more expert consumers would use functional interdependences more than overlapping functions. We did not find evidence for this specific claim but we discussed possible explanations. However, we did find a direct positive relationship between prior adoption and the probability of linking. This implies that experienced consumers are better able to place the innovations into a more detailed context. It exemplifies the fact that in any innovation communication process it is important to tailor the message to the level of a consumer's prior adoption. Based on our results, this is more important than differentiating between types of linkages. Finally, we wish to conclude by indicating two avenues for further research. On one hand, a further challenge relates to situations in which functional linkages also depend on product attributes. This is likely to be the case when infrastructural linkages differ across brands. Take the example of the choice of a game console cluster. This cluster starts with the purchase of a television, after which almost any type of game console can be bought. Once the choice for a certain brand or type of game console has been made (e.g. Nintendo Wii, Xbox or Playstation 3), consumers are locked in a certain path. They are bound to the products (video games, controllers and other extensions) that the specific console has to offer, unless they are willing to invest in another type of console. The prior adoption of consumers also gets more specialized as the cluster gets more specialized. In case of switching, consumers can apply many of their basic skills in the new cluster, but the more specialized knowledge cannot be applied in the new situation.

Further research could also focus on other product domains, to find out how consumers relate products that are not explicitly physically connected to each other. This gives a larger probability of linking technologies based on aspects of the taxonomy of Yeh and Barsalou (2006) other than taxonomic concepts. Also the addition of some less known or even non-existent technologies to a set of technologies could provide interesting results in a future study. Relatedly, research could aim at a richer conceptualization of technology clusters by taking into account more attribute levels. Diversified product attributes may render a certain product more attractive than another even when the two are functional substitutes.

## **Acknowledgements**

We would like to thank Jaco van Dijk for helping to collect and analyse the qualitative data, Rogier Donders for his help in carrying out the research, and Martin Dijst and Jenny van Doorn for helpful comments. Finally, we thank the two anonymous reviewers for their helpful comments.

**Appendix A:**

The typology of all possible links: OF = Overlapping functions, FI = Functional Interdependencies, SBT = Shared base technologies, Unk = Unknown, no relationship

	Pda	HDTV	Ipod	FPTV	Game	Webcam	Mp3	NB	Dolby	MPC	Dicam	Broadint	Desk	Dvd	MP
Pda															
HDTV	Unk														
Ipod	SBT	Unk													
FPTV	Unk	OF	Unk												
Game	Unk	FI	Unk	FI											
Webcam	SBT	Unk	SBT	Unk	Unk										
Mp3	OF	Unk	OF	Unk	Unk	SBT									
NB	FI	Unk	FI	Unk	OF	FI	FI								
Dolby	Unk	FI	SBT	FI	FI	SBT	SBT	FI							
MPC	OF	Unk	OF	Unk	Unk	Unk	OF	FI	Unk						
Digicam	SBT	FI	SBT	SBT	SBT	SBT	SBT	FI	SBT	OF					
Broadint	SBT	Unk	SBT	Unk	FI	SBT	SBT	FI	SBT	Unk	SBT				
Desk	FI	Unk	FI	Unk	OF	FI	FI	OF	FI	Unk	FI				
Dvd	Unk	FI	Unk	FI	SBT	Unk	Unk	Unk	FI	Unk	Unk	Unk	Unk		
MP	OF	Unk	OF	Unk	Unk	Unk	OF	Unk	Unk	OF	Unk	Unk	Unk	Unk	
TV	Unk	OF	Unk	OF	FI	Unk	Unk	Unk	FI	Unk	FI	Unk	Unk	FI	Unk

**Appendix B:**

The results of binomial logistic random effects model. The numbers represent the number of times that the connection was made. The asterisks represent the p-value of the binomial random effects model: \*\*\*, p < 0.01, \*\* p < 0.05, \* p < 0.1. The smaller the p-value, the larger the likelihood that the perceived links are not based on chance.

	Pda	HDTV	Ipod	FPTV	Game	Webcam	Mp3	NB	Dolby	MPC	Dicam	Broadint	Desk	Dvd	MP
Pda															
HDTV	2														
Ipod	16**	4													
FPTV	1	40***	1												
Game	15**	9*	9	12**											
Webcam	22***	6	8	5	29***										
Mp3	12**	1	42***	1	7	6									
NB	27***	2	10*	3	27***	39***	9								
Dolby	4	21***	15**	25***	10*	10*	19***	8							
MPC	25***	2	12*	2	3	6	11*	8	2						
Digicam	19***	4	15**	6	6	9	13*	9	5	30***					
Broadint	20***	5	8	6	31***	43***	6	37***	12*	5	8				
Desk	20***	4	7	7	32***	42***	6	40***	13**	3	7	42***			
Dvd	0	35***	6	39***	11*	5	7	0	29***	3	4	4	3		
MP	25***	2	13*	1	1	4	12*	6	5	45***	22***	3	3	2	
TV	1	37***	2	44***	10*	6	1	2	23***	1	4	5	5	40***	2

**Appendix C:**

The results of the binary association procedure.

	Pda	HDTV	Ipod	FPTV	Game	Webcam	Mp3	NB	Dolby	MPC	Digicam	Broadint	Desk	DvD
Pda														
HDTV	0.22													
Ipod	0.30	0.27												
FPTV	0.34	0.62	0.29											
Game	0.38	0.32	0.39	0.30										
Webcam	0.53	0.46	0.53	0.42	0.57									
Mp3	0.50	0.43	0.42	0.40	0.51	0.51								
NB	0.71	0.50	0.52	0.46	0.48	0.47	0.46							
Dolby	0.63	0.69	0.50	0.62	0.52	0.50	0.47	0.45						
MPC	0.69	0.60	0.80	0.57	0.73	0.69	0.68	0.63	0.60					
Digicam	0.80	0.74	0.64	0.79	0.66	0.71	0.70	0.72	0.72	0.60				
Broadint	0.90	0.86	0.89	0.84	0.89	0.90	0.86	0.81	0.79	0.77	0.65			
Desk	0.88	0.85	0.78	0.85	0.84	0.83	0.78	0.58	0.76	0.61	0.65	0.56		
Dvd	0.90	0.89	0.84	0.92	0.87	0.78	0.78	0.75	0.87	0.68	0.68	0.51	0.47	
MP	0.99	0.94	0.98	0.90	0.96	0.95	0.92	0.93	0.86	0.97	0.80	0.71	0.62	0.51

### 3 The effect of innovativeness on different levels of technology adoption<sup>13</sup>

#### Abstract

In this article, we look at the personality characteristic “global innovativeness” as a predictor for the adoption of consumer electronics; the latter being termed “actualized innovativeness”. Global innovativeness is tested as a predictor for three levels of actualised innovativeness: at the domain-specific, cluster-specific and product-specific levels. Our theoretical propositions are tested using two different surveys; one, consisting of adolescent bachelor students (Valid N = 138), and the second, consisting of a heterogeneous broad sample (Valid N = 450). The results of these studies show that the higher the level of abstraction of actualised innovativeness, the stronger are the effects of global innovativeness. The implications of these findings are discussed.

#### Introduction

In consumer research, the concept of innovativeness has been defined and analysed at multiple levels (Garcia and Calantone 2002); ranging from a personality trait to the result of actual (purchasing) behaviour. Midgley and Dowling (1978) define innovativeness as the degree to which an individual is receptive to new ideas and makes decisions on innovations independent of the communicated experience of others. Hirschman (1980) defines innovativeness as a type of inherent novelty-seeking attitude, whereas Rogers (2003) uses it as a concrete measure for the adoption of new products. Steenkamp, ter Hofstede et al. (1999) adopt an intermediate position by stating that innovativeness is the tendency to be attracted by new products.

Three different levels of innovativeness are usually distinguished in literature (Mudd 1990; Goldsmith, Freiden et al. 1995; Roehrich 2004): global innovativeness as a personality trait; domain-specific innovativeness, which refers to the adoption of new items within a category of products; and product-specific innovativeness, which refers to the adoption of a single product. The latter two reflect the actually displayed innovative behaviour (or actualised innovativeness), whereas the first level considers innovativeness as a personality trait. Another potential analysis level that has received much less attention in research is that of technology clusters (Larose and Atkin 1992; Rogers 2003; Vishwanath and Chen 2006). Innovations that are often perceived to be related also have a higher likelihood of

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13 This chapter is published as: Van Rijnsouwer, F. J. and A. R. T. Donders (2009). “The Effect of Innovativeness on Different Levels of Technology Adoption” *Journal of the American Society for Information Science and Technology* 60(5): 984-996.

being adopted in combination with each other. These perceived-to-be-related innovations are called technology clusters. According to Van Rijnsoever and Castaldi (2009), technology clusters can be viewed as an intermediary level between the domain-specific and product-specific levels.

Past research has shown that global innovativeness represents those personality aspects that can be predictive for actualised innovativeness. Foxall (1994) has found effects of global innovativeness on actualised innovativeness in some categories of products, but not in others. Im, Bayus et al. (2003) have found that global innovativeness is directly related to the adoption of innovations within a product domain. Vishwanath (2005) reports that the effect of global innovativeness on cluster-specific innovativeness is mediated by media use and information-search strategies. These studies relate global innovativeness to a specific level of actualised innovativeness, but the effect of global innovativeness has never been tested at all the three levels of actualised innovativeness.

The first contribution of this article is that it tests the effects of global innovativeness at these different levels of actualised innovative behaviour. In general behavioural terms, the relationship between personality traits and specific behaviours has been very difficult to illustrate empirically (Ajzen 1988; 2005), because there are many confounding situational influences. The more specific the behaviour is, the larger are the chances of confounding influences on the behaviour. We provide evidence for the proposition that global innovativeness predicts domain-specific innovativeness better than predicting cluster-specific or product-specific innovativeness. Cluster-specific innovativeness, in turn, is better predicted than product-specific innovativeness by global innovativeness. This study thus helps future scholars who study actualised innovativeness in choosing an appropriate level of analysis.

The second aim of this article is to test the relationships between global innovativeness and the two different measures of actualised domain-specific innovative behaviour. It is subsequently argued that different measures are suitable for analysing the actualised innovative behaviour of different samples.

Finally, the results from this study show how global innovativeness, attitudinal constructs and demographic characteristics are related to the measures of actualised innovativeness. We show that the effects of global innovativeness are relatively independent of the effects of demographics and attitudinal constructs.

Past research has established that actualised innovativeness is mostly limited to a single product domain (Rogers 2003). People tend to be innovative within a product domain, rather than among various domains. Consequently, we limit ourselves to the domain of consumer electronics; these are electronic products intended for everyday use by consumers. This study presents the results of two studies within this product domain. These studies provide support for the effects of global innovativeness at the various levels of actualised innovativeness. The first study concerns the adoption of information-technology objects, in relation to global innovativeness and attitudinal constructs, by a homogenous sample of undergraduate students.

The second study concerns the time of adoption of three accepted information technology products: mobile telephones, computers and the Internet. These innovations are related to global innovativeness and demographic variables in a broad sample of consumers.

## Theoretical Framework

This section presents our research model. First, the dependent variables are discussed; these are product-specific, cluster-specific and domain-specific innovativeness. Subsequently, the effect of global innovativeness on the dependent variables is considered. Next, we discuss the effects of the additional variables considered in the separate studies. The additional variables considered are the attitudinal constructs commonly associated with actualised innovativeness, such as leadership (Summers 1970; Flynn, Goldsmith et al. 1996), and trendiness (a type of involvement) (Dickerson and Gentry 1983; Chrysochoidis and Wong 2000). We also include demographics that are often used in the adoption literature (Dickerson and Gentry 1983; Im, Bayus et al. 2003). Of course, many other variables are related to actualised innovativeness. In this paper we have chosen to exclude other actual displayed behaviours, such as media use or personal contacts, and only concentrate on actualised innovativeness.

### Levels of actualised innovativeness

Actualised innovativeness is the relative time of adoption of an innovation (Midgley and Dowling 1978; Rogers 2003). It thus reflects actual displayed behaviour. This fixes it as a more objective method of conceptualising innovativeness than the self-designated scales, such as those proposed by Goldsmith and Hofacker (1991) and Flynn, Goldsmith et al. (1996), which are more sensitive to common method biases (Podsakoff, MacKenzie et al. 2003).

Our dependent variables are the three levels of actualised innovativeness: domain-specific innovativeness, cluster-specific innovativeness and product-specific innovativeness.

Product-specific innovativeness is defined as the actual purchasing behaviour of an individual of a specific new product. Domain-specific innovativeness is not the adoption of a specific product, but rather the degree of product adoption within a product domain or category. Domain-specific innovativeness is the aggregate of the various purchased products, which are used to measure product-specific innovativeness. It thus reflects the adoptive behaviour throughout an entire product domain, rather than being related to only a single product. For both these levels, the same theoretical arguments are applicable, but we expect them to be stronger at the domain-specific level than at the product-specific level. This is because the effects of personality traits are better visualised by aggregating a series of behaviours, rather than by investigation of a specific behaviour (Ajzen 2005).

Within a product domain, various technology clusters can be distinguished. These products have a larger chance of being adopted simultaneously (Rogers 2003; Vishwanath and Chen 2006). This becomes more probable if the innovation is perceived to be closely functionally related to other innovations (Larose and Atkin 1988; Vishwanath and Chen 2006; Van Rijnsouwer and Castaldi 2009). For example, Leung (1998) has found a significant influence of technology-clustering with reference to mobile-telephone ownership. Furthermore, Vishwanath and Goldhaber (2003) have found that cellular-telephone ownership is predicted well by computer ownership.

When the relationship between the innovations is very close in terms of functionality, the chances of adopting both technologies simultaneously can decrease, because it is not very useful to buy two different items with exactly the same function (Van Rijnsouwer and Castaldi 2009). The cluster-specific level thus indicates the products that are related in ownership within a product domain.

If the products within technology clusters are indeed adopted together, then the cluster-specific level should represent an intermediary analysis level that could be more accurate than the domain-specific level. This is because the adoption of products from different clusters within a domain might be determined different factors, whereas the adoption of products from within the same cluster is influenced by the same factors.

## **Global innovativeness**

Across the years, researchers have consistently found that the personality of an individual can be explained by five factors (McCrae and John 1992; Feist 1998; John and Srivastava 1999; Ajzen 2005), that are known as the Big-five. These five different factors are: extraversion, agreeability, conscientiousness, emotional stability/neuroticism and originality. Extraversion and originality are the two factors that are most related to seeking new ideas and experiences, and hence innovativeness can be construed as a combination of these two factors (Kwang and Rodrigues 2002).

One prominent theory, proposed by Kirton (1976), describes global innovativeness by using a spectrum between adaption and innovation. In the problem-solving process, people either try to improve on existing solutions (adaption) or try to find new solutions (innovation) (Kirton 1994). Adaptive individuals are known to be precise and reliable, to think within the existing frameworks and prefer to work with well-established procedures. Innovators, on the contrary, are observed to be less focussed on details, less reliable, but they propose more radical perspectives and are more inclined to challenge established rules and authority (Kirton 1976; Kirton 1994). Furthermore, innovators are willing to accept more risks than adaptors (Kirton 1994). The less a product has diffused amongst its potential buyers, the more probable it is to be perceived as new and the more probable that it differs from previous choices and existing norms; therefore, early adoption of innovation entails more risk (Boyd and Richerson 1985).

Because early adoption involves more risk, innovative individuals are more inclined to be the earliest adopters of new items than adaptive individuals. Adaptors, on the contrary, are more liable to remain loyal to their existing products, until ownership of the new product is an established norm.

## **Leadership**

Opinion leaders act as role models in the process of technology diffusion (Rogers 2003; Richerson and Boyd 2005); they have the degree of freedom to introduce new norms into a group (Homans 1974). Other members of the group copy from the leader to comply with established norms related to leadership and to prevent any loss of rank (Homans

1974) or in the hope of copying the traits that made the opinion leader successful, thereby improving their own chances of success (Fisher and Price 1992; Richerson and Boyd 2005). However, opinion leadership and leadership are not identical. Opinion leadership is *'the degree to which an individual is able to influence other individuals' attitudes or overt behaviour informally in a desired way with a relative frequency. It is a type of informal leadership, rather than a function of the individuals' formal position or status in the system'* (Rogers 1983). They serve as a gate through which new innovations can be introduced into a population (Katz and Lazarsfeld 1964; Valente 1995).

Leadership can be defined as *'a process that includes influencing the task objectives and strategies of a group or organization to implement the strategies and achieve the objectives, influencing group maintenance and identification, and influencing the culture of the organization'* (Yukl and Van Fleet 1992). Rogers focuses mainly on the informal aspects of leadership, because these are the most relevant for the diffusion process of innovations. In this article, leadership will be treated as a characteristic perceived by an individual, unchanged by any situational setting. Differences are expected between those individuals who perceive themselves to be leaders and those who do not. Moreover, leadership is expected to be positively related to domain-specific, cluster-specific and product-specific innovativeness.

## **Trendiness**

Trendiness is defined as the extent to which an individual perceives him/herself to be involved in the latest (technological) trends. Trendiness can be considered as part of a lifestyle, in contrast to innovativeness which is a personality trait: people purchase new technologies to enhance their social identity (Leung 1998). This trendiness is expected to have a positive influence on the adoption process of innovations (Foxall 1994; Foxall 1995; Boyd and Mason 1999; Chrysochoidis and Wong 2000). In accordance with Rogers (1983), we expect that trendiness will have a positive influence on domain-specific, cluster-specific and product-specific innovativeness.

## **Socioeconomic status**

The relationship between socioeconomic level and actualised innovativeness is straightforward and has been widely researched. The higher the education of an individual, the more resources he has to spend (Advokaat, Chruchten van et al. 2005) and the more probable that a new innovation will be adopted by him/her (Boone 1970; Dickerson and Gentry 1983; Brancheau and Wetherbe 1990; Van den Bulte 2000; Yang 2005; Chia, Li et al. 2006). In his qualitative study on the relationship between social class and financial behaviour, Henry (2005) has found that highly educated young professionals are more inclined to experiment with new products, thus expanding their boundaries, whereas the less-educated young working class are busy in consolidating their current financial situation. These differences in attitudes may provide an explanation for the higher socioeconomic status being positively related to domain-specific, cluster-specific and product-specific innovativeness.

## **Place of residence**

The diffusion of innovations is also a function of the distance and density of potential adopters (Tolnay 1995; Wejnert 2002). In several instances, innovations are initially available in densely populated areas such as cities. This has several reasons. An innovation might require an underlying infrastructure (this has been the case for electricity or the mobile telephone and, more currently, broadband Internet). Deploying these infrastructures can be more advantageous in cities, because there are more potential adopters per unit of infrastructure (Brown 1975). Moreover, in the case of telecommunications, cities need to be more connected to each other than the rural regions (Moss and Townsend 2000).

In more densely populated areas, people have more chances of exchanging ideas and information, thus increasing the probability for observable innovations to be adopted (Richerson and Boyd, 2005). Innovations diffuse generally from large to small settlements (Hägerstrand 1967; Farag, Weltevreden et al. 2006). Consequently, the number of inhabitants in the place of residence of an individual has been added as an additional variable.

## **Age and Gender**

Various studies have explored the impact of the variables “age” and “gender” on the adoption of technologies (e.g. Dickerson and Gentry 1983; Leung and Wei 1999; Chia, Li et al. 2006).

The effect of age varies for different innovations. Chia, Li et al. (2006) have found a negative relationship between age and the intention of adopting the Internet. For the adoption of mobile telephones also, Leung and Wei (1999) have found a negative relationship. On the contrary, (Dickerson and Gentry 1983) have found a positive relationship for the adoption of home computers, although their study is rather old. The difference between the results is probably a consequence of the lack of the required resources for young people to buy an (in those days) expensive computer.

With regard to gender, men are more interested in new technology than women (Mammes 2004) and are therefore more inclined to adopt new technologies. This general statement may, however, vary depending on the technology.

## **Study 1: The relationship between global innovativeness and different levels of actualised innovativeness in a student sample**

### **Sample and data collection**

Undergraduate students of a first-year research-methodology class and students of a second-year bachelor course on innovation and organisation theory were asked to fill in a questionnaire. The size of the sample was 138 respondents, varying in age between 19 and 28; among these, 112 were men and 26 were women.

## Measurement and analysis

The questionnaire the respondents filled in contained items measuring, global innovativeness using a translated adapted version of Kirton (1976), perceived leadership, and trendiness. The latter two scales used were developed by the authors themselves. Two factor analyses showed unidimensional structures and acceptable Cronbach's Alpha indices (the exact items and the results of the factor analyses are presented in appendix A). Domain-specific innovativeness was measured by the 'cross-sectional method' ((Midgley and Dowling 1978; Goldsmith and Hofacker 1991; Im, Bayus et al. 2003). The questionnaire enquired about the ownership of eight different products at the time of the survey. Each product was measured as a dummy (0/1) variable. This measure is appropriate, because of the relatively young age of the respondents in the sample: measuring the number of years the respondents owned a certain item would be inaccurate, because certain items are only purchased above a certain age. In addition, parental interventions and influences would affect the results (Cotte and Wood 2004). The products were selected in such a manner that they would be both affordable and remain within the range of interest of the respondents. Because all students were roughly of the same age and in the same phase of life, they had approximately the same purchasing power.

To measure cluster-specific innovativeness, the clusters in ownership were first determined. This was accomplished by extending the method proposed by Van Rijnsoever and Castaldi (2009). They provided an asymmetric association measure for binary variables, which that operates as follows: consider the following simple 2 x 2 matrix, in which the cell 'd' represents the combined ownership of two technologies.

	0 ( $C_0$ )	1 ( $C_1$ )
0 ( $R_0$ )	a	b
1 ( $R_1$ )	c	d

Van Rijnsoever and Castaldi (2009) used the following formula to associate pairs of combined ownerships:

$$match = \frac{d - \min d}{\max d - \min d}, \quad (1)$$

where

- match = the matching coefficient between 0 and 1
- $d$  = the value of cell 'd'
- $\min d$  = the minimum value of cell 'd'
- $\max d$  = the maximum value of cell 'd'

This method to determine clusters is preferred to other measures, such as the principal-component or a phi-coefficient analysis, for the two reasons. First, it is an asymmetric measure; this means that it considers only the combined ownership of technologies, not the common absence of technologies. Second, it permits guaranteed matches (such as

matches that are based on chance). Not considering these guaranteed matches has the consequence that widely diffused technologies always have a higher degree of association. If product 1, for example, is owned by 80% of the population and product 2, by 90%, then by definition, 70% of the population owns both products. However, the measure by Van Rijnssoever and Castaldi (2009) considers only the pairs that are based on chance and does not calculate p-values..

Clusters in ownership are characterised by the fact that the technologies within the clusters are adopted more in combination with each other. The matching coefficient should thus significantly depart from the value expected based on chance. Therefore, we test the matching coefficients obtained by calculation against the expected values using a chi-square test with one degree of freedom. This chi-square test, in turn, is corrected for the pairs that are not formed based on chance. The standard formula for calculating the chi-square is as follows:

$$\chi^2 = \sum \frac{(O - E)^2}{E}, \quad (2)$$

where:

$\chi^2$  = the chi-square,

O = the observed values in cell 'd'

E = the expected values of cell 'd'

The expected values for cell 'd' can be calculated from the cross table. The pairs not based on chance are the minimum number of pairs formed (mind). Correcting for these pairs, the formula

can be written as follows: 
$$\chi^2 = \sum \frac{((O(d) - \min d) - (E(d) - \min d))^2}{(E(d) - \min d)} \quad (3)$$

Because both O and E are corrected for the same number of pairs, the difference between them is not affected by 'min d'. The formula can therefore be simplified to:

$$\chi^2 = \sum \frac{(O(d) - E(d))^2}{(E(d) - \min d)} \quad (4)$$

This is tested against a chi-square distribution with one degree of freedom, the critical value for  $p < 0.05$  is 3.84.

The table shows that there are three significant relationships, from which two clusters can be formed. The first cluster consists of a portable global positioning system (GPS), a Notebook computer less than 3 years old and a digital camera. The second cluster consists of a digital video disc (DVD) player and a desktop computer less than 3 years old. However, both desktop and notebook computers essentially carry out the same functions. A further analysis shows that if the dummy variables for the Notebook and Desktop computers are added together and recoded again to a dummy variable (values > 0 become 1 again), there is an even stronger relationship with the DVD player. Therefore, the Notebook computer

was also included in the cluster. The dummy variables in both clusters were added up to provide the variables for cluster-specific innovativeness. The first cluster consists of technologies that are relatively less widely adopted, compared to the technologies in the second cluster.

The operationalisation of the variables and their descriptive statistics are presented in Table 3.1.

Variables	Details	Std.	
		Mean	Deviation
Adoption	The number of times a person answered “yes” is the final score.	3.76	1.66
Global innovativeness	Scale adapted from Kirton (1976) ranging between 32 to 160 points (Cronbach’s alpha = 0.693)	99.90	8.96
Leadership	On a 5-point Likert scale, 7 different items were presented on leadership (Cronbach’s alpha = 0.848).	23.81	4.57
Trendiness	On a 5-point Likert scale, 5 different items were presented (Cronbach’s alpha = 0.726).	15.58	3.28
Age	The age of the respondent	20.86	1.85
Gender	No. Male/female	112/26	
Mobile telephone with camera function	Ownership (no. yes/no)	91/ 47	
iPod	Ownership (no. yes/no)	22/ 116	
Desktop, less than 3 years old	Ownership (no. yes/no)	89/ 49	
Memory stick with MP3 function	Ownership (no. yes/no)	81/ 57	
Digital camera	Ownership (no. yes/no)	62/ 72	
Portable GPS	Ownership (no. yes/no)	13/ 125	
Notebook PC, less than 3 years old	Ownership (no. yes/no)	41/ 138	
DVD player	Ownership (no. yes/no)	113/ 25	

*Table 3.1:* The measurements and descriptive statistics of Study 1.

A Pearson correlation showed no interdependencies among the variables; all correlations remained at an acceptable level (see appendix B for the full correlation matrix). A multiple ordinary least-squares (OLS) regression was used to analyse the variables describing domain-specific adoption. Cluster-specific innovativeness was analysed using ordinal

regression analysis (McCullagh 1980; McCullagh and Nelder 1998). Eight binary logistic-regression models were fitted to estimate the probability of owning one of the independent technologies for product-specific innovativeness.

Each model was analysed in two blocks: in the first block, only global innovativeness was entered; in the next step, leadership, trendiness, gender and age were added. The performance of the linear-regression model is expressed as the adjusted R-square. In case of the ordinal and the binary logistic-regression models, the Nagelkerke R-square was used as pseudo R-square measure.

## Results and Discussion

Table 3.2 presents the results of the regression analyses. At the domain-specific level, the standardised residuals are distributed normally. In the first block, global innovativeness has a significant (at the 10% level), but very limited, explanatory value (adjusted R-square = 0.017). After the addition of the variables in block 2, the adjusted R-square becomes 0.232 and global innovativeness remains significant at the 10% level. The largest contributions to the model are from trendiness and gender. Trendiness is a far better predictor than global innovativeness in predicting the probability of adoption at a domain-specific level. Age has no influence on domain-specific adoption; this probably is due to the homogeneity of the respondents in the sample or because of the wide range of products included in the dependent variable. Finally, men are more inclined to adopt new technologies than women. This is consistent with the findings of Mammes (2004), who claims that males have more interest in technology than females.

*See next page* ►

*Table 3.2:* The results of the regression estimates. The first column shows the independent variables included in each version of the model. The second column shows the result of the linear regression model at the domain-specific level. The following two columns show the results at the cluster-specific level. The remaining columns show the results of the binary logistic-regression models. The dependent variable is the ownership of a certain technology (0 = no, 1 = yes). The following technologies have been included: (1) a mobile telephone with camera function, (2) an iPod, (3) a PC less than 3 years old, (4) a memory stick with MP3 function, (5) a digital camera, (6) a portable GPS, (7) a Notebook PC less than 3 years old, and (8) a DVD player. N = 138; \*: p < 0.1; \*\*: p < 0.05; \*\*\*: p < 0.01.

	Domain-Specific										
	Cluster 1	Cluster 2	Prod.1	Prod. 2	Prod.3	Prod.4	Prod.5	Prod.6	Prod.7	Prod.8	
Beta			Odds Ratio								
Block 1	Global innovativeness	0.03	0.03	1.02	1.03	1.02	1.00	1.04*	1.00	1.01	1.03
	Constant			0.24	0.01*	0.43	1.55	0.02*	0.08	0.13	0.19
	Chi-square model			1.05	1.26	0.52	0.00	3.53*	0.01	0.31	1.62
	(Nagelkerke) R-square model	0.02	0.01	0.01	0.02	0.01	0.00	0.03	0.00	0.03	0.02
Block 2	Global innovativeness	0.16*	0.02	1.02	1.05	1.02	1.01	1.03	1.00	1.01	1.03
	Leadership	0.02	0.01	1.06	0.95	1.05	0.96	1.02	1.00	0.95	1.05
	Trendiness	0.42***	0.13**	1.28***	1.26***	1.16**	1.10*	1.14**	1.27**	1.07	1.12
	Age	0.08	0.20**	1.09	0.84	0.93	0.89	1.16	1.24	1.22*	1.11
	Gender	-0.17**	0.01	-1.02**	0.66	0.67	0.25***	0.92	0.46	1.42	0.47
	Constant			0.000**	0.01	0.34	4.40	0.00***	0.00*	0.00*	0.01
	Chi-square Block			21.54***	10.15**	17.57***	5.62	8.792*	9.64**	5.83	7.73
	Chi-square model			22.59***	11.40**	18.09***	5.62	12.32**	9.65*	6.14	9.36*
Block 3	(Nagelkerke) R-square model	0.23	0.11	0.16	0.21	0.14	0.05	0.11	0.15	0.06	0.11
	Global innovativeness			1.02	1.06*	1.01	1.02	1.03	0.96	1.01	1.02
	Leadership			1.07	0.93	1.04	0.95	1.03	1.02	0.95	1.04
	Trendiness			1.23***	1.28**	1.10	1.10*	1.07	1.20	1.03	1.04
	Age			1.08	0.77	0.95	0.81	1.15	1.12	1.21	1.17
	Gender			0.77	0.80	0.31**	0.63	1.05	0.30	1.16	0.72
	Product (1)			1.00	1.04	1.33	1.80	1.48	2.40	1.83	1.23
	Product (2)			1.00	1.04	2.35	0.24***	1.56	0.67	1.41	1.70
	Product (3)			1.30	2.13	1.18	1.18	0.77	3.89	0.27***	4.89***
	Product (4)			1.83	0.22***	1.19	1.59	1.59	0.66	1.71	1.64
	Product (5)			1.39	1.12	0.73	1.56	7.77**	0.90	1.56	1.56
	Product (6)			1.15	1.27	4.11	0.69	6.60**	5.17**	0.41	0.41
	Product (7)			1.90	1.45	0.29***	1.68	0.89	5.39**	1.40	1.40
	Product (8)			1.12	1.61	4.84***	1.57	1.50	0.26	1.30	1.30
	Constant			0.00**	0.01	0.21	13.44	0.00***	0.00	0.00*	0.00
	Chi-square Block			5.69	9.77	18.726***	13.24*	9.96	15.13**	15.49**	12.31
	Chi-square model			28.28***	21.17**	36.81***	18.85*	22.29**	24.78**	21.63**	21.67
	(Nagelkerke) R-square model			0.26	0.24	0.32	0.17	0.20	0.35	0.21	0.24

53 Table 3.2: See previous page ▲

On a cluster-specific level global innovativeness does not have significant effect on predicting both clusters. After the addition of the variables in block 2, trendiness is significant in both instances. Age is positively related to cluster 1, whereas men are more inclined to own products from cluster 2. These two results would not have been found if the cluster-specific level was not analysed. Analyses at the cluster-specific level thus can show interesting results, but these clusters are perhaps too specific to measure the effects of a personality trait such as global innovativeness.

At a product-specific level, global innovativeness does not have a significant effect at the 5% level. This finding is in accordance with that of Ajzen (2005) and Goldsmith et al. (1995). Surprisingly, leadership does not have any predictive value in any of the models. This result could be due because of the homogeneity in the age of the sample or because this characteristic only begins to exert its effect at a later stage in life. The results imply that there is a difference between perceived leadership (by the individual) and opinion leadership. People who think of themselves as being leaders do not necessarily determine norms in a group regarding technology by being the first to adopt new consumer electronics.

At a product-specific level, the mobile telephone with camera function, the iPod and the portable GPS are best predicted by trendiness. The mobile telephone with camera function and the iPod can be considered to be trendy products, they have an additional brand label or functionality attached, which distinguishes them from other similar products. Trendiness for these two products is a better predictor than it is for the ordinary mobile telephone (of the 138 respondents, only one did not own a mobile telephone at all) and the MP3 player. The portable GPS is the least diffused of all technologies and can hence be considered as the most innovative product and, therefore, trendy. The other products are generally less fashionable or trendy; therefore, there is a weaker relationship, or even none, with trendiness.

Gender only plays a role in the ownership of a computer; apparently, in this sample, men are more interested in having a relatively new computer than women.

There are limitations to this study. The sample used is a convenience sample; therefore, the results can be generalised to a limited extent only. The results from this study do however provide interesting insights about the levels at which actualised innovativeness can be analysed and on the methodology for determining clusters.

## **Conclusions of Study 1:**

Due to the limitations of sampling method, we formulate our conclusions in such a manner that they are only about the sample that is being studied:

- In this study, global innovativeness is a better predictor for domain-specific innovativeness than it is for cluster-specific and product-specific innovativeness.
- In this study, the results indicate that trendiness is a better predictor for the adoption of new consumer electronics than global innovativeness at all three levels. Trendiness, however, is a very sample-specific measure.
- The results from this study indicate that the cluster-specific level can be a suitable level of analysis to show specific effects that would not have been found at the domain-

specific level. The product-specific level on the other hand is probably a too detailed level of analysis to draw any general conclusions from.

## **Study 2: The relationship between global innovativeness and actualised innovativeness with reference to sociodemographic characteristics**

### **Sample and data collection**

Each of the 101 students of a first-year bachelor course on research methodology at a European University was asked to distribute a questionnaire to six individuals he or she knew. Two of these individuals were to be the parents of the students, if possible; two were to be brothers or sisters, if possible, and two other persons were to be from his or her social environment. If a person did not have a certain relative, a brother for example, he/she was obliged to substitute that relative with an individual from his/her own social environment. This resulted in a sample of 450 respondents (all students did not complete the assignment entirely). The sample consisted of 266 men and 184 women; the age varied between 13 and 80. Because of the approach by which the questionnaires were distributed, the respondents were inclined to be young, over 50% of them being younger than 30 years of age.

The method of sampling resulted in there being two distinct age groups in the sample. Therefore, the sample was split into two subsamples: one subsample, containing all the respondents who were 27 years of age or younger ( $N = 271$ ); and the second subsample, with respondents older than 27 years ( $N = 179$ ). The splitting of the sample into two groups allowed us to compare the results between the older and the younger age groups. This comparison will help us to address the applicability of the measure used for actualised innovativeness.

### **Measurement and analysis**

The respondents were provided with a questionnaire consisting of 52 different items. These items were indicators for product-specific innovativeness, global innovativeness (using a translated, adapted version of Kirton;(1976) and demographic factors, such as gender, age, socioeconomic level and the number of inhabitants in the place of residence. Product specific innovativeness was measured as the years of ownership of a mobile phone, a personal computer (PC) and Internet access, three technologies that have revolutionised our technique of communication and data processing over the past few decades.

These technologies were chosen, because the heterogeneity of the sample limits the number of products that can be included. Individuals of different ages have different interests and occupations, which can lead to different times of adoption for different products (Midgley and Dowling 1978). Using a limited number of products, but adding the time of adoption of the technology, provides us with an adequate measure for product-specific innovativeness in this sample. Because the products were not measured as dummy

variables, but as continuous variables, we did not need to use the method by Van Rijnsoever and Castaldi (2009) to identify technology clusters. Instead, we followed Vishwanath (2005) and carried out a principal-component analysis, the extracted factors of which represent clusters. Only one factor was extracted, which implies that the domain-specific level and cluster-specific level are equal in the sample for this set of technologies. We refer to this result as the domain-specific level. The values of the product-specific variables were standardised and added up to derive the domain-specific variable.

The measurement of the variables and their descriptive statistics are presented in Table 3.3. We analysed the total sample and the two subsamples separately. To check for interdependencies among the independent variables, we again conducted a Pearson correlation (appendix C): a strong, but acceptable –in terms of collinearity, significant correlation was found between age and socioeconomic status in the entire sample ( $r = 0.703$ ,  $p < 0.001$ ). For the total sample, four OLS-regression models were estimated, one for domain-specific innovation and three for product-specific innovation. Furthermore, for each of the two subsamples, an OLS-regression model was estimated at the domain-specific level. The analyses were carried out in multiple blocks. The first block contained global innovativeness as the only independent variable; in the second block, the other demographic variables were added. In the product-specific models, the other two technology variables were added as a third block. Multiple imputation was used to explain the missing values (Donders, van der Heijden et al. 2006), using the R-Program (R Development Core Team 2007). This did not yield different results compared to the analysis without the imputation. The models without imputation will be presented herein, because this allows us to present model-performance estimators.

Variables	Details	Complete sample		Subsample 1: (age ≤ 27)		Subsample 2: (age > 27)	
		Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation
Domain-specific innovativeness	The number of years an individual possesses a PC, mobile telephone or Internet. Values were standardised; then, the average value of the three was calculated.	0.01	0.71	-0.153	0.60	0.26	0.78
PC-adoption time	The number of years an individual possesses a PC.	7.38	5.91	5.52	4.59	10.19	6.56
Mobile telephone—adoption time	The number of years an individual possesses a mobile telephone.	4.36	2.98	4.10	2.36	4.74	3.71
Internet-adoption time	The number of years an individual is connected to the Internet	5.30	3.06	4.99	2.99	5.75	3.11
Global innovativeness	Scale adapted from Kirton (1976), ranging between 32 to 160 points (Cronbach's alpha = 0.809)	96.08	12.10	96.94	10.90	94.78	13.66
Socioeconomic level	The job level and the highest education level an individual has. Both values were standardised and averaged. (Cronbach's alpha = 0.903)	0.01	0.96	-0.516	0.69	0.79	0.74
Place of residence	The number of inhabitants in the place of residence in the preceding 15 years. (on a 4-point scale, 1 = 0–10,000, 2 = 10,000–50,000, 3 = 50,000–100,000, 4 is > 100,000)	2.44	1.11	2.45	1.10	2.41	1.12
Age	The age of the respondent	31.62	15.42	19.77	2.96	49.56	7.02
Gender	Male/Female	266/184		177/94		89/90	

Table 3.3: The measurements and descriptive statistics of Study 2.

## Results and discussion

Table 3.4 shows the results of the OLS-regression analyses.

	Dom.-spec. Innov.	Dom.-spec. Innov. Sub-sample 1: age ≤ 27	Dom.-spec. Innov. Sub-sample 2: age >27	Prod.-spec. Innov. (PC)	Prod.-spec. Innov. (Mobile Phone)	Prod.-spec. Innov. (Internet)
Block 1	Global innovativeness	0.13***	0.10*	0.23***	-0.81*	0.14***
	Adj R-square Block 1	0.02	0.01	0.05	0.00	0.02
Block 2	Global innovativeness	0.13***	0.11*	0.13*	0.09**	0.14***
	Socio-economic level	0.27***	0.09	0.28***	0.20***	0.31***
	Place of residence	-0.08*	0.01	-0.20***	-0.08*	-0.01
	Age	0.12**	0.09	-0.02	0.27***	0.10
	Sex	-0.11**	-0.06	-0.15*	-0.08*	-0.07
	Adj R-square Block 2	0.16	0.02	0.18	0.19	0.04
Block 3	Global innovativeness				0.04	0.11**
	Socio-economic level				0.11*	0.02
	Place of residence				-0.05	0.01
	Age				0.26***	-0.02
	Sex				-0.03	-0.05
	PC time of adoption					0.31***
	Mobile Phone time of adoption				0.24***	-0.07
	Internet time of adoption				0.31***	
	Adj R-square block 3				0.34	0.16

*Table 3.4:* The standardized estimates of the OLS regression analysis for the full sample. The columns represent the different dependent variables. The first column gives the names of the independent variables added in each step of the model. The second column gives the results for the domain specific level, the others give the

There is a significant positive relationship between global innovativeness and domain-specific innovativeness. The addition of the other variables in the second block does not change the results related to global innovativeness.

However, for the three separate technologies, this is not always the case. Global innovativeness is not a significant predictor for the time of adoption of the mobile telephone, but it is for the PC and the Internet.

There are a few explanations for these differences. An explanation can be found in the compatibility of the innovation with the user; the more radical the innovation, the less probable that it fits existing values and competences (Henderson and Clark 1990; Gatignon, Tushman et al. 2002). Although the introduction of the mobile telephone significantly broadened the possibilities for communicating, using a mobile telephone was not a completely new method of communication, but rather a substitution for or addition to the traditional fixed telephone (Mahler and Rogers 1999; Sung and Lee 2002). The PC was a substitute for a number of devices (Utterback 1996). With its various functions related to administration purposes, gaming and Internet, it broadened possibilities to a far larger extent (in the early years) than does the mobile telephone. A possible interpretation is that the PC was a more radical innovation than the mobile telephone, making it more likely for people with a higher global innovativeness to adopt it. Another potential explanation is the dependence on a supporting infrastructure (Kaufman and Techatassanasoontorn 2005): both mobile telephones and Internet need a supporting infrastructure to operate. However, because global innovativeness influences the adoption of Internet, but not that of the mobile telephone, it is improbable that this factor plays a role here.

Socioeconomic level explains a large part of domain-specific innovativeness in general and of the adoption of computers and mobile telephones in particular. The socioeconomic level does not contribute significantly in explaining the adoption of the Internet. This may partly be explained by the fact that the adoption of the Internet depends on the ownership of a PC. Furthermore, compared to the other two technologies, Internet is relatively cheap to adopt.

Place of residence as a predictor for domain-specific innovativeness is significant at the 10% level. Contrary to our expectations, domain-specific innovativeness is slightly higher in the smaller communities than in the larger cities. This might be due to the fact that many high-income families live in suburbs, rather than in large cities.

Gender and age are significant in the domain-specific model but not always in the product-specific models. In general, there is a positive relationship between age and actualised innovativeness, although this may depend on the specific technology. Men, at the domain-specific level, are also quicker to adopt new technologies than women, but this phenomenon is hardly reflected at the product-specific level.

The third block replicates the results of Vishwanath and Goldhaber (2003): mobile-telephone ownership is predicted by computer ownership. Logically, there is also a strong relationship between computer ownership and Internet use.

When the results from the subsamples are compared, large differences are found. Global innovativeness has a strong significant positive effect on domain-specific innovativeness in subsample 2, whereas it is only significant at the 10% level in subsample 1. Furthermore, none of the demographic variables are significant in subsample 1 (age  $\leq$  27), whereas socioeconomic level and place of residence are highly significant in subsample 2 (age  $>$  27).

For these differences, there are a number of possible explanations. First, the measure for domain-specific innovativeness is based on the number of years the products are owned. The relatively young age of the respondents in subsample 1 limits the number of years the technologies can be owned by the respondents. Moreover, because of their age, the chances that these respondents were not actively involved in the purchasing process are larger. A cross-sectional measure, such as that in study 1, could have been more appropriate for subsample 1. Following the measure for the dependent variable, the homogeneity of the respondents in subsample 1 is probably an additional reason for there being no effect of the demographic variables on domain-specific innovativeness. The respondents are roughly of the same age and predominantly have the same socioeconomic status. In subsample 2, the effects of socioeconomic status are predicted by our theoretical framework for the socioeconomic level, but not for the place of residence, which is strongly negatively related to domain-specific innovativeness. Again, this might be explained by the fact that many relatively high-income households live in suburbs, rather than in the big cities. The main limitation of this study is the method of sampling. Although this sample is broader and therefore more representative than the sample in the first study, it is still not an accurate representation of the population. This study, however, does show what the differences in effects between the two groups are when using the time of adoption as a measure for actualised innovativeness.

## **Conclusions of study 2:**

Due to the limitations of sampling method, we formulate our conclusions in such a manner that they are only about the sample that is being studied:

- In this study, based on these three technologies, global innovativeness has an explanatory value for domain-specific innovativeness, next to and operating independently from demographic variables.
- For this sample, differences are found in the effects of global innovativeness at a product-specific level. The attributes of the different technologies can be helpful in explaining these differences.
- It has been established for this sample that measuring the time of adoption can be used as a measure for actualised innovativeness. The respondents in the sample, however, do have to be old enough for this measure to be applicable.

## **General discussion**

The results of the two studies complement each other. At a domain-specific level, the results of the first study are also partly found in the second study. In both studies, we found that the higher the aggregation level of the actualised innovativeness is, the stronger are the effects of the manifested global innovativeness. This finding is in accordance with previous claims by Ajzen (2005). Analysing at the domain-specific level may thus visualise the effects of personality traits. The high level of abstraction, however, also masks other effects from variables that are more related to a specific product or technology cluster.

In both studies, these types of effects were found. We therefore recommend scholars to conduct their future studies on actualised innovativeness at more than one level of aggregation. This does not have to be at the product-specific level, which can very rapidly lead to plenty of analyses with only a few usable results. The cluster-specific level can be a good alternative, because the technologies in a cluster have a higher probability of being adopted together and are therefore more probable to be predicted by the same variables.

The studies have also shown the importance of choosing the right type of method for measuring actualised innovativeness. The cross-sectional method worked in the first study because of the homogeneity of the sample. In more heterogeneous samples, there would probably have been biases caused by other variables because finding products that are equally interesting for all respondents would have been much more difficult.

The use of time of adoption as a measure for actualised innovativeness provides more information than only measuring the ownership of a product. It also permits the products that are not innovative anymore at the present to be still included in the measure, thus providing an image of actualised innovativeness throughout a longer period of time. A condition for using time of adoption as a measure is that all respondents should have had equal chances in the past to easily adopt the innovation. This measure is thus very susceptible to the influence of age or other time-related variables.

The different measures applicable for actualised innovativeness also imply use of different methods for finding technology clusters. When measuring the time of adoption, the variables are of a continuous nature; therefore, a factor analysis can be applied to identify clusters. The cross-sectional method does not allow the use of a factor analysis. Methods such as those used in Study 1 of this article and in the report by Van Rijnsouwer and Castaldi (2009) are usable alternatives.

Global innovativeness, by itself, remains a poor practical measure for directly explaining domain-specific, cluster-specific or product-specific innovativeness. It is relatively distinct from the other concepts in the various models used currently, which can warrant the use of global innovativeness in future models, but the effects of global innovativeness on actualised innovativeness were rather small. In our two studies, factors such as socioeconomic level and trendiness proved to have a greater predictive value, but these are also very sample-specific measures. Interestingly enough for subsample 2 of study 2, the effect of global innovativeness proved to be much stronger than that for subsample 1. The age of the respondents thus plays a role in determining the potency of the influence of innovativeness.

Due to the method of sampling used herein, it is difficult to generalise the results from both studies, but they provide interesting insights regarding the role of global innovativeness in the adoption processes of individuals. Therefore we stress that these studies should be considered as pilot studies. Further research will have to be conducted to learn whether the insights found bear greater external validity.

## **Acknowledgements**

The authors thank Henk van Peer for his advice and help with administering the questionnaires.

**Appendix A:**

Scales of perceived leadership and perceived trendiness.

<b>Items for perceived leadership (alpha = 0.848)</b>		<b>Factor loadings (principal axis factoring)</b>
1	I am a natural leader	.801
2	I am a natural chairman	.751
3	Among others, I am often the most talkative	.718
4	In discussions I often win	.422
5	In a group I often take the initiative	.678
6	I am charismatic	.570
7	I aspire a function in which leading is a central part	.697

<b>Items for perceived trendiness (alpha = 0.726)</b>		<b>Factor loadings (principal axis factoring)</b>
1	I always try to participate in the latest trends	.814
2	I am fashionable	.617
3	I always try keep in touch with the latest trends	.715
4	I am always fast with buying new equipment	.400
5	I think looks are very important	.454

## Appendix B:

Correlation matrix of the variables in study one.

	Domain Specific adoption	Product 1	Product 2	Product 3	Product 4	Product 5	Product 6	Product 7	Product 8	Global innovativeness	Leadership	Trendiness	Age	Sex
Domain Specific adoption														
Product 1	.565(**)													
Product 2	.318(**)	.062												
Product 3	.468(**)	.138	.158											
Product 4	.433(**)	.174(*)	-.157	.054										
Product 5	.544(**)	.188(*)	.084	.061	.107									
Product 6	.436(**)	.127	.063	.136	.019	.257(**)								
Product 7	.380(**)	.133	.020	-.180(*)	.095	.082	.225(**)							
Product 8	.485(**)	.138	.102	.319(**)	.102	.122	.023	.018						
Global innovativeness	.157	.087	.096	.061	-.004	.159	.006	.047	.108					
Leadership	.143	.179(*)	.024	.130	-.048	.123	.036	-.059	.127	.325(**)				
Trendiness	.433(**)	.343(**)	.232(**)	.234(**)	.140	.196(*)	.216(*)	.074	.158	-.063	.166			
Age	.168(*)	.121	-.053	.027	-.071	.170(*)	.145	.169(*)	.118	.213(*)	.054	.052		
Sex	-.228(**)	-.123	-.058	-.262(**)	-.085	-.063	-.092	.011	-.158	-.007	.029	-.102	-.215(*)	

\*\* Correlation is significant at the 0.01 level (2-tailed).

\* Correlation is significant at the 0.05 level (2-tailed).

N=138, all are Pearson correlations

**Appendix C:**

Correlation matrix of the variables in study two.

	Domain-specific innovativeness	PC time of adoption	MP time of adoption	Internet time of adoption	Global innovativeness	Socio-economic level	Age
PC time of adoption	.804(**)						
MP time of adoption	.664(**)	.341(**)					
Internet time of adoption	.686(**)	.387(**)	.091				
Global innovativeness	.127(**)	.072	.065	.136(**)			
Socio-economic level	.356(**)	.392(**)	.237(**)	.136(**)	-.026		
Place of residence	-.069	-.076	-.093	.021	.041	-.029	
Age	.305(**)	.410(**)	.108(*)	.138(**)	-.058	.703(**)	-.015
Sex	-.093	-.036	-.089	-.076	-.193(**)	.035	.121(*)

\*\* Correlation is significant at the 0.01 level (2-tailed).

Correlation is significant at the 0.05 level (2-tailed).

N=450

# 4 The relationship between innovativeness and the use of information sources during consumer ongoing search<sup>14</sup>

## Abstract

This paper studies the relationship between consumers' innovativeness and their use of information sources during consumer ongoing search. We hypothesize a linear relationship between innovativeness and internal search. We also hypothesize inverted U-shaped relationships between innovativeness and the use of external information sources. The turning points of these curves are expected to be influenced by the relative costs associated with the use of each source. Our theoretical framework is tested on a sample of 2094 consumers for the product domain of consumer electronics. Innovativeness is measured in both an attitudinal and a behavioral manner. Both measures give comparable results and largely confirm our expectations.

## Introduction

Innovative consumers play an important role in the innovation diffusion process. People with a high degree of innovativeness are often the first consumers who take the risk to adopt new products about which little is known (Midgley and Dowling 1978; Rogers 2003; Roehrich 2004). Further, they partly test the product's functionality and can even contribute to improvement of the product (Von Hippel 2005; Van Rijnsoever, Faber et al. Forthcoming). Innovative consumers also familiarize a broader audience with the characteristics and functionality of the new product. This is because early adopters can serve as opinion leaders that introduce new norms and ideas into a social system (Rogers and Cartano 1962; Katz and Lazarsfeld 1964). Additionally, in the case of interdependent innovations, the early adoption of products by innovators enables the build-up of what is called 'critical mass', the point after which the diffusion of the innovation becomes self-sustaining (Rogers 2003). Having a sufficient number of innovative individuals in a population is thus a critical component to the diffusion process.

For all consumers, the purchase of new products entails many uncertainties (Urbany, Dickson et al. 1989). This is especially true for consumers who are among the first to adopt a new product, since less product information is available. To reduce uncertainty and thereby enhance the quality of the purchase outcome, consumers can engage in a

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14 This chapter is co-authored with Carolina Castaldi.

search for information (Punj and Staelin 1983), thereby consulting several sources of information.

The sources of information consulted (Kiel and Layton 1981) is a dimension of search that has been somewhat neglected in the search literature (Klein and Ford 2003). A handful of articles have investigated the determinants of choice among different sources, but only for pre-purchase search. Such studies discriminate between internal search and multiple external information sources (Blackwell, Miniard et al. 2001). An internal search is nothing more than an internal memory scan of the accumulated experience and information. External search relies instead on consulting external information sources, ranging from inter-personal relations to mass-media, and more recently the World Wide Web (WWW). Recent studies that consider the choices among multiple sources all focus on specific product domains: Kerstetter and Cho (2004) on the domain of tourism, Klein and Ford (2003) on the domain of automobiles, and Mattila and Wirtz (2002) on credence services.

A second dimension of search that is often identified is the phase of search. Two phases of search are distinguished: *pre-purchase search* and *ongoing search* (Bloch, Sherrell et al. 1986). During pre-purchase information search, the consumer gathers information to enhance the quality of a specific purchase outcome (Punj and Staelin 1983). The most important distinguishing feature of pre-purchase information search is that it is goal directed by nature (Janiszewski 1998). Ongoing search, on the other hand, is exploratory by nature. The search patterns are less focused and do not necessarily have a purchase outcome (Moe 2003). The most important motivations for engaging in ongoing search are either recreational or related to acquiring a bank of product information for future purchase decisions (Bloch, Sherrell et al. 1986; Moe 2003). Ongoing search is largely driven by hedonistic motives, while pre-purchase search is more utility driven (Babin, Darden et al. 1994). This study focuses its attention on the gathering of new ideas during the process of ongoing search. Since successful product diffusion depends on innovative individuals, it is important to better understand where these consumers collect information about new purchases.

Until now, little research has attempted to understand the search patterns of innovative consumers. Many studies focus on diffusion patterns at an aggregate level (see for instance Danaher, Hardie et al. 2001; Pae and Lehmann 2003), using the famous Bass model (see Mahajan and Peterson 1985), or use a social network perspective (see Valente 1995; Valente 1996; Burt 1999), but both strands of research pay less attention on underlying micro-patterns of search. At the individual level, an older tradition of research on the use of communication channels has proposed that innovative individuals tend to prefer certain channels (Katz and Lazarsfeld 1964; Robertson 1971; Rogers 1983). Since communication channels are also carriers of information, the insights from this literature, even though not always systematically tested and grounded in theory, are of value for understanding innovativeness and consumer search. The only recent study that relates innovativeness to search is the paper by Vishwanath (2005), who models search as a part of the innovation adoption process. However, no studies consider both distinguished dimensions of search, sources of information and type of search, explicitly.

The aim of this study is to understand the relationship between innovativeness –measured from both an attitudinal and behavioral perspective- and use of different information

sources, during ongoing search. In the next section, a theoretical framework is developed which is tested for the product domain of consumer electronics using survey data from a sample of 2094 Dutch consumers. In the conclusion, we discuss the theoretical and managerial implications of our results.

## Theoretical framework

### Innovativeness

In consumer research, the concept of innovativeness has been defined and analyzed at multiple levels (Garcia and Calantone 2002) ranging from a personality trait to the result of actual (purchasing) behaviour. Midgley and Dowling (1978) defined innovativeness as the degree to which an individual is receptive to new ideas and makes innovative decisions independent of the communicated experience of others. Hirschman (1980) defined innovativeness as a form of inherent novelty seeking behaviour, while Rogers (2003) used it as an objective measure related to the adoption of new products. Steenkamp, Ter Hofstede et al. (1999) have taken an intermediate position by stating that innovativeness is the tendency to be attracted to new products.

In the literature, innovativeness is sometimes seen as a personality trait, unrelated to a specific context (see Kirton 1976). Other authors view innovativeness as product domain specific measure (Goldsmith, Freiden et al. 1995): consumers are not considered to be innovative with all types of products, but rather in a limited number of domains (Goldsmith and Hofacker 1991; Van Rijnsoever and Donders 2009). In this study, we also consider innovativeness as a domain specific characteristic of consumers.

Conceptually, innovativeness can be viewed as comprised of two parts: consumers can actually display innovative behavior or they can have more innovative attitudes, implying that they are involved in the developments made in the category. Therefore, in this study, two concepts are used as approximations of innovativeness. These are actualized innovativeness and enduring product involvement, the former is a behavioral measure for innovativeness, the latter is an attitudinal measure.

Actualized innovativeness is a concept that originates from the diffusion of innovation literature. It is defined as the time of adoption of an innovation compared to other potential adopters (Midgley and Dowling 1978; Rogers 2003; Van Rijnsoever and Donders 2009). Enduring involvement captures a consumer's involvement with a product class (Mittal and Lee 1989). Enduring involvement is defined as "independent of purchase situations and is motivated by the degree to which the product relates to the self and/or the hedonic pleasure received from the product" (Richins and Bloch 1986, p. 280). The concept reflects the perceived personal relevance of a product to the consumer in terms of needs, values, goals and interests (Zaichkowsky 1985; Celsi and Olson 1988; Mittal and Lee 1989).

We view actualized innovativeness and enduring involvement as approximations of innovativeness for two reasons. First, we take into account that both attitudes and behavior are relevant dimensions of innovativeness. Attitudes capture individual dispositions towards an idea or object and are subjective by nature. Displayed behavior is about past events and can therefore be seen as a more objective measure. Past research has shown that

these two measures of innovativeness are positively related to each other (Van Rijnsoever and Donders 2009), but that not all attitudes are directly translated into behavior (Ajzen 2005; Van Rijnsoever and Donders 2009; Van Rijnsoever, Farla et al. 2009). Second, both concepts are partly related to a third underlying concept: prior knowledge (Sujan 1985; Celsi and Olson 1988; Rogers 2003). Prior knowledge is the knowledge a consumer has about a specific product class. Consumers with a higher actualized innovativeness are more knowledgeable about the product class since they have a longer history of adoption in the product class. In addition, more involved consumers tend to be more knowledgeable about a product category. Prior knowledge is one of the most important antecedents of consumer search and, as we will discuss in the next section, plays an important part in explaining the relationship between innovativeness and search (Schmidt and Spreng 1996).

## **Innovativeness and consumer search**

A prominent view to explain search in economics (see Stiglitz 2000) and in consumer behavior studies (see Wilde 1980; Moorthy, Ratchford et al. 1997) is the economics of information (EI) perspective, pioneered by Stigler (1961). The EI perspective offers a utilitarian based explanation for actor search behavior. This view argues that agents will search as long as the marginal costs of searching are lower than the marginal gains. In the consumer behavior literature, the two most important elements of search costs are the resources invested in the search and the efficiency of the search (Goldman and Johansson 1978; Blackwell, Miniard et al. 2001). For consumers, resources can be time, money, cognitive effort, and reputation (Borgatti and Cross 2003). The efficiency of the search is the amount of knowledge retrieved during the search per unit of invested resource. From the EI perspective, it follows that if the search efficiency becomes too small, the search will cease.

There are many empirical consumer studies that have used the EI perspective to explain consumer search (see for instance Beatty and Smith 1987; Moorthy, Ratchford et al. 1997; Jones, Mothersbaugh et al. 2000), because a utilitarian explanation allows to formulate more rigorous hypotheses that are based on economic incentives (Moorthy, Ratchford et al. 1997).

In addition to the EI perspective, researchers claim that individuals who are more familiar with the product category, are more able to search, because they better comprehend the information (Bower and Hilgard 1981; Johnson and Russo 1984; Cohen and Levinthal 1990; Schmidt and Spreng 1996).

This means that prior knowledge plays a role in explaining consumer search in three manners (see Johnson and Russo 1984; Moorthy, Ratchford et al. 1997). First, consumers with a larger amount of prior knowledge have less need for additional searches, therefore a negative relationship is implied. Second, a higher amount of prior knowledge allows consumers to better interpret the knowledge gathered during the search, as a result they are able to search more efficiently; each resource invested in search facilitates future search efforts (Johnson and Russo 1984). The third argument is a combination of the former two; the consumer is better able to search as the amount of prior knowledge increases, until the point where the consumer does not find it worthwhile to search any further.

After this turning point the amount of search decreases, so that the overall relationship is an inverted U-shape. This inverted U-shape implies that there is some point after which the consumer does not find it worthwhile to continue to search, from the EI perspective it follows that this point is when the costs of searching exceed the expected gains.

However, the utilitarian view has also been criticized by scholars that claim that consumers not only have utilitarian motives for searching, but also other more hedonic reasons, this is certainly the case for ongoing search (see for instance Bloch, Sherrell et al. 1986; Babin, Darden et al. 1994; Sands, Oppewal et al. 2008). In the literature it is claimed that actualized innovativeness (Rogers 2003) and enduring involvement (Celsi and Olson 1988; Schmidt and Spreng 1996) are both positively related to hedonic motivations for search.

For the purposes of this paper, we aim at formulating hypotheses about the relation between innovativeness and the use of different information sources. We consider that each source has its own information content and specific costs for its use, as perceived by consumers. We assume that consumers will use the information source that provides a satisfactory amount of information against the best cost-benefit ratio, in terms of the costs and gains discussed earlier, but also in terms of leisure experience from searching for information. If the amount of knowledge that the consumer already possesses exceeds the amount of information available from a particular source, the consumer is more likely to make use of another, more costly, information source. In our framework, the benefits of using a specific information source will refer mostly to the amount and quality of the informational content offered by the source. Such quality relates both to the degree of specialization of the information and to the extent to which consumers are able to understand it and absorb it.

## Hypotheses

We start formulating our hypotheses by considering the effect of innovativeness on the extent of internal consumer search. Less innovative consumers are also less knowledgeable, and therefore less able to assess new products using their own experience (Punj and Staelin 1983; Rogers 2003). A low level of innovativeness also implies a limited repertoire of ideas and experience accumulated from the past. The ability to rely on internal search, is thus expected to grow with the amount of prior knowledge (Mattila and Wirtz 2002; Kerstetter and Cho 2004) and therefore with innovativeness.

*H1: There is a positive relation between innovativeness and internal ongoing search.*

Because they have little knowledge about the progress within the product domain, consumers with a low degree of innovativeness cannot rely solely on internal search to gather ideas for new purchases during ongoing search. Therefore, consumers turn to external sources for additional information.

We consider three groups of external information sources: interpersonal channels, the World Wide Web (WWW), and mass media. Interpersonal channels are the relations that a consumer has with the people from his or her social environment (e.g. friends, family, and colleagues). The WWW comprises all online information sources. Mass media, such as radio, TV or newspapers, are the information sources that do not require a personal interaction. In this study, we do not consider salespersons as a source of information. According to Sambandam and Lord (1995), consumers engage in retailer search after they have decided upon a set of products based on their search of other channels. Retailer search can thus be viewed as a separate stage in the search process, which consumers usually go through, regardless of their level of innovativeness. Further, the contribution of retailers during ongoing search does not necessarily depend on innovativeness, but more on aspects such as geographical proximity (Frag, Weltevreden et al. 2006).

Initially, the relationship between innovativeness and external search is expected to be positive, since consumers are better able to comprehend information from an information source as their knowledge grows (Johnson and Russo 1984). Further, as argued above, innovative consumers also have higher motivation to search.

If the first external source consulted does not provide new information anymore or if the costs to retrieve additional ideas from the information source exceed the expected gains, the consumer can make the utilitarian choice to rely on another external information source perceived to be more informative or less costly. Further, part of the hedonic motivation for search is the gathering of new information for fun (Bloch, Sherrell et al. 1986; Schmidt and Spreng 1996) If the source does not provide any new information, then the consumer is likely to enjoy the search less. As a result, the use of the initial source declines. This means that the use of each external information source is related to innovativeness in the form of an inverted U-shape.

The general relationships between innovativeness and use of information sources are depicted in figure 4.1 for the case of two external information sources following an internal search.

*H2: There is an inverted U-shape relation between innovativeness and the use of each external information source during ongoing search.*

The precise turning point of the curve for each source depends on the cost-benefit ratio of gaining additional information from the given source compared to the cost-benefit ratio of retrieving the information from another external information source. This turning point is likely to depend on the specific product domain considered, on the amount of experience the consumer has with the source, and on the consumers' preferences for certain sources. Further, the costs associated with each information source are different during ongoing search as compared to pre-purchase information search. Since there is little previous research on comparing the use of information sources in consumer search, let alone during ongoing search, the following discussion represents a more explorative contribution. The hypothesis that we formulate at the end of this section summarizes how far we can go in the formulation of a general proposition capturing whether decreasing returns to search emerge earlier for certain information sources.

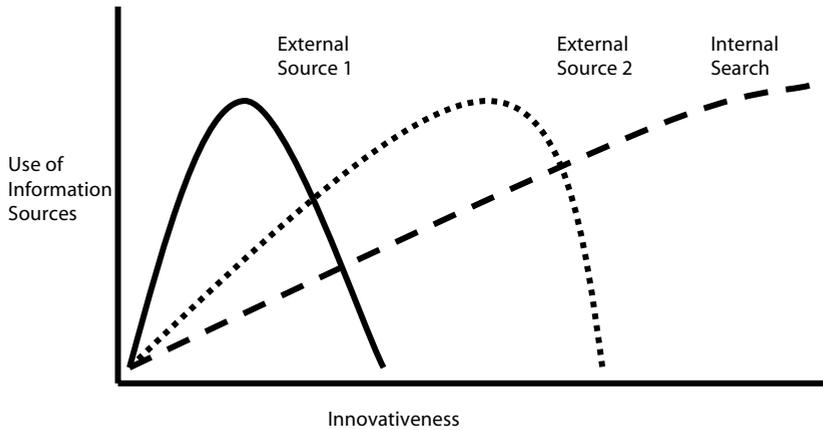


Figure 4.1: A graphical display of the relationships between innovativeness and the use of information sources.

According to Borgatti and Cross (2003), the costs that are associated with the use of interpersonal channels are a potential loss of reputation by admitting ignorance and the obligations resulting from knowledge exchange and overcoming physical distance. Less innovative individuals have little reputation to lose with regard to the product category (Homans 1974). The other two types of costs are relevant for all consumers. The potential gains from the use of interpersonal channels are high because they can provide information and ideas that are tailored to the knowledge level of the individual that enquires about the information. Moreover, ideas gathered from interpersonal channels have a larger chance to fit in with the norms in the social environment of the individual, because interpersonal channels are by definition a part of the social environment. These factors make interpersonal channels relatively cheap to use. However, the amount of information provided by interpersonal channels is restricted to the information about the product category available in the social environment. Although the informational content of interpersonal channels might be quite large in absolute terms, it is less than the informational content of the WWW or of the entire spectrum of mass media sources. Given all the above considerations, we assume that interpersonal channels are the cheapest external information source, but their informational benefits also run out relatively fast—as soon as the consumer’s level of innovativeness increases. We expect that the turning point of the relationship between innovativeness and interpersonal channels is at the lowest level of innovativeness among all the external sources considered.

The next external information source that we consider are mass media. For many mass media sources, consumers do not need to make a great investment in terms of effort to find information, since mass media provide a one-way stream of information that the consumer can absorb. In terms of quantity and quality of their information content, mass media carry more information and more diverse information (often more specialized) than interpersonal channels do (Katz and Gurevitch 1973). Also, the messages from mass

media are often tailored to the needs of specific segments of consumers (Blackwell, Miniard et al. 2001), which enhances the effectiveness of the medium. However, not everyone is interested in or is able to make sense of the content of mass media. Appreciating the more specialized knowledge from mass media requires affinity with the product category (Alba and Hutchinson 1987). Further, it is more uncertain whether ideas adopted from mass media suit the social environment of consumers better than interpersonal channels do, because mass media feed a social network with ideas, but are not a part of it.

The last source that we consider is the World Wide Web. There is no doubt that the rise of the World Wide Web (WWW) has revolutionized modern ways of communication (Alba, Lynch et al. 1997; Hoffman and Novak 1997; Klein 1998; Peterson and Merino 2003; Biswas 2004). Prince and Simon (2009) showed that people using the Internet are more innovative than other people, probably because of better access to information. The costs of retrieving information from the Web are undoubtedly low in terms of time and money, but there are some other costs. First, navigating the WWW is cognitively a more active process than using mass media. People have to navigate their way through the pages by consciously clicking on the link buttons, while mass media are often more passive to use. Second, the Web often provides an overload of information, with a large number of alternatives (Biswas 2004). This makes it more difficult to sort and filter out the information needed. Moreover, Forsythe and Shi (2003) found that certain types of perceived risks are a barrier to online searching. Consumers can perceive the information from the Web as being less reliable. These are factors that mostly play a role for consumers with a limited amount of experience with the Web (Biswas 2004). Besides, greater knowledge about the product category is required to be able to interpret the overload of results, so that the information gains increase with the level of prior knowledge (Klein and Ford 2003). Given the limited understanding that we have of the relative costs and gains of using the WWW with respect to mass media, we only expect that both the WWW and mass media sources will reveal a turning point at higher levels of innovativeness than interpersonal channels.

All the previous considerations lead to the following research hypothesis:

*H3: Interpersonal channels have the lowest turning point in the relationship between innovativeness and use of external information sources in ongoing search, followed by mass media, and the WWW.*

Notice that hypothesis H3 does not put forward a full rank ordering of the different information sources. We believe that the relative position of the turning points for mass media and WWW depends upon the specific product domain considered.

In the next section, we test our research hypotheses in the domain of consumer electronics.

## Methods

A survey among Dutch consumers was administered in a three week time span in December 2006. Respondents were approached in public places across the Netherlands and were asked whether they would fill out a questionnaire. They were told that they would receive twenty Euros for participating. Filling in the questionnaire took about ten minutes. While quotas by age groups and sex were used to ensure a representative sample of the Dutch population was included, the sample did contain an overrepresentation of individuals with higher education. The final sample consisted of 2094 consumers, varying in age between 16 and 88 years (mean = 44.3); 1046 respondents were male, 1048 were female.

Of the data, 0.46 % was a missing value. We dealt with these missing values by using multiple imputation (Donders, van der Heijden et al. 2006) with the PRELIS program (Jöreskog and Sörbom 2006), which resulted in 2050 usable cases (54 cases were not imputed).

Many studies measure search by the actual time spent on the search activity, which is an objective measure. Still measuring search time can be very problematic, because consumers are asked the exact amount of time spent in retrospect. This is even more the case for ongoing search, whose actual start time may be difficult to recall. Therefore, we chose a series of 5-point scale indicators related to the different search channels used to find ideas about consumer electronics. As mentioned earlier, we enquired about the use of four different types of information sources: (1) Internal search, (2) Interpersonal channels (3) Mass media (4) the World Wide Web<sup>15</sup>. Table 4.1 reports the full operationalization together with some descriptive statistics.

Actualized innovativeness was measured by asking whether the respondents owned consumer electronic products from a list of 15 items (see Table 1), this measure was standardized. The measure for enduring involvement was given by responses to a set of five-point Likert scale using questions used by Van Rijnsoever & Donders (2009) to capture the degree to which the respondent is involved in trends in the domain of consumer electronics. To minimize the risk of response biases (Podsakoff, MacKenzie et al. 2003), the questions that measured enduring involvement were posed prior to the ones that measured actualized innovativeness. This minimized the chance that the factual items of the behavioral measure affected the responses to the attitudinal items. To prevent other potential biases, the items for attitudinal items were interspersed with items that enquired about other topics. To further minimize the chances of false correlations, the innovativeness indicators were included in separate sections from the search indicators.

Using the LISREL 8.80 program (Jöreskog and Sörbom 2006), two measurement models were fitted, one for enduring involvement and the other for the information sources.

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<sup>15</sup> Preliminary testing revealed no strong significant relationship between innovativeness and retailer search. This confirms our theoretical notion, therefore retailer search was not further considered in the model.

Since actualized innovativeness is a single-indicator variable, there was no need to fit a measurement model. Table 4.1 further presents the results of the measurement models.

For both the behavioral and attitudinal indicators of innovativeness, we fitted a structural equation model using maximum likelihood estimation. As model performance indicators, we report the Goodness of Fit index (GFI), the Normed Fit Index (NFI), the Root Mean Squared Error of Approximation (RMSEA), and the model Chi-square.

To model the inverted U-shape, the squared value of innovativeness was included as regressor. To obtain this variable for enduring involvement, we squared the standardized value of the number of consumer electronic products. For enduring involvement, we extracted a latent variable in the measurement model from the Likert-scale questions. We obtained the squared term of this variable (which is an interaction of the variable with itself) by following a two-step technique by Ping (1996) implemented in the EXCEL template of Ping (2003). By averaging the measurement loadings of the indicators and the error terms, the EXCEL template allowed for the calculation of a factor loading and measurement error for a single indicator variable that is the squared term of the original latent linear predictor. The resulting squared term had an explained variance of 0.64.

To estimate the relative use of the sources compared with each other, we calculated the intercept of each function. We obtained all intercepts from the measurement model of the information source variables. Since the independent variables in the models have a mean of zero, the means of the latent dependent variables are equal to the intercepts in the equations.

For each inverted U-shaped relationship found to be significant, we calculated the turning point, expressed in the number of standard deviations from the average of innovativeness. We calculated the turning point by dividing the negative of the estimated value of the linear predictor in the equation by two times the estimated value of the squared predictor. Further, we calculated where the curves of the equations intersected. If our theoretical assumptions are correct, a comparison of the turning points and intersections enables us to determine the relative costs and gains for each source relative to the others. Since the independent variables have a mean of zero and a standard deviation of one, the turning points and intersections can be expressed as the number of standard deviations from the average of innovativeness. Under the assumption of a normal distribution and a representative sample, this allows us to calculate their values back to population proportions.

Finally, to explain the difference between the behavioral and attitudinal model, we followed the suggestion of Brenner et al. (1996) and subtracted the standardized actualized innovativeness variable from the underlying factorial construct that represents enduring involvement. If the mean of the outcome variable emerges with a positive value, then the respondents have overestimated their level of perceived enduring involvement, compared to their observed actualized innovativeness; if the mean is negative, then respondents have underestimated their perceived enduring involvement, compared to their observed actualized innovativeness.

Variable	Measurement		Mean, (S.D.); Explained variance	Model Fit
Innova- tiveness	(1) The following questions (using a 5-point Likert scale)	Enduring involve- ment	2.42, (1.13); 0.64 2.57, (1.15); 0.63 2.85 ,(1.21); 0.52 2.33, (1.09); 0.53 2.36, (1.06); 0.51	GFI = 0,99 NFI = 0.99, RMSEA = 0.064, $\chi^2 = 85.23$ with df = 9
	1. I always try to participate in the latest trends in consumer electronics.			
	2. I am fashionable in the area of consumer electronics.			
	3. I try to remain aware of the latest trends in consumer electronics.			
	4. I am always quick to purchase new consumer electronics.			
	5. I think it is important to own new consumer electronic products.			
	(2). The number of consumer electronic products owned from the following list: PDA, HDTV, iPod, Flatpanel television, Game console, Webcam, MP3-player, Notebook or laptop, Dolby-surround system, Mobile telephone with camera function, Digital camera, Broadband internet, Desktop computer, DVD-player, Mobile Phone	Actua- lized innovati- veness	6.49, (2.99); 1.00	
Use of information sources	I find ideas to purchase new consumer electronics from: (using a 5-point Likert scale)			
	1. My own experience	Internal search	3.28, (1.08); 1.00	GFI = 1.00, NFI = 0.99, RMSEA = 0.046, $\chi^2 = 24.66$ with df = 4
2. Family living in my household	Interper- sonal	3.07, (1.18); 0.24		
	3. Friends and relatives	channels	3.37 (1.07); 0.45	
	4. Internet sites (no e-mail and chatting)	World Wide Web	2.65, (1.22); 1.00	
	5. Radio and television	Mass- media	2.80, (1.07); 0.69	
	6. Advertisements and folders		2.94, (1.09); 0.46	

*Table 4.1:* The measurement, means, standard deviations (S.D.) and explained variances of the variables in the measurement models.

## Results

This section presents the results of the empirical study. Table 4.2 shows the results for the behavioral model. The columns refer to information sources as dependent variables; the first three rows refer to the intercept and the independent variables. We report unstandardized estimates which are required for calculating the turning points and the intersections. The table also reports the explained variance of each dependent variable. Where applicable, we include the turning points of the U-shapes and the intersections of the curves as the number of standard deviations from the average of innovativeness. The model GFI is 1.00, the NFI is 0.99, the RMSEA is 0.045, and the model Chi-square is 36.32 with 7 degrees of freedom. This indicates an excellent fit.

	Internal search	Interpersonal channels	Mass media	World Wide Web
Intercept	3.28	3.07	2.81	2.65
Innovativeness	0.49***	0.04**	0.24**	0.76***
Innovativeness <sup>2</sup>	0.00	-0.29***	-0.00	-0.15***
R <sup>2</sup>	0.08	0.13	0.07	0.27
Turning point (in SD)	n.a.	0.07	n.a.	2.53
Intersection internal search	n.a.	n.a.	-1.88	n.a.
Intersection interpersonal channels	n.a.	n.a.	-1.35/0.66	n.a./0.53
Intersection mass media	-1.88	-1.35/0.66	n.a.	0.34/3.12
Intersection World Wide Web	n.a.	n.a./0.53	0.34/3.12	n.a.

*Table 4.2:* The results of the behavioral model using the actualized innovativeness measure. \*:  $p < 0.05$ ; \*\*:  $p < 0.01$ ; \*\*\*:  $p < 0.001$ . The GFI is 1.00, the NFI is 0.99 the RMSEA is 0.045. The model Chi-square is 36.32 with 7 degrees of freedom.

Figure 4.2a graphically represents the relationship between actualized innovativeness and the use of information sources. We found evidence of a positive relationship between actualized innovativeness and internal search, but no indication of a quadratic relationship between the concepts is discernible, which is in line with our first hypothesis. The predicted inverted U-shaped relationship between actualized innovativeness and interpersonal channels is confirmed. The turning point of the curve is at 0.07 SD from the average of actualized innovativeness. For mass media use, the model only depicts a positive linear relationship and not a quadratic one. There is an inverted U-shaped relationship between actualized innovativeness and WWW search. The turning point of this curve is at 2.53 SD from the average of actualized innovativeness. WWW reaches its peak in use later than interpersonal channels do. Hypothesis 2 and 3 are thus largely supported in this model. In terms of relative use of information sources, consumers with a actualized innovativeness of 1.88 SD below the average make most use of mass media. After this point, internal search becomes the most important alternative. Mass media remains relatively important, however. For consumers with actualized innovativeness that ranges between 1.35 SD below the average and 0.34 SD above the average, interpersonal channels are the

most important external source. For individuals with actualized innovativeness ranging between 1.35 SD above the average and 3.12 SD above the average, the WWW is the most important source. Above 3.12 SD, mass media becomes the most important source once again. The explained variances of the models are rather low, except for the prediction of WWW search. This means that there are other potential variables, together with actualized innovativeness, that explain the use of information sources (see for instance Moore and Lehmann 1980; Bloch, Sherrell et al. 1986) during ongoing search.

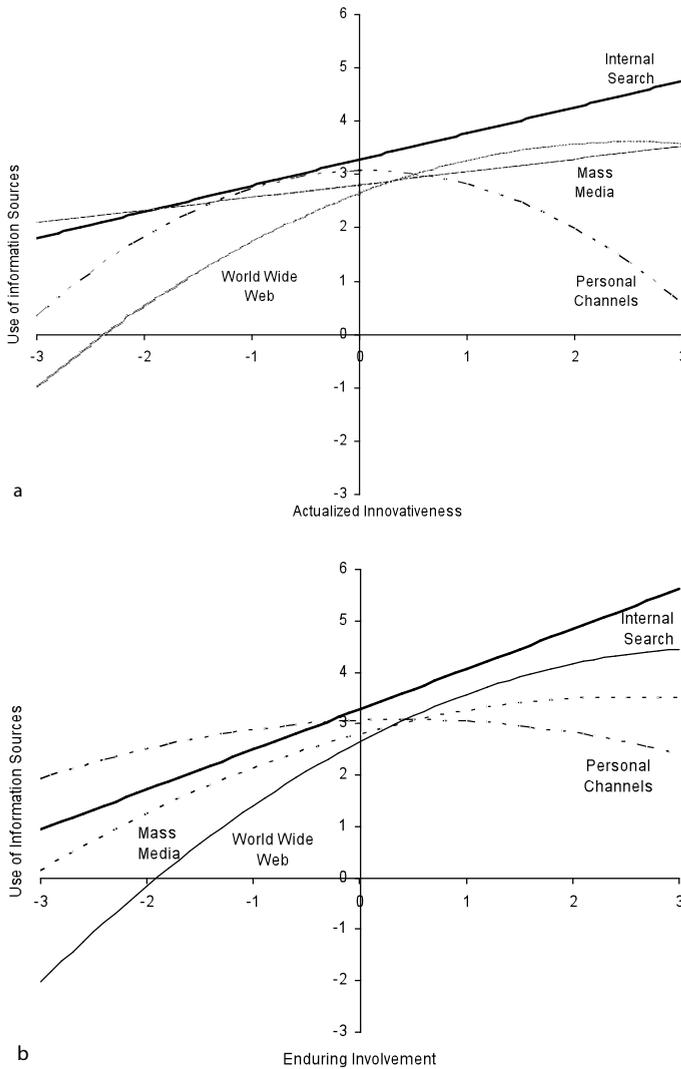


Figure 4.2: (a) The relationship between actualized innovativeness and use of information sources; (b) The relationship between enduring involvement and use of information sources.

Table 4.3 displays the results of the attitudinal model. This model has a GFI of 0.98, the NFI is 0.97, and the RMSEA is 0.054. The model Chi-square is 290.30 with 41 degrees of freedom, indicating a very good fit.

	Internal search	Interpersonal channels	Mass media	World Wide Web
Intercept	3.28	3.07	2.81	2.65
Innovativeness	0.78***	0.08*	0.56***	1.08***
Innovativeness ^2	-0.03	-0.10**	-0.11***	-0.16***
R <sup>2</sup>	0.13	0.02	0.06	0.30
Turning point (in SD)	n.a.	0.40	2.54	3.38
Intersection internal search	n.a.	n.a./-0.31	n.a.	n.a.
Intersection interpersonal channels	n.a./-0.31	n.a.	0.54/n.a.	0.43/n.a.
Intersection mass media	n.a.	0.54/n.a.	n.a.	0.32/n.a.
Intersection World Wide Web	n.a.	0.43/n.a.	0.32/n.a.	n.a.

Table 4.3: The results of the attitudinal model using the enduring involvement measure.

\*:  $p < 0.05$ ; \*\*:  $p < 0.01$ ; \*\*\*:  $p < 0.001$ . The GFI is 0.98, the NFI is 0.97 the RMSEA is 0.054. The model Chi-square is 290.30 with 41 degrees of freedom.

The attitudinal model also confirms the positive relationship with internal search, further supporting hypothesis 1. There are inverted U-shaped relationships between enduring involvement and all three external information sources. Figure 4.2b graphically represents the relationships between enduring involvement and the use of information sources. The turning points for interpersonal channels, mass media, and WWW search are at 0.40, 2.54 and 3.38 SD from the average of enduring involvement. In this model, hypothesis 2 and 3 are thus supported.

Although the inverted U-shaped relationship is confirmed for enduring involvement and the WWW, the turning point is at 3.38 SD from the average of enduring involvement. It is, therefore, difficult to assert whether this is actually a turning point or whether the curve reaches its maximum value, and stays at this level.

In the attitudinal model, interpersonal channels are the most important source of information until enduring involvement reaches 0.31 SD below the average. Beyond this point, internal search is the most important overall source and interpersonal channels remain the most important external information source until the enduring involvement is larger than 0.43 SD above the average. Then the WWW becomes the most important external information source, although all external sources have about the same score then. If we compare the results between the behavioral and attitudinal models, we notice that they are quite similar. However, the explained variances in the attitudinal model are higher than in the behavioral model. Thus, consumers base their search behavior more on their innovative attitudes than on their actual innovative behavior. The only difference in

predictions between the models is the predicted relationship between innovativeness and mass media search.

When looking at the relative use of the sources, the models indicate that internal search is the most important source for highly innovative consumers and that the WWW is the most important external source for this group. In both models, the intersections between interpersonal channels and WWW are roughly at the same point.

The main difference is that in the attitudinal model, consumers with low involvement claim to use interpersonal channels the most, while in the behavioral model, consumers with low innovativeness make most use of internal search and mass media. Interpersonal channels are relatively unimportant in the behavioral model for consumers with low innovativeness.

To explain the differences between the models, we subtracted the standardized actualized innovativeness variable from the enduring involvement construct. We found that the mean of the resulting difference variable was approximately zero. This means that on average there was no under- or overestimation of innovativeness. However, after additionally regressing the “difference variable” on actualized innovativeness a significant negative relationship ( $b = -0.469$ ) was found, with no significant intercept and an adjusted  $R^2$  of 0.234. This means that the lower the actualized innovativeness is, the more people tend to overestimate their innovative attitude, and the higher the actualized innovativeness is, the more people tend to underestimate their innovative attitude. To check whether the negative correlation explained the differences between the two models, the correlation coefficient was applied as a correcting factor for the estimators in the actualized innovativeness model. The analysis revealed (result not shown here), that this factor greatly reduced the differences between the curves of both models with regard to internal search, mass media sources, and WWW, but not for interpersonal channels. The different curves of the enduring involvement model, compared to the actualized innovativeness model, are thus largely the result of the over- and underestimation of innovativeness. In the case of mass media this difference in estimation even means that the squared term in the actualized innovativeness model is not significant, which leads to a linear prediction. For the use of interpersonal channels, apparently other mechanisms are at work. One explanation might be that when using interpersonal channels, people consider the products they actually own in comparison to what others own. People can thus estimate the amount of information that a person can offer in an objective manner, and base their choice of whether to use the source on this estimation.

## Discussion and Implications

The study investigated the effect of innovativeness on the use of different information sources during ongoing search. In this concluding section, we discuss the theoretical implications of our study together with a number of managerial implications.

## Theoretical implications

Our framework has proposed that clear differences exist among information sources in the relationship between innovativeness and the use of each source in the ongoing search process. We have extended the current understanding of the relationship between innovativeness and information search by explicitly addressing the information sources dimension (Kiel and Layton 1981). We have shown that highly innovative consumers find new ideas using mass media and WWW as external sources, while less innovative consumers rely most on interpersonal channels. This is in line with earlier observations by (Katz and Lazarsfeld 1964; Rogers 1983). Our theoretical framework has been mostly derived from the economics of information perspective and from hedonic arguments for search, which have not been applied so far—either to the comparison of different information sources or to explain the relationship with innovativeness.

Our empirical results for the product domain of consumer electronics have largely confirmed our theoretical predictions. The amount of internal search increases with the degree of innovativeness. The higher the degree of innovativeness, the better the consumer is able to assess new information with their own experience (Rogers 2003).

We predicted that interpersonal channels would be the first external sources to be used. After a certain point, the consumers' level of innovativeness becomes so large that the combined consideration of costs and gains motivates the consumer to choose other external sources as the most important information sources.

Interpersonal channels are also the most important source in the attitudinal model for the consumers with a low degree of involvement. However, this result was not found in the behavioral model considering actualized innovativeness. Both models agree that consumers with a higher degree of innovativeness use the WWW as their most important source. In both models, mass media remain nearly as important as the WWW for more innovative consumers.

We found only mixed evidence of an inverted U-shaped relationship between involvement and WWW search in the attitudinal model. This finding does not necessarily contradict our theoretical proposition. The Web has the largest information content, leaving no alternative source that a consumer can easily turn to. Therefore, the WWW shows no decline for increasing involvement. An additional reason could be that people with higher involvement have more hedonistic motives for search (Bloch, Sherrell et al. 1986; Babin, Darden et al. 1994); highly involved consumers might actually enjoy searching more than less involved ones.

Based on our findings as well as on the limitations of our study, we identify several avenues for further research.

First, our theoretical hypotheses have only been tested for the domain of consumer electronics, testing them on other product domains is required to confirm their general validity.

Second, future research will be required to provide more insight into which type of knowledge consumers search in an information source. In this paper, we explicitly focused on where consumers get their ideas for new purchases. Further studies could assess

whether other types of knowledge are searched for in a different manner, and whether the same patterns are observed during different phases of the search process.

Third, the results confirm the relevance of considering both attitudinal and behavioral measures of innovativeness. The two measures complement each other and provide a more complete characterization of innovativeness.

Finally, the low explained variances in some of the models indicate that there are many other potential explanations for the use of information sources during ongoing search in addition to innovativeness, such as the general experience that consumers possess with certain sources. Other important determinants of search mentioned in the literature are socio-demographic variables. We acknowledge the role that these variables play, but our focus in this study has been on the role of innovativeness. Future research could incorporate these variables as well.

## **Managerial implications**

In the introduction, it was stated that innovative consumers are important for the innovation diffusion process. Innovative consumers take the risks for others by adopting early, by partly testing the products' functionality, by contributing to further improvement of the product, and by familiarizing others with the product, contributing to the build-up of sufficient critical mass for the diffusion process to become self-sustaining.

Our results clearly show that there are different patterns in the use of certain information sources in relation to innovativeness. From a managerial perspective, these findings can help device marketing strategies that target specific segments of consumers when gathering ideas during ongoing search. Although consumers base their search behavior on their enduring involvement, information provision strategies by suppliers of innovations are most easily tailored on the actual behavior displayed by consumer in the market. Therefore, our managerial implications are based on the results of the behavioral model.

The sources that are easiest to use from a managerial perspective are the WWW and mass media. For marketing managers, interpersonal channels are the most difficult to exploit directly in a marketing strategy. When using interpersonal channels, marketers have to rely on third party information brokers to get the message through to the broader audience (Katz and Lazarsfeld 1964). The information from the WWW and mass media can directly be manipulated. Mass media is the most important external source for low innovative consumers (until  $-1.35$  SD of the average); this corresponds to about 9% of the population. Consumers with an innovativeness between  $-1.35$  SD and  $0.66$  SD of the average make most use of interpersonal channels; this is about 66% of the population. For the top 25% of the innovative consumers, the WWW is the most important source, while the use of interpersonal channels rapidly declines. Mass media remains relatively important. For marketers, this means that although mass media are the sources that can be used to target consumers with all levels of innovativeness (as long as the right group is targeted), they are relatively more effective in targeting less innovative consumers because these make relatively less use of other external information sources.

Highly innovative consumers make the most use of the WWW. From an information supply perspective, the relatively limited use of the WWW by all other consumers is

problematic, since it is cheaper to provide information via the Web than through mass media. It is, therefore, worthwhile to consider bringing the intersections of the WWW with mass media and interpersonal channels to the left. This will enable a larger group of consumers to obtain their ideas from the WWW. A possible strategy is to design web-based engines that lower the experience costs of information search for less innovative consumers. The information overload problem can be tackled by presenting less detailed information, and tailoring the information to the demographic profile of the consumer and their personal preferences. Such an engine based on segmented marketing would enable more consumers to better comprehend the information presented.

Further, marketers should focus on making the WWW part of the social environment of the consumer to increase the effectiveness of their efforts. At present, the information provided by interpersonal channels is most likely to fit with the norms of the social environment. There is no guarantee, however, that the ideas presented on the Web will suit the norms of the social environment of the consumer. Strategies that are based on using social network sites such as Facebook and Myspace, could help to extend the social domain into the WWW.

# 5 Involvement and use of multiple search channels in the automobile-purchase process<sup>16</sup>

## Abstract

This study investigates the relationship between involvement and use of multiple search channels in the case of pre-purchase information search for automobiles. We derive theoretical hypotheses by combining arguments from both an economic (or cost/benefit) approach and a motivational perspective. We test our theoretical framework on a sample of 1392 Dutch consumers using a structural equation–model approach. We find that interpersonal sources and retailers are consulted relatively often and their use is not strongly related to involvement. The use of channels such as the World Wide Web and mass media is instead strongly related to involvement, because their specialized content is best appreciated by highly involved consumers. Finally, the theoretical and managerial implications are discussed.

## Introduction

In order to reduce the perceived risks that are associated with purchasing a product, consumers can search for information about the product prior to purchasing (Gemünden 1985; Dowling and Staelin 1994; Chaudhuri 1998). This pre-purchase information search is one of the most widely investigated topics in consumer research. In literature, two types of search are distinguished, namely internal and external (Blackwell, Miniard et al. 2001; Guo 2001). Internal search consists of internal memory scans by the consumer for information relevant to a purchase decision. External search refers to consulting external information sources. Examples of external search channels include interpersonal channels, mass media, retailers (Kiel and Layton 1981), and the World Wide Web (WWW) (Biswas 2004).

An important antecedent of search is enduring involvement with a product (Beatty and Smith 1987; Schmidt and Spreng 1996; Gursoy and McCleary 2004). Enduring product involvement captures a consumer's involvement with a product class (Mittal and Lee 1989). The concept reflects the perceived personal relevance of a product to the consumer in terms of needs, values, goals, and interests (Zaichkowsky 1985; Celsi and Olson 1988;

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<sup>16</sup> This chapter is co-authored with Martin J. Dijkstra and Carolina Castaldi and has been submitted for publication.

Mittal and Lee 1989). Several studies discuss a positive relation between involvement and the extent of external search (e.g. Punj and Staelin 1983; Richins and Bloch 1986; Beatty and Smith 1987; Schmidt and Spreng 1996; McColl-Kennedy and Fetter 2001; Gursoy and McCleary 2004).

However, these studies only investigate the extent of external search in general. They neglect an important dimension of pre-purchase information search suggested by Kiel and Layton (1981), namely the types of search channels used. Many studies focus on the relationship between involvement and the use of a particular search channel, such as the Internet (see for instance Peterson and Merino 2003; Mathwick and Rigdon 2004) or interpersonal channels (see Gilly, Graham et al. 1998). To our knowledge, there are no recent studies that comprehensively analyze the use of different information-search channels in relation to product involvement. The present study formulates theoretical propositions on the relationship between enduring product involvement and the use of various search channels in the purchasing process. It also provides explorative empirical insights from a study on car purchases by comparing the different search channels in terms of their relationships with involvement. The findings of this study can help marketers to identify the most appropriate channels for targeting segments of either more or less involved consumers.

In the next section, we present our theoretical model and relate it to the existing literature. We then discuss an empirical test of the model for the case of car purchases. In the methodology section, we describe the survey conducted to collect data to test our model and the measurement of the key concepts and relations. The empirical results are based on a sample of 1392 households owning a car in the Netherlands. In the empirical analysis, we also consider the role of the consumers' general experience with channels and of their socio-demographic characteristics. Considered together, these variables provide insights into the potential explanatory mechanisms underlying the main relations in our model. Finally, we discuss the theoretical and practical implications of our findings.

## **Theoretical framework**

In this section, we briefly review the literature on the antecedents of pre-purchase information search and discuss the different search channels considered therein. We then build a research model to explain the use of different information channels and formulate a set of hypotheses about the role of product involvement.

### **Product involvement and pre-purchase information search**

There are two types of involvement: enduring (or ego) and purchase involvements (Beatty, Kahle et al. 1988). Enduring involvement is "independent of purchase situations and is motivated by the degree to which the product relates to the self and/or the hedonic pleasure received from the product" (Richins and Bloch 1986,p. 280). Purchase involvement

(similar to situational involvement, but more narrow) “relates to the level of concern for, or interest in, the purchase process triggered by the need to consider a particular purchase” (Beatty, Kahle et al. 1988, p.150). A high level of enduring involvement leads to a higher involvement during the purchase process (Beatty, Kahle et al. 1988). However, some scholars argue that these two types of involvement are antecedents of the consumers’ levels of felt involvement and are not separate types (Celsi and Olson 1988). Because we are interested in the relationship between involvement and search independent from the specific purchase situation, we consider the concept of enduring involvement as the main independent variable. Our dependent variable is the use of various search channels.

According to Schmidt and Spreng (1996), there are two dominant theoretical streams that explain search<sup>17</sup>. The first is the economic stream, which uses a cost-benefit framework to explain consumer-search behavior. The second is the psychological/motivational stream, which reasons from the motivation and ability to search. The two streams are not entirely unrelated because the perceived costs and benefits of the search also influence the motivation to search.

Schmidt and Spreng (1996) classify enduring involvement as a variable proposed by the psychological/motivational stream, whereas situational involvement is classified as a part of the economic stream. Research has shown that enduring involvement is closely related to previous knowledge about the product category (Sujan 1985; Celsi and Olson 1988; Okechuku 1992), which is instead classified as an antecedent of search by the economic approach (Schmidt and Spreng 1996). Because it is not entirely clear whether the two types of involvement are conceptually different and because the economic and motivational streams are related, the role of involvement in the choice among different types of search channels can be understood by combining arguments from an economic perspective with arguments from a motivational perspective.

From an economic perspective, each search channel has a specific information content and certain attached costs in terms of time, money, and effort to get the required information (Srinivasan and Ratchford 1991; Lapersonne, Laurent et al. 1995; Moorthy, Ratchford et al. 1997; Borgatti and Cross 2003). In an economic or utility framework, consumers try to minimize their search costs while simultaneously maximizing benefits (Stigler 1961; Ratchford 1982; Schmidt and Spreng 1996; Moorthy, Ratchford et al. 1997). The primary search costs consist of time, money, and cognitive effort. According to Borgatti and Cross (2003), search costs can further consist of loss of reputation by admitting ignorance when searching, obligations resulting from knowledge exchange, and physical distance. The extent of involvement affects the costs and benefits of search.

From a motivational perspective, search channels can have certain characteristics that make them more attractive to use for highly involved consumers compared to other channels. For example, certain channels can provide additional hedonic value during the search (Babin, Darden et al. 1994; Lapersonne, Laurent et al. 1995), thus consumers may enjoy searching those particular channels.

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17 Srinivasan (1990) claims that there is also a third ‘information-processing’ stream. Schmidt and Spreng (1996) argue that this third stream is actually part of the psychological/motivational stream.

In terms of types of search channels, Kiel and Layton (1981) discern three main categories: interpersonal channels, mass media, and retailers. Interpersonal channels (also called word-of-mouth) are defined as “informal communications directed at other consumers about ownership, usage, or characteristics of particular goods and services and/or their sellers” (De Matos and Rossi 2008 p. 578). Mass-media channels are the impersonal information sources that target a broad audience, such as radio, television (TV), and newspapers. Finally, retailers advise consumers as part of their service offer to consumers. More recently, information search by the consumer is also heavily influenced by the WWW (Alba, Lynch et al. 1997; Bakos 1997; Biswas 2004). Compared to other external channels, such as retailers or specialized media, the WWW provides a wealth of information against relatively low costs (Biswas 2004). As a result, the Web competes with other channels in the search process (Ratchford, Talukdar et al. 2007). On the contrary, the Web-search channel is not necessarily more efficient, because it provides an overload of information that the consumer cannot always comprehend (Biswas 2004). It is therefore worthwhile to consider the WWW separately from the other external search channels.

## Research model and hypotheses

We aim to investigate the effect of product involvement on the use of the four different categories of search channels outlined above. For each proposed relationship, arguments from both the economic and motivational streams will be used.

Ultimately, we also wish to compare the relationships to find out which channels are more affected by involvement and how. This additional conceptual step can only be highly speculative and is likely to strongly depend on the specific product category considered. We will only investigate similarities and differences among the types of search channels ex post, based on the empirical results.

### Internal search

Internal search takes place before the external search (Blackwell, Miniard et al. 2001), because the consumer typically first evaluates his/her own previous knowledge before consulting other sources (Punj and Staelin 1983). The use of the information obtained from the internal search directly depends on the previous knowledge that the consumer has (Blackwell, Miniard et al. 2001). Because more involved consumers are also more knowledgeable (Gursoy and McCleary 2004), they also have more information at their disposal (Johnson and Russo 1984; Kerstetter and Cho 2004). Hence, a positive relationship<sup>18</sup> between involvement and internal search is expected.

*H1: There is a positive relationship between involvement and internal search.*

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<sup>18</sup> Note that all proposed hypotheses are formulated in a non-causal manner; we do not make any claims about cause and effect, only regarding whether the concepts are related to each other or not

### **Interpersonal search**

Several authors claim that during their external search for information, consumers rely mostly on interpersonal (or word-of-mouth) communication (Katz and Lazarsfeld 1964; Price and Feick 1984; Gilly, Graham et al. 1998; Harrison-Walker 2001; Brown, Barry et al. 2005). The primary reasons for this tendency are that interpersonal channels are easy to access and the information drawn from them is considered reliable (Price and Feick 1984; Borgatti and Cross 2003). The use of interpersonal search is thus expected to be relatively high compared to the other external search channels considered.

From an economic perspective, the expected relationship between involvement and interpersonal search is unclear. On one hand, consumers with a larger expertise need to find less additional information to make their purchase decision and therefore make less use of interpersonal search (Punj and Staelin 1983; Gilly, Graham et al. 1998); this implies a negative relationship between involvement and interpersonal search. On the other hand, a greater expertise allows the consumer to better interpret new knowledge (Johnson and Russo 1984). The ability to search thus increases with expertise, because expertise is positively linked to involvement (Sujaan 1985; Celsi and Olson 1988); hence, a positive relationship between involvement and interpersonal search can be expected.

To consider the role of involvement in the interpersonal search for a motivational perspective, one needs to take into account that the interpersonal channel is the only type of source where the consumer can have two different roles, that of sender and receiver (Gilly, Graham et al. 1998). From the sender's perspective, according to De Matos and Rossi (2008), the most important antecedent of word-of-mouth communication about a product is commitment to a certain product or brand (Moorman, Zaltman et al. 1992:p.316). At the same time, an important antecedent of commitment is enduring involvement (Beatty, Kahle et al. 1988). Hence, a positive relationship between involvement and use of interpersonal sources as sender is expected. We are primarily interested in the use of interpersonal sources from a receiver's perspective. The question is whether highly involved consumers use interpersonal channels to transmit their knowledge to others because they like to share information or whether they instead use interpersonal channels to confirm and match their own knowledge with other highly involved consumers. Especially in the second case, we would expect that more involved consumers are more motivated to use interpersonal channels to search for product-related information than less-involved consumers.

To summarize, the economic argument provides support for either a negative or a positive relationship, and the motivational argument suggests a positive relationship between involvement and interpersonal search. Overall, the arguments point to a positive relationship:

*H2: There is a positive relationship between involvement and interpersonal search.*

### **Mass Media**

Mass-media search channels contain abundant, often more specialized, information than interpersonal search (Katz and Gurevitch 1973). At the same time, the information one can get is restricted by the content of the channel and by the moment that the information

is made available (for example, the time when a show is being broadcasted or when a new type of car is discussed in a car magazine).

From an economic perspective, it can be argued that mass-media channels are relatively expensive, because the consumer cannot get access to information at all times. Also, because of their specialized content, mass-media channels are mostly of interest to higher-involved consumers, who are able to interpret the information (Johnson and Russo 1984; Alba and Hutchinson 1987; Sambandam and Lord 1995).

To explain the relationship between involvement and mass-media search from a motivational perspective, it can be argued that the specialized content of such channels is only of interest to selected groups of consumers. Car magazines and automobile shows on TV, for example, mostly appeal to users that are more involved in cars and derive pleasure from searching through mass media.

Both the economic and motivational arguments thus predict a positive relationship between involvement and mass-media search. Empirical evidence has indeed shown that highly involved individuals, such as opinion leaders, make more use of mass-media channels than others to obtain information (Katz and Lazarsfeld 1964; Rogers 2003).

*H3: There is a positive relationship between involvement and use of mass-media channels.*

## **WWW**

Although the WWW has drawn considerable attention from researchers as a new search channel, a study by Johnson et al. (2004) reported evidence that the amount of actual searching carried out on the Web is actually quite limited, compared to what one might expect. From an economic perspective, the WWW has dramatically reduced the search costs for new product information (Alba, Lynch et al. 1997; Bakos 1997; Peterson and Merino 2003; Lindsey-Mullikin and Grewal 2006). However, the WWW also provides an overload of information (Biswas 2004). Consumers have to develop the skill of either sorting the information they have obtained, making sense of such information, and determining its reliability or find the Internet sites that can help them with conducting these tasks. Highly involved consumers are better able to do all this, because they are more knowledgeable about the product and can already, for instance, identify a few dimensions with reference to which different products can be compared.

From a motivational perspective, we also expect a positive relationship between involvement and online search. Mathwick and Rigdon (2004) find that highly involved consumers experience more enjoyment and escapism (so-called “perceived play”) during online searching than less-involved consumers. This is in line with previous arguments from Bloch et al. (1986) and (1983).

Therefore, we expect a positive relationship between involvement and use of WWW as a search channel.

*H4: There is a positive relationship between involvement and use of WWW.*

## **Retailer search**

According to Sambandam and Lord (1995), consumers engage in retailer search after they have decided upon a set of products based on their search of other channels. Retailer search can thus be viewed as a separate stage in the search process, which every consumer usually goes through, regardless of the levels of involvement.

In addition to a utilitarian value, consumers attach hedonic values to the shopping experience (Babin, Darden et al. 1994; Sands, Oppewal et al. 2008). It has been shown that product involvement is an important factor for obtaining pleasure during retailer search (Titus and Everett 1995; Jones 1999). Therefore, we expect consumers with a higher involvement to make more use of retailer search than less involved consumers.

*H5: There is a positive relationship between involvement and retailer search.*

## **Methods**

### **Sample and data collection**

Totally, 1392 households in The Netherlands owning a car were surveyed. The sample was obtained by personally delivering questionnaires to households all over The Netherlands. Households were screened for the presence of a car and the willingness of the person who had been most involved in the purchase process to fill in the questionnaire. Households unwilling to participate were replaced with other households until 1500 questionnaires had been distributed. The filled-in questionnaires were collected a few days after delivery. Quotas were set by gender and age for the sample to be representative for the Dutch population. Verification with the data from the Dutch Central Statistical Office (CBS 2007) confirmed the data to represent these population statistics of Dutch households owning a car well. Only the education level of the respondents was higher than that observed for the general population.

The questionnaire included items measuring the current level of involvement with cars, the use of search channels in the car-purchasing process, current experience with the use of channels in general, and a number of socio-demographic variables. Involvement was measured with the IPCA Automobile Involvement Scale used by Bloch (1981). Items from the factors “readiness to talk to others about cars” and “interest in cars” were used as indicators for involvement. To measure the use of search channels, statements were formulated about the use of various information channels in the process of purchasing the car. Respondents could rate them on a 5-point Likert scale that varied from ‘fully disagree’ to ‘fully agree’. Many studies measure search by the actual time spent on search. However, measuring search time during the car-purchase process can be very problematic, because consumers are asked the exact amount of time in retrospect over a relatively long period of time. Therefore, we used a series of 5-point-scale indicators. To minimize the risk of common method bias (Podsakoff, MacKenzie et al. 2003), the use of search channels was measured in a separate section of the questionnaire. Table 5.1 explains the exact operationalization of involvement and the use of search channels. Multiple imputation

(Donders, van der Heijden et al. 2006) was used to deal with missing values, using the PRELIS 2.0 program (Jöreskog and Sörbom 2006). Among the responses, 2.25% of the values were missing; all but four cases were successfully imputed.

We controlled for two potentially confounding effects that might affect the main relationships proposed. First, a larger experience with an external search channel can reduce the information-search costs (Moorthy, Ratchford et al. 1997). Such experience makes it easier for consumers to acquire and process new information (Brucks 1985; Biswas 2004), which increases the efficiency of the search (Goldman and Johansson 1978). This in turn will lead to an increased use of the channel for information search (Blackwell, Miniard et al. 2001). Therefore, we control for the amount of experience a consumer has of the available communication channels, which include (1) telephoning, (2) being with family and friends, (3) emailing, (4) watching TV, (5) listening to the radio, (6) newspapers and magazines, (7) car magazines, (8) surfing the Internet, and (9) shopping. All these channels are possible sources of product-related information, but information search is of course not the only reason for consumers to use these channels. The experience with channels 1, 2, and 3 can be considered to influence the use of interpersonal channels; the experience with channels 4 to 7 relates to mass-media channels; channel 8 is Web-related; and channel 9 is retailer-related. We measure the general use of channels as the average hours per week spent on the various channels. Because this variable captures the use of a channel on a regular basis, the issue of retrospective bias does not apply.

The second set of control variables considered concerns the demographic characteristics of consumers. Past studies have shown that socio-demographic characteristics are associated with search behavior (e.g. Kiel and Layton 1981; 2003; Gursoy and McCleary 2004; Ratchford, Talukdar et al. 2007). Therefore, the following demographic variables are added to the model: age, sex, education level, income, and the number of inhabitants in the town of residence.

Table 5.2 shows the measurement of the two sets of control variables.

No.	Indicator	Estimator	Indicator Mean (S.D.)	Latent variable (explained variance; mean)
1	I enjoy discussing cars with friends	0.88	2.78 (1.23)	Involvement (0.52; 2.23)
2	I get bored when other people talk to me about cars*	0.54	3.04 (1.15)	
3	When with a friend, we often end up talking about cars	0.81	2.12 (1.04)	
4	I regularly discuss cars with friends	0.84	2.27 (1.09)	
5	Cars are nothing more than mere appliances*	0.56	2.25 (1.08)	
6	I do not pay attention to car advertisements in magazines or TV*	0.65	2.50 (1.22)	
<i>When buying a car, I make use of the following information sources:</i>				
7	My own experience	0.29	3.83 (0.95)	Internal search (0.45; 3.44)
8	My own knowledge about cars	0.58	3.32 (1.14)	
9	My close relatives	0.32	3.20 (1.15)	Interpersonal search (0.49; 2.98)
10	My friends	0.63	2.98 (1.07)	
11	People from my direct environment, e.g., school or work	0.52	2.79 (1.08)	
12	Advertisements and magazines about cars	0.48	2.80 (1.15)	Mass-media channels (0.51; 2.42)
13	Television programs about cars	0.47	2.33 (.99)	
14	Radio and television commercials	0.56	2.58 (1.16)	World Wide Web (0.59; 2.67)
15	Internet websites of various car brands and manufacturers	0.68	3.11 (1.24)	
16	Internet forums for consumers of cars	0.62	3.01 (1.24)	
17	Search engines, such as Google and Yahoo	0.47	2.55 (1.22)	
18	Garage owners	0.52	3.13 (1.10)	Retailer search (0.53; 2.96)
19	Car salesmen, dealers, or lease companies	0.55	2.82 (1.16)	

*Table 5.1:* The operationalization of the constructs and the measurement model. Completely standardized estimators, mean values of indicators, average explained variances, and mean values of latent constructs are reported. All estimators were significant at the 0.001 level. \*: Items are reverse-scored, i.e. mean values after reversing the scores are presented.

		Mean	Standard deviation
Telephoning	Average hours per week spent on the channel	3.46	3.97
Friends and family		9.73	9.96
Email and chat		6.61	4.58
TV		11.81	7.10
Radio		8.37	10.36
Newspapers and magazines		5.05	4.22
Car magazines		0.51	1.49
Surfing the internet		5.42	5.78
Shopping		2.63	2.82
Age	2007-Birthyear	46.18	15.38
Sex	1 = male, 2 = female	1 = 897 2 = 491	
Education level	7-point scale (1 to 7) ranging from illiteracy to a university degree, according to the Dutch education system	4.33	1.69
Income	7-point scale (1 to 7), indicating the net monthly household income, each point indicates a net increase of € 1000.	3.72	1.58
Inhabitants	5-point scale measuring the number of inhabitants in the place of residence	2.71	1.10

*Table 5.2: Operationalization of the control variables*

## Analysis

A structural equation model was fitted using the maximum-likelihood estimation procedure available in the software LISREL 8.80 (Jöreskog and Sörbom 2006) using. First, two confirmatory factor analyses were conducted to establish the measurement model for involvement and for the use of search channels. The measurement model for search channels contained two constructs with two indicators each (see Table 5.1). Because this limited number of indicators leads to under-identification of parts of the measurement model, equality constraints were enforced.

Both measurement models and the single-indicator control variables were combined into a single model to test our hypotheses. In the model, we allowed for covariance among search-channel variables. Furthermore, error covariances among indicators were allowed if the modification indicated that this would dramatically improve the model fit, no covariances between the indicators of the dependent and independent variables were required.

To test our hypotheses, we estimated the slopes of the latent variable equations relating involvement to the use of each search channel. To investigate the use of channels, we are also interested in the intercepts of the latent variable equations. The intercepts indicate the use of the various channels when the involvement variable has the value zero. Normally, LISREL uses mean-centered variables. As a result, the measurement equations have no intercept. Furthermore, when estimating a latent variable, LISREL automatically gives this variable a mean value of zero. Intercepts were specified for latent variables in the measurement models by using the mean values of the indicators. This was accomplished by substituting the mean values that LISREL provides by default for the indicators as a result of polychoric correlations with the actual calculated mean values of the original items. Per latent construct, equality constraints were enforced on the intercepts of the measurement equations. As a result, the intercepts for all indicators per latent variable became equal to each other. The intercepts of the measurement model are an estimator for the mean values of latent variables. These mean values in turn are required to estimate an intercept for the latent variable equations.

To estimate the intercepts for the latent variable equations, we used the Alpha-matrix in the LISREL program<sup>19</sup>. Estimation of the intercepts in the model does not change the size of the estimators nor the p-values. It does, however, influence the amount of variance explained for each equation and also the overall model-performance indicators, because additional parameters are estimated. Therefore, we report these values for both versions of the model: either including or not including intercepts. Reporting the values for a model without intercepts allows for a better comparison with models from other studies and therefore enables a better interpretation of the results.

Model-performance indicators are the Goodness-of-Fit Index (GFI), Root-Mean-Square Error of Approximation (RMSEA) and Normed-Fit Index (NFI), and model Chi-square with degrees of freedom. For the model relating involvement to use of search channels, the discriminant validity was assessed using the method of Fornell and Larcker (1981). The discriminant validity test requires that the average amount of variance explained by each of the measurement constructs be larger than the variance explained by the latent constructs in the structural model.

We present the unstandardized estimators for both direct and total effects. Total effects capture both the direct and the indirect effects that independent variables have on dependent variables; in our case, the indirect effects include the effects that the control variables have on the use of search channels through their effects on involvement. Presenting both the

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19 This was achieved by fixing the values in the Alpha-matrix to the mean values of the latent variables (in case of independent variables, the negative of the mean values); the program was able to estimate the intercepts for the latent-variable equations. In this manner, we were able to estimate a model that provides both estimators and intercepts for latent-variable equations.

direct and total effects thus provides information on how the involvement and the control variables are related to each other, which gives a better understanding of the results<sup>20</sup>.

## Results

Tables 5.3 and 5.4 report the estimated direct and total effects for the latent variable equations of our model: the columns represent dependent variables, whereas the rows correspond to the independent variables. In each table, we show the unstandardized effects and the intercept, which is an indicator representing the relative use of the channel when involvement is zero. The GFI of the version without an intercept is 0.93, the RMSEA is 0.054, and the NFI is 0.94; this indicates that the model has an excellent fit. The model Chi-square is 1602.72, with 317 degrees of freedom. For all paths, the conditions for discriminant validity were met. The version of the model that contains intercepts has a GFI of 0.93, an NFI of 0.76, and an RMSEA of 0.75. The model Chi-square is 2907.32, with 330 degrees of freedom. This is still an acceptable fit, although these indicators are difficult to compare with the normal model-performance indicators.

The first column of results in Table 5.3 shows the positive relationships between involvement and experience for the activities of watching TV, hours of shopping, reading car magazines, and telephoning. There are negative relations between involvement and experience regarding surfing the Internet, reading newspapers, age, education level, and the number of inhabitants. Furthermore (hardly surprising), men are more involved with cars than women. In total, the control variables explain a large part of the involvement variable.

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20 The questionnaire measured the search effort before purchasing a new car. A potential problem in modeling the hypothesized relationships could be a confounding effect by the number of years from the time the consumer last purchased a car. People whose last purchase is more recent could use different search channels and have different levels of involvement than consumers whose last car purchase is further back in the past. To control for this ambiguity, a model was fitted with the year of purchase interacting with involvement. The results showed that there were no significant interaction effects and only one significant direct effect by year of purchase that only explained less than 1% of the variance. Therefore, the time of purchase has no influence, and we do not include it in the final model.

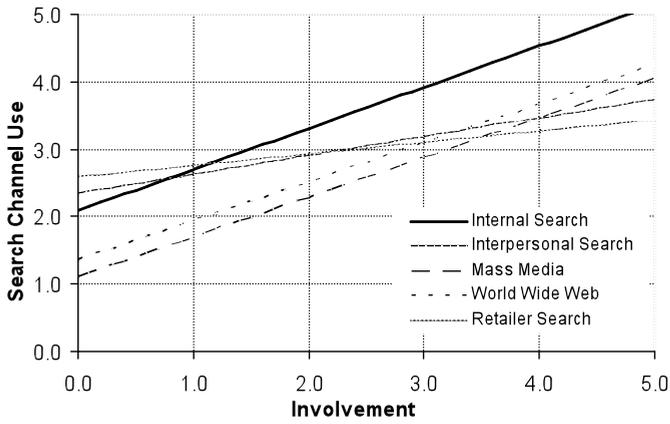


Figure 1a

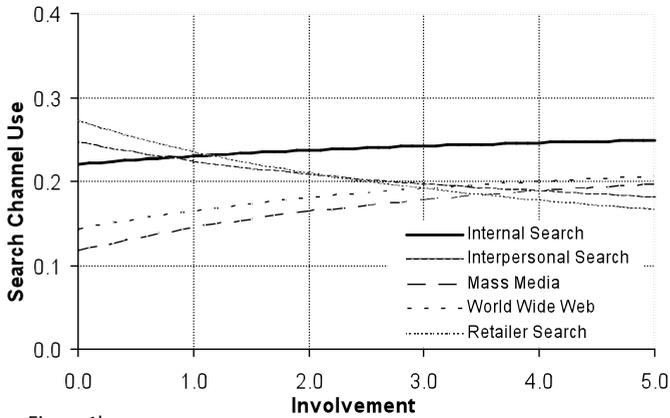


Figure 1b

Figure 5.1: Estimated relationships between involvement and the use of various search channels. Figure 1a shows the absolute relationships; figure 1b shows the channel use as a proportion of the total amount of search.

	Involvement	Internal search	Interpersonal search	Mass media	WWW	Retailer search
Intercept		2.09	2.35	1.11	1.36	2.59
Involvement		0.61***	0.28***	0.59***	0.58***	0.17***
TV	0.02***	-0.01	0.00	0.01*	0.00	0.00
Radio	0.00	-0.01*	0.00	0.00	0.00	0.00
Surfing the Internet	-0.02***	0.00	0.00	0.02**	0.05***	0.00
Email	0.00	-0.01	0.00	-0.02**	0.00	0.00
Shopping	0.04***	-0.01	-0.01	0.01	-0.02	0.02
Newspapers and magazines	-0.02*	0.01	0.01	0.02**	-0.02	0.01
Car magazines	0.14***	-0.02	-0.01	0.01	-0.11***	-0.03
Telephoning	0.00**	0.02**	0.02**	0.00	-0.01	0.01
Family and friends	0.00	0.01**	0.00	0.00	0.00	0.00
Age	-0.02***	0.02***	-0.01***	0.00	-0.02***	0.00
Sex	-0.74***	-0.19***	0.28***	0.19***	0.25***	0.24***
Education level	-0.10***	0.09***	0.08***	0.04*	0.17***	0.00
Income	0.02	-0.01	-0.05**	-0.01	0.09**	-0.01
Inhabitants	-0.05*	-0.05*	-0.08*	0.02	-0.02	-0.02
With intercepts R <sup>2</sup>	0.87	0.62	0.38	0.67	0.47	0.08
R <sup>2</sup>	0.43	0.49	0.27	0.51	0.32	0.07

Table 5.3: Unstandardized direct effects

\*:  $p < 0.05$ ; \*\*:  $p < 0.01$ ; \*\*\*:  $p < 0.001$ .

	Internal search	Interpersonal search	Mass media	WWW	Retailer search
Intercept	2.09	2.35	1.11	1.36	2.59
TV	0.00	0.00	0.02***	0.01	0.00
Radio	-0.01*	0.00	0.00	0.00	0.00
Surfing the Internet	-0.01	0.00	0.00	0.04***	0.00
Email	-0.01	0.00	-0.02*	0.00	0.00
Shopping	0.01	0.00	0.03**	0.00	0.02
Newspapers and magazines	0.00	0.01	0.01	-0.03*	0.01
Car magazines	0.06*	0.03*	0.09***	-0.03	-0.01
Telephoning	0.04***	0.02***	0.02*	0.00	0.02*
Family and Friends	0.01**	0.00***	0.00	0.00	0.01
Age	0.00	-0.01**	-0.01***	-0.03***	0.00
Sex	-0.63***	0.07**	-0.24***	-0.18***	0.11***
Education level	0.03	0.05*	-0.02	0.11***	-0.02
Income	0.00	-0.04*	0.00	0.10**	-0.01
Inhabitants	-0.11**	0.00	-0.01	-0.05	-0.03
With intercepts R <sup>2</sup>	0.47	0.28	0.42	0.37	0.05
R <sup>2</sup>	0.29	0.15	0.15	0.19	0.04

Table 5.4: Unstandardized total effects

\*:  $p < 0.05$ ; \*\*:  $p < 0.01$ ; \*\*\*:  $p < 0.001$ .

## Involvement and search-channel use

Table 5.3 shows that involvement has a significant positive relation with the use of search channels. There are, however, significant differences in the size of coefficients and in the amount of variance explained. In particular, there is no significant difference between the predictors for internal search, mass-media channels, and the use of WWW, whereas interpersonal channels and retailers have significantly lower slopes for the estimated relation. The positive estimates imply that the total search effort increases as involvement increases. A graphical representation of the relationships between involvement and use of search channels is shown in Figure 1. Because the total search effort increases with involvement, the figure shows two graphs. Figure 1a represents the relationships in absolute terms and relates directly to the testing of our hypotheses. Figure 5.1b represents the relationships relative to the total amount of search, which is the sum of the use of all search channels. This figure shows the change in the proportion of each search channel with varying levels of involvement.

Figure 5.1a reveals that consumers rely on retailers and interpersonal channels in purchasing a car, but the use of these channels is not strongly related to their involvement.

There is instead a strong relationship between involvement and use of the WWW and mass-media channels. Consumers with low involvement hardly rely on these channels, whereas those with high involvement use them more frequently than they use retailers and interpersonal channels. Finally, internal search is also strongly related to involvement, but with a much higher intercept. As soon as involvement becomes larger than 1.14 (on a five-point scale), consumers make more use of internal search than using retailers or any other channel. The increase in the total search effort with involvement is thus largely a result of an increase in use of internal search, mass media, and the WWW. These results provide support for the hypotheses 1, 2, 3, and 4. There is also a weak but significantly positive relationship between involvement and retailer search. However, the amount of explained variance is very low; therefore hypothesis 5 is only weakly supported. The use of retailers has the highest intercept, which indicates that less involved consumers mostly rely on retailers when buying a car. This supports the claim by Sambandam and Lord (1995) that retailer visits are a separate and necessary stage in the car-purchasing process.

Relative to the total amount of search (figure 5.1b), it can be seen that interpersonal and retailer searches are of particular importance to less-involved individuals, whereas for highly involved individuals, the share for each external search channel is approximately the same. This result means that although the total amount of search increases with involvement, the relative amount of search per channel also changes with varying levels of involvement. Less involved consumers rely more on channels that are generally accessible for everyone, and much less on the channels that require higher efforts for their use as information sources (mass media and the WWW).

## **General experience with channels**

The estimates of the total effects table show that internal search is negatively related to listening to the radio and positively related to reading car magazines, telephoning, and spending time with family and friends. Similar results are found for direct effects, except for the relationship with reading of car magazines, which is explained by involvement.

In terms of total effects, experience with two interpersonal communication media (telephoning and spending time with family and friends) and reading car magazines are positively related to the use of interpersonal search channels. Direct effects show that involvement explains the effects of reading car magazines and spending time with friends and family. However, the effects of friends and family are very small. This indicates that involvement has a limited explanatory influence on the relationship between the experience with using these two interpersonal channels and search channels in the car-purchasing process.

In the total effects model, mass-media search is positively related to the experience of watching TV, shopping, reading car magazines, and telephoning, and there is a negative relationship with emailing and chatting. In the direct effects model, the effects of shopping, reading car magazines and telephoning are explained by involvement. Due to

their negative relationship with involvement, the experience with surfing the Internet and reading newspapers and magazines becomes significant. An interesting finding is the strong positive relationship between the use of mass-media search channels and time spent on surfing the WWW in the total effects model; this is evidence that mass-media search and WWW search are somehow related to each other.

In the total effects model, there is a strong positive relationship between experience with surfing the WWW and using the WWW as a search channel. Also, a negative effect of newspapers and magazines is found. The effect of the WWW remains after controlling for involvement in the direct effects model. Furthermore, an additional negative relationship between car magazines and the WWW is apparent. The negative effect of car magazines is an indication that people surf the WWW as a substitute for car magazines. Finally, neither in the total effects model nor in the direct effects model predicting retailer search do we find any significant effects of channel experience.<sup>21</sup> This result is in line with the previously cited argument by Sambandam and Lord (1995).

## Demographics

The results in Table 5.4 show that age has no effect on internal search but has a negative effect on the use of all external search channels, except the retailers. This supports previous findings that external search decreases with age (Kiel and Layton 1981). When looking at the direct effects, however, we see that a positive relationship exists between age and internal search. This implies that, when controlling for involvement, older people engage more in internal search. This is possibly due to the fact that older people are likely to have more experience than younger people and are therefore better able to conduct an effective internal search. The negative relationships between age and external search channels observed in the total effects model weaken or completely disappear in the direct effects model. Involvement thus explains a large part of the relationship between age and external search. If the experience of older people allows them to conduct a more effective internal search, then this would also explain why they engage less in external search. An efficient successful internal search decreases the need for an external search.

In the total effects model, it can be detected that women make more use of interpersonal channels and retailers, whereas men rely more on mass media and the Internet. The direct effects model shows that these differences are in fact explained by involvement. When controlling for involvement, men make significantly greater use of internal search, whereas women rely more on external search channels. This finding might be due to the fact that men and women have different learning styles (see for instance: Severiens and Tendam 1994; Philbin, Meier et al. 1995)

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21 Moreover, a model including experience with the search channels but no socio-demographic variables did not give any significant results for retailer search.

In the total effects model, education level has a small positive relation with the use of interpersonal channels and the WWW, whereas there is a negative relationship with the use of mass-media channels. In the model controlling for involvement, a positive relationship appears on internal search. Education level can be viewed as a measure of general knowledge (not related to a specific product domain). It is possible that when searching, consumers rely on their domain-specific knowledge, resulting from their involvement and their general knowledge base. In the direct effects model, a positive effect of education level and use of all external search channels, except retailers, is found. When correcting for involvement, the highly educated thus conduct more external search. This result for interpersonal channels and mass media is in line with the findings of Klein and Layton (1981); the results of the WWW are in accordance with those of Klein and Ford (2003) and Ratchford et al. (2007).

The effects of income are relatively small in the total effects model. There is a negative relationship with the use of interpersonal channels and a positive relationship with Internet use. However, the difference in estimators between the total effects and the direct effects models is very small. There are no significant indirect effects of income on search-channel use (result not shown here). Because this effect is minimal, it is difficult to say whether the results is the outcome of the large sample size or the method of measurement, or whether it has actual implications. A possible explanation is that higher-income respondents work more hours and have less time to use interpersonal channels. Another reason can be that consumers with higher incomes are more likely to drive leased vehicles, which makes the use of car more work-related. This can reduce the need to consult interpersonal channels. The positive effect of income on the WWW use has previously been reported by Ratchford et al. (2007).

Finally, there is a small negative effect of the number of inhabitants in the place of residence on internal search, and there is no significant indirect effect. Again, this effect is relatively small and thus can be caused by the large sample size.

## Concluding remarks

This paper aimed to relate involvement to the use of various search channels in the car-purchasing process. By considering the dimension of information sources, we have been able to provide a more detailed account of the relation between involvement and consumer search. In developing our research hypotheses, we combined arguments from both economic and motivational perspectives in an original theoretical framework. The theoretical hypotheses were tested in a large sample of Dutch consumers for the domain of automobiles.

The results of this study offer more detailed insights on how information-search channels are used in combination with each other and in relation to involvement. This adds to the insights provided by studies that investigated (i) involvement and external search without considering separate sources (e.g. Punj and Staelin 1983; Schmidt and Spreng 1996; Guo

2001) and (ii) the use of a single source only (e.g. Gilly, Graham et al. 1998; Peterson and Merino 2003).

Our empirical results indicate, first of all, that the positive relation between involvement and search is strongest for mass-media and WWW, whereas the use of interpersonal channels and retailers is only mildly related to involvement. An interesting finding here is that the relationship between involvement and WWW search hardly differs from the relationship between involvement and mass-media search. In fact, we also find a strong positive correlation between the use of mass-media channels and WWW. Although these relationships look similar, the underlying processes that explain them may differ. As discussed earlier, the use of mass-media search channels depends on how easily the demanded content is made available. Instead, being able to use the WWW depends on the ability to make sense of the large amount of information it contains. We found similarities in terms of the demographics of heavy users of both channels; they are both most appreciated by a specific type of consumer (young men). This indicates that although the manner of providing the information by the two channels may differ, the nature of information provided and the corresponding use of both channels are remarkably similar.

Second, in terms of relative use, low-involved consumers rely mostly on retailers and interpersonal channels, whereas high-involved consumers use all channels to almost the same extent.

Third, next to involvement, control variables such as general experience with channels and socio-demographics also influence the use of search channels. In spite of the fact that such control variables account for some variance, some models (especially the model predicting retailer search) still have a large part of the variance left unexplained. This could partly be attributed to situational variations (Wendel and Dellaert 2005) or additional motives, such as instrumental or symbolic values attached to the car (see for instance Steg, Vlek et al. 2001). Future research could aim at improving the predicting power of models for channel use by expanding the set of explanatory variables included.

Finally, we note that, in line with other studies, the choice of consumers among different search channels depends on the product category being studied. In this study, the product category under investigation was cars, and our conclusions are thus limited to this product category. Still, the research hypotheses proposed are worth being tested with similar methods in other domains to establish how general they are. Further research could test the relation of involvement with search-channel use for other product domains.

We wish to conclude by discussing the managerial implications of our findings. Both the absolute and the relative use of search channels provide interesting insights for marketers to develop targeted strategies based on involvement.

The results indicate that low-involved consumers generally search less in absolute terms. In the search process, they mostly rely on retailers and interpersonal channels. Instead, highly involved consumers spread their search efforts more across the channels and can be effectively targeted through mass media and the Internet.

Models that incorporate demographic variables offer marketing managers practical tools for segmented-marketing strategies. By relating demographic variables to involvement, this study provides insights into whether the content of the message directed to a

specific type of consumer should be basic or more advanced. It turned out that young, less-educated males are most involved with cars. The two channels that are easy to use for marketing managers, namely mass media and the WWW, are also preferred by the more involved consumers. The user profile of these channels also fits with the profile of the highly involved consumers in the domain of cars (young males). High-income and highly educated consumers also have a clear preference for the WWW as an information channel. This provides opportunities to communicate more about expensive car models through the Web. Compared to the other search channels, interpersonal channels and retailers are used more by younger women in the car-purchasing process.

Similar to the use of retailers, the use of interpersonal search channels is relatively high and not very strongly related to involvement. For marketing managers, interpersonal channels are the most difficult to use directly among the external search channels discussed here. When using interpersonal channels, one has to rely on third-party information brokers to get the message through to the broader audience. In spite of this difficulty, it can still be worthwhile for marketers to use interpersonal channels because these channels are used relatively often by less involved consumers.

## 6 Consumer Car Preferences and Information Search Channels<sup>22</sup>

### Abstract

In this paper, we measure the relations between stated and revealed car preferences and the use of information sources in the car purchasing process, based on a survey of households in the Netherlands. The analysis showed that attitudinal and behavioral constructs are found for 'environmental', 'performance', and 'convenience' preferences, but that there is a 'gap' between attitude and behavior. The results show that people with a positive environmental attitude who also show environmentally friendly behavior have more involvement with cars than people who do not translate their environmental attitude into the corresponding behavior. This leads to the idea that not only environmental knowledge but also involvement with cars is a prerequisite for buying an environmentally friendly car.

### Introduction

Eight out of ten citizens in the European Union share the opinion that the type of car and the way people use their cars have important impacts on the environment in the respondent's area (European Commission 2007). Although 75% of the Europeans say that they are ready to buy environmentally friendly products, even if these are more expensive, only 17% are likely to take actions that are directly related to their lifestyles and consumption habits, such as using their cars less and purchasing green products (European Commission 2008).

These figures support the idea that there is a high awareness about negative environmental impacts of automobility, but this does not translate into changes in car use and purchasing behavior. Studies have been conducted in which the relation between attitudes and environmentally friendly behavior is investigated and all conclude that although attitudes and the corresponding behaviors are related, the explanatory value of attitudes on behavior is limited. Furthermore, it has been shown that the assumption that if people know more about the environmental implications of their behavior, they will act more pro-environmentally, is untenable. On the other hand, it is acknowledged that information provision is a prerequisite for changing environmental behavior.

Environmental innovation in mobility requires the development of cleaner fuels and propulsion techniques on the one hand. On the other hand, the greening of consumption,

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22 This chapter is published as: Van Rijnsoever, F.J., J. Farla and M.J. Dijst (2009). "Consumer Car Preferences and Information Search Channels." *Transportation Research Part D-Transport and Environment* 14: 334-342.

which includes changes in mobility behavior and also the uptake of environmentally benign innovations, is of paramount importance. In relation to changing behavior, different audiences behave differently and require targeted and/or tailored interventions. A question from the policy domain is thus how to effectively address different target groups. One of the opportunities for policy makers and marketers to effectively convey information to specific groups of car drivers is at the point in time when it can matter most: the moment when people buy a car.

We empirically explored the attitudes that consumers have towards car attributes in the purchase process and what behaviors these consumers displayed when buying their current cars. Next, we explored whether consumers can be clustered into distinguishable groups on the basis of these attitudes and behaviors. Finally, the consumers' attitudes and behaviors towards car purchasing are combined with a model for pre-purchase information search.

## Theory

According to Ajzen (2005) an attitude is defined as "a disposition to respond favourably or unfavourably to an object, person, institution or event. [...] The main characteristic of attitude is its evaluative nature." Attitude theory (Eagly and Chaiken 1993; Ajzen 2005) typically relates attitude to behavior through an intermediary intention construct. Before purchasing a new car, a consumer forms an attitude towards the possibility of owning a car. This attitude can be translated into an intention to buy a specific car, and finally the consumer can act on his intention and take steps to purchase a car. In order to preserve theoretical parsimony in this study we only measure aggregated attitudinal and behavioral constructs, although we recognize the importance of intention as an explanatory construct. A consumer will have attitudes towards all the attributes of a new car. We are mainly concerned with consumers' attitudes towards environmentally friendly aspects of a car. It is well-known that not all attitudes are translated into behavior; there is an attitude-behavior gap. Such a gap is present with regard to environmental concerns (Owens 2000; Bartiaux 2008). Anable et al. (2006) concluded that many barriers obstruct the translation of awareness into travel behavior. These barriers apply at the personal and at the collective level and consist of both subjective and objective factors. At the individual level, important subjective factors are values, norms, perceived behavioral control, instrumental and affective attitudes, identity, and status. The objective individual factors identified by Anable et al. are knowledge/awareness of consequences, habits, and resource constraints. Collective factors include social dilemmas, group culture, and shared norms. Ajzen claims that the more specific the attitude is towards behavior, the smaller the gap becomes. For example, a favorable attitude to waste recycling has a higher correlation with recycling behavior than a favorable attitude towards the environment in general. To measure the attitude-behavior gap we include both the consumers stated and revealed preferences about cars in the purchasing process.

Prior to the actual purchasing of a new vehicle, consumers typically engage in an information search process. Two types of pre-purchase information search can be distinguished: internal search and external search (Blackwell, Miniard et al. 2001). An internal search is nothing more than a memory scan by the consumer for decision-relevant information.

An external search is the consulting of external information sources for decision-relevant information in the purchase process. A consumer can use various external search channels to gather information. Van Rijnsoever et al. (2009) measures the size of the car-related involvement in relation to information search in the car-purchasing process and identify four external information search channels: personal channels, mass media channels, the World Wide Web, and use of retailers. Personal channels refer to the relations of an actor with people from his or her social environment (e.g. friends, family, and colleagues). Mass media channels are the information sources that do not require direct local interaction with the actor; examples are radio, TV, or newspapers. The World Wide Web relates to all information that consumers retrieve from Web pages. Retailers are defined as people who advise consumers about cars as part of their profession.

An important determinant of information search is the consumer's involvement with the product category under investigation (Schmidt and Spreng 1996). Involvement is the perceived personal relevance of a product to the consumer in terms of needs, values, goals, and interests (Zaichkowsky 1985). It is strongly related to the prior knowledge and experiences the consumer has with the product category.

Relating attitudinal and behavior constructs to involvement and the use of information search channels leads to the conceptual model displayed in Figure 6.1. We expect that different types of attitudes and behaviors can be related to involvement and the use of search channels.

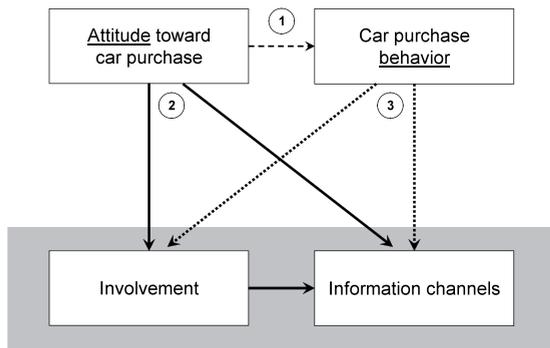


Figure 6.1: Schematic presentation of the concepts and measured relations in the model

## Research Design

### Data Collection and Measurement

In December 2007, during a period of three weeks, 1500 questionnaires were personally delivered to households throughout the Netherlands. To ensure a representative sample, the students who collected the data were given quotas for sex and age of the respondents that had to be filled. If there was a car in the household, then the person who was most responsible for the purchase process was asked to fill in the questionnaire. If the person

did not want to fill in the questionnaire, another household was included, until 1500 questionnaires were distributed and all quotas were filled. Respondents were told that they were participating in a survey on car use and the environment. If they filled in the questionnaire they could win a gift voucher worth €20. In this manner, 1392 households owning a car were surveyed. After checking with data from the Dutch Central Statistics Office, the sample turned out to be a good representation of households owning a car. Only the educational level of the respondents turned out to be too high compared to that of the population.

In the questionnaire attitudes were measured with regard to 19 attributes of new cars based on research for the UK Department for Transport (Department for Transport 2004) in which people were asked what factors are important in deciding which make and model of car to buy. From this listing, factors that are not car attributes were left out, such as 'dealership' and 'personal experience'. Participants could respond on a five-point scale that varied from 'very important' to 'very unimportant'. An exploratory principal component analysis revealed that a three-factor solution best fitted the data. This solution was modeled in a confirmatory factor analysis (Table 1). The three factors were:

- An environmental attitude: a favorable disposition towards environmentally friendly aspects of a car.
- A performance attitude: a favorable disposition towards elements of a car that enhance driving performance and the image of a car.
- A convenience attitude: a favorable disposition towards elements of a car that enhance the comfort and practicality of a car.

An issue with regard to the measurement of attitudes is the fact that attitudes are not constant; they change with the situational context in which the attitudes arise. The situations in which the questionnaires were filled in did not match the actual car-buying situation in, for example, a showroom. Nijhuis and Spaargaren (2006) argue that the situational context may be as important for the behavioral outcome as the consumer's attitudes and this is one of the reasons why behavioral constructs were also measured. The advantage of measuring behavior is that its measurement is more reliable, since it is factual information. The main disadvantage of measuring behavior in a survey is that it relates to behavior in the past. There is no real telling whether the attitudes that we measured were formed because of the past behavior or whether they were formed prior to the behavior. If the attitudes have evolved since the past behavior, this might explain a part of the attitude-behavior gap that we find. As indicators for displayed behavior, the respondents were asked to state a number of characteristics of the car they had most recently bought.<sup>23</sup> A principal component analysis gave a three-factor solution that corresponded with the attitudinal solution. This solution was modeled in a confirmatory model. The indicators and solutions are provided in Tables 6.1 and 6.2.

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<sup>23</sup> We only looked at the technical characteristics of the car and did not enquire about the respondent's driving behavior, which is also important for the environmental effects of car driving.

Indicator	Explained Variance	Latent Variable	Model Performance
How important do you find the following aspects when purchasing a new car? (on a one to five point scale)			
Greenhouse gas emissions	0.84		
Emission of polluting chemicals	0.91	Environment	
The energy label of the car	0.54	Attitude	
Environmentally friendly materials	0.65		
Appearance	0.63		
Brand	0.42		
The "feeling" you get from the car	0.37		
Engine size	0.35		GFI: 0.92
Image	0.61	Performance	NFI: 0.95
Speed	0.45	Attitude	RMSEA: 0.073
Color	0.44		$\chi^2 = 1209.54$
Extra accessories on the inside (such as aircon, heated seating, sunroof)	0.34		df = 143
Extra accessories on the outside (such as metallic paint, fog lights)	0.45		
Electronic products (such as a CD player, DVD player, navigation system)	0.33		
Type of car (size, arrangement of the car, etc.)	0.47		
Comfort	0.35		
Volume of the car (number of seats, volume of the trunk)	0.50	Convenience	
Length of the car	0.29	Attitude	
Reliability	0.32		

Table 6.1: The measurement models for the attitudinal constructs

Indicator	Explained Variance	Latent Variable	Model Performance
CO <sub>2</sub> reducing tires	0.32		
Silent tires	0.25	Environment Behavior	
Econometer/shift indicator	0.15		
Particle filter	0.14		
Leather seats	0.29		
Seat heating	0.34		
Top speed	0.22		
Fuel economy	0.03		
Cruise control	0.39		GFI: 0.95
Automatic gears	0.17	Performance Behavior	NFI: 0.93
Navigation system	0.30		RMSEA: 0.048
Four wheel drive	0.15		X <sup>2</sup> = 847.58
Hands-free mobile phone application	0.20		df = 205
Length of the car	0.06		
Winter tires	0.15		
Airbags	0.34		
Year of build	0.18		
Power steering	0.31		
Anti-lock breaking system (ABS)	0.37	Convenience Behavior	
Air conditioning	0.41		
Price	0.27		
New/second-hand	0.18		

Table 6.2: The measurement models for the behavioral constructs

The involvement construct was measured with six items from the IPCA automobile involvement scale by Bloch (1981). This is a validated scale that measures involvement with automobiles. To measure the use of search channels, questions were asked about the use of various information channels in the process of purchasing a car. Respondents could respond on a five-point scale that varied from 'fully disagree' to 'fully agree' (Table 6.3).<sup>24</sup>

Indicator	Explained Variance	Latent Variable	Model Performance
I enjoy discussing cars with my friends	0.75	Involvement	GFI: 0.99 NFI: 0.99 RMSEA: 0.054 X <sup>2</sup> = 40.68 df = 8
I get bored when other people talk to me about cars*	0.29		
When I'm with a friend, we often end up talking about cars	0.65		
I regularly discuss cars with friends	0.71		
Cars are nothing more than appliances*	0.32		
I do not pay much attention to car advertisements in magazines or on TV*	0.42		
<i>When purchasing a car, I make use of the following information sources:</i>			
My own experience from the past	0.18	Internal Search	GFI: 0.93 NFI: 0.94 RMSEA: 0.075 X <sup>2</sup> = 783.11 df = 89
The results of a test drive**	0.33		
My own knowledge about cars	0.81	Personal Channels	
My close relatives	0.33		
My friends	0.62		
People from my direct environment, for example school or work	0.53		
Advertisements and magazines about cars	0.46	Mass media Channels	
I look at other cars in the street	0.28		
Television programs about cars	0.49		
Radio and television commercials	0.55	World Wide Web	
Internet websites of the various car brands and manufacturers	0.68		
Internet websites for consumers about cars	0.64		
Search engines like Google and Yahoo	0.45	Retailers	
Garage owners	0.12		
Retailers	0.36		
Car salesmen, dealers, or lease companies	0.41		
The results of a test drive**	0.33		

*Table 6.3:* The operationalization of the variables, explained variance of the indicators, and performance indicators of the measurement models. \* Items are reversed scored; means are after reversing the scores. \*\* This indicator is factorially complex: it was used in both internal search and use of retailers.

<sup>24</sup> Five-point scales were used rather than three-point scales because they give a larger variety of values of the composite scale. Seven-point scales might be perceived as too complex by respondents.

## Analysis

A two-step cluster analysis was initially conducted to identify groups of consumers based on the three attitudinal constructs. The same procedure was done to identify consumers based on their displayed behavior. The log-likelihood was used as a distance measure for the clusters. With the help of Schwarz's Bayesian information criterion (BIC), the best cluster solution was determined. The attitude cluster solution and the behavioral cluster solution were compared using a cross tabulation showing the extent to which the two types of clusters correspond, and can thus serve as a measure for the attitude-behavior gap at the population level.

The attitudinal and behavioral constructs were analyzed in relation to involvement and search channels. Pre-testing revealed that analyzing the constructs separately yielded superior results compared to using the cluster solution. In the cluster solution too much valuable information is lost that can help to explain channel use. Therefore the constructs were analyzed separately. Three models were built (see Figure 6.1 again). In the first model the attitudinal and behavioral constructs were related to measure the attitude-behavior gap. In the second model the attitudinal constructs were used to predict involvement and search channel use, this extends the work by Van Rijnsoever et al. (2009) (indicated by a gray background in Figure 6.1). In the third model the behavioral constructs were related to the Van Rijnsoever et al model. In the models we allowed for covariance among the information channel variables, the attitudinal constructs, and the behavioral constructs. Error-covariances among the indicators were also allowed if the modification indicated that this would improve the model fit. The goodness of fit index (GFI), the root mean square error of approximation (RMSEA), the normalized fit index (NFI) and the model chi-square with the degrees of freedom were used as model performance indicators.

## Results

### Cluster analysis

The two-step cluster analysis revealed that for the attitudinal constructs a four-cluster solution would be optimal. Table 6.4 displays the percentages of cases of each cluster and the cluster means and standard deviations. Since the constructs were standardized variables it is only possible to make claims relative to the average, which is by definition zero. In interpreting the results any number that does not differ significantly from zero ( $p > 0.05$ ) is considered 'average'; all values that have a mean of 0.5 above or below this are 'moderately deviating'; all values that have a mean of 0.5 to 1.0 above or below the average are 'high' or 'low deviations'; and all values that have a mean of more than 1.0 above or below the average are 'very high' or 'very low deviations'.

<b>Attitude Cluster</b>	<b>Percentage</b>	<b>Environmental Mean</b>	<b>Performance Mean</b>	<b>Convenience Mean</b>
1	15.3%	-0.42***	-1.28***	-1.34***
2	18.8%	-1.33***	0.29***	-0.07
3	46.0%	0.44***	-0.03	-0.05*
4	19.9%	0.57***	0.78***	1.23***

<b>Behavior Cluster</b>	<b>Percentage</b>	<b>Environmental Mean</b>	<b>Performance Mean</b>	<b>Convenience Mean</b>
A	24.4%	-0.24***	1.08***	0.76***
B	46.1%	-0.37***	-0.52***	0.06*
C	13.9%	2.11***	0.72***	0.58***
D	15.6%	-0.41***	-0.79***	-1.88***

*Table 6.4:* The cluster solutions for the attitudinal constructs and the behavioral constructs  
\* p < 0.05; \*\* p < 0.01; \*\*\* p < 0.001.

Attitudinal cluster 1 consists of respondents with moderately low environmental attitude scores, and very low scores for performance and convenience attitudes. Cluster 2 has very low environmental attitude and moderately high performance attitude scores. The convenience attitude score is average. Respondents in cluster 3 have a moderately high environmental attitude score and a moderately low convenience attitude score, although this is negligible. This is by far the largest cluster. Finally respondents in cluster 4 have high scores for environmental and performance attitudes and a very high score for convenience attitude. For this cluster solution, clusters 1 and 4 are rather uninformative. The respondents in these clusters either think that all three aspects are not important or that they are important. There is no strong discrimination between the three constructs. It is thus difficult to tell whether this difference is the result of response biases or real differences between the groups.

The same type of analysis was performed for the behavioral constructs. This also gives a four-cluster solution. The percentages, means, and standard deviations are displayed in Table 6.4. Behavioral cluster A contains respondents with a moderately low score for environmental behavior, but with very high performance behavior and high convenience behavior scores. Cluster B also shows moderately low environmental behavior and low performance behavior scores; the convenience behavior score is moderately high, but the difference from zero is negligible. This is by far the largest cluster. Respondents in cluster C score very high on environmental behavior and score high on performance and convenience behaviors; this is the smallest cluster. Finally cluster D scores moderately low on environmental behavior, low on performance behavior, and very low on convenience behavior. Again one could ask whether clusters C and D are different from one another, since they do not discriminate between the constructs themselves. However, since these are behavioral measures, the answers are less sensitive to response biases, and so in this case there are real differences between the clusters.

Finally, a cross tabulation that indicates the difference in attitudes and behaviors among the clusters is presented in Table 6.5 which shows how the respondents from the attitude clustering are distributed over the behavioral clusters. The rows represent the attitude clusters, the columns the behavioral clusters. The cells give the percentages of the sample that have specific combinations of cluster memberships.

		Behavioral Clusters				Total
		A	B	C	D	
Attitude Clusters	1	1.30%	8.93%	0.36%	4.76%	15.3%
	2	6.77%	7.13%	2.02%	2.88%	18.8%
	3	10.66%	22.69%	6.41%	6.20%	46.0%
	4	5.69%	7.35%	5.12%	1.73%	19.9%
	Total	24.4%	46.1%	13.9%	15.6%	100.0%

Table 6.5: The cross tabulation that links the attitudinal clusters to the behavioral clusters

Nearly 66% of the respondents have a positive attitude toward the environment (attitude clusters 3 and 4); but only 11.5% out of these have translated these attitudes into pro-environmental behaviors (members of attitude clusters 3 and 4 who are also in behavioral cluster C). This also means that 2.4% of the population who do not feel that environmental aspects are important, still have relatively environmentally friendly cars (cluster combinations 1C and 2C). Of the 38.7% of respondents who have a positive attitude toward performance (members of attitude clusters 2 and 4), approximately half show the corresponding behavior (members of attitude clusters 2 and 4 who are also in behavioral clusters A and C; 19.6% of the population). Further, 18.7% of the population possess a car that has more performance attributes than average even though they do not deem these attributes to be important. Finally, of the 19.9% of the population who have a positive attitude towards convenience (members of attitude cluster 4), almost all also have a car that scores above average with respect to convenience<sup>25</sup> (cluster combinations 4A, 4B, and 4C: 18.6% of the population). We can thus conclude that on a population level the average attitude–behavior gap is the largest for the environmental constructs and the smallest for convenience constructs.

## Structural equation modeling

We now turn to the models in which the different constructs are related to involvement and information search channels. First, we discuss the model that estimates the attitude–behavior gap in terms of explained variance (Table 6.6). The columns represent the independent variables and the rows the dependent variables. Each cell gives the completely standardized direct effect estimator allowing comparisons of the effect sizes.

<sup>25</sup> To verify these results a two-step cluster analysis was run with the attitude–behavior pairs of constructs. These gave similar results for each construct.

		Attitude			R <sup>2</sup>
		Environment	Performance	Convenience	
Behavior	Environment	0.21***	0.30***	0.16*	0.23
	Performance	-0.16***	0.44***	0.11**	0.26
	Convenience	0.01	0.20***	0.24***	0.14

*Table 6.6:* The attitude–behavior model.

\*  $p < 0.05$ ; \*\*  $p < 0.01$ ; \*\*\*  $p < 0.001$ .

GFI: 0.95; NFI: 0.94; RMSEA: 0.026; chi sq.: 1467.19; df: 763.

Model 1 measures the relationship between the three-attitudinal concepts and the three displayed behavioral concepts on an individual level. As seen from the diagnostic statistics, the model provides a good fit. When looking at the explained variance, there is quite a large attitude–behavior gap, although the result is somewhat different from the results from the cluster solution. As predicted by attitude theory, all corresponding attitude–behavior relationships are significantly positively related. A surprising result is that environmental behavior is predicted better by performance attitude than by environmental attitude, this indicates that there is some form of technology clustering (Van Rijnsoever and Castaldi 2009). This is the phenomenon that products are adopted in combination with each other. In this case well-performing cars also have more environmentally friendly attributes. The convenience attitude has the weakest relation to environmental behavior. There is a negative relationship between environmental attitudes and the performance of the car owned. A positive relationship is found between convenience attitude and performance behavior. Finally, there is minimal relationship between environmental attitude and convenience behavior; environmental attitude thus has no influence on the level of comfort of the adopted car.

Table 6.7 presents the direct effects of the model that relates the attitude constructs to involvement and the use of search channels, the model performance indicators show a reasonable fit. Table 6.8 presents the total effects of this model. The total effects model takes into account the indirect effects, from attitudes through involvement to search channel use. This provides insight into whether or not the relationships found are explained by involvement.

		Attitude				
		Environment	Performance	Convenience	Involvement	R <sup>2</sup>
Information Search Channels	Involvement	-0.21***	0.73***	-0.17***		0.48
	Internal search					
	Search Channels	-0.06	-0.05	0.28***	0.61***	0.46
	Personal channels	-0.01	-0.14*	0.02	0.38***	0.10
	Mass media	0.09**	0.12**	0.03	0.63***	0.51
	World Wide Web	0.07*	-0.06	0.12**	0.46***	0.20
	Retailers	0.03	0.03	0.10*	0.04	0.02

Table 6.7: Direct completely standardized effects of the attitude model.

\* p < 0.05; \*\* p < 0.01; \*\*\* p < 0.001.

GFI: 0.86; NFI: 0.93; RMSEA: 0.062; chi sq.: 4554.79; df: 734.

		Attitude				
		Environment	Performance	Convenience		R <sup>2</sup>
Information Search Channels	Involvement	-0.21***	0.73***	-0.17***		0.48
	Internal search					
	Search Channels	-0.19***	0.39***	0.18***		0.27
	Personal channels	-0.09**	0.14***	-0.04		0.02
	Mass media	-0.04	0.58***	-0.08 *		0.30
	World Wide Web	-0.03	0.28***	0.04		0.09
	Retailers	0.02	0.06	0.09*		0.02

Table 6.8: Total completely standardized effects of the attitudes model.

\* p < 0.05; \*\* p < 0.01; \*\*\* p < 0.001.

In the model, performance attitude is strongly positively related and environmental and convenience attitudes negatively related to involvement. People with high scores on environmental attitudes generally have less involvement with cars.

Table 6.8 shows that environmental attitudes are negatively related to internal search, while performance attitude is positively related to internal search. In the direct effects model (Table 6.7) it can be seen that both these effects are explained by involvement. Convenience attitude is also positively related to internal search in the total effects model. When correcting for involvement, this effect becomes stronger. In the total effects model, a positive environmental attitude is negatively related to the use of personal channels, while a positive performance attitude is positively related to personal channels. The explained variance is, however, very low.

The greatest effect of an attitudinal construct on the use of the search channels in Table 6.8 is the relationship between performance attitude and the use of mass media. Using mass media emerges as the most effective when addressing consumers with positive attitudes towards performance.

Another search channel that is strongly positively related to performance attitude is the Internet. Again this relationship is explained by involvement. Interesting in the direct effects model is that under the influence of involvement, environmental attitude and convenience attitude become significant. The implications of these findings will be discussed in the next section. Finally the use of retailers is only related to convenience attitude. However, this relationship is very small and not affected by involvement.

Behavior		Environment	Performance	Convenience	Involvement	R <sup>2</sup>
Information Search Channels	Involvement	-0.05	0.62***	-0.33***		0.16
	Internal search					
		0.08	0.15	0.00	0.56***	0.42
	Personal channels	-0.16*	0.26*	-0.23*	0.25***	0.13
	Mass media	-0.06	-0.01	0.16 *	0.69***	0.50
	World Wide Web	-0.04	0.08	-0.01	0.40***	0.18
	Retailers	-0.06	0.11	-0.03	0.04	0.01

Table 6.9: Direct completely standardized effects of the behavior model.

\* p < 0.05; \*\* p < 0.01; \*\*\* p < 0.001.

GFI: 0.95; NFI: 0.93; RMSEA: 0.022; chi sq.: 1451.90; df: 865.

Behavior		Environment	Performance	Convenience	R <sup>2</sup>
Information Search Channels	Involvement	-0.05	0.62***	-0.36***	0.16
	Internal Search	0.05	0.49***	-0.20	0.15
	Personal channels	-0.17*	0.41***	-0.32***	0.08
	Mass media	-0.09	0.42***	-0.09	0.10
	World Wide Web	-0.07	0.33***	-0.15	0.05
	Retailers	-0.06	0.13***	-0.04***	0.01

Table 6.10: Total completely standardized effects of the behavior model.

\* p < 0.05; \*\* p < 0.01; \*\*\* p < 0.001.

Table 6.9 presents the direct effects of the model that relates the behavioral constructs to search channel use, while Table 6.10 shows the total effects. Again the diagnostic statistics reveal a good fit. There is a positive relationship between performance behavior and

involvement and a negative relationship between convenience behavior and involvement. These relationships are the same as in the attitude model. In contrast to the attitude model, there is no negative relationship between environmental behavior and involvement.<sup>26</sup> This means that consumers who actually display environmentally friendly behavior have more involvement with cars than people who only have environmental friendly attitudes.

In the total effects model, there is a positive relationship between performance behavior and internal search that is entirely explained by involvement in the direct effects model. Personal channels are related positively to performance behavior and negatively to environmental and convenience behavior in the total effects model. People with higher scores on environmental and convenience behavior make less use of personal channels in the search process. The relationship with environmental behavior is similar to the one found in the attitude model.

The model also shows a positive relationship between performance behavior and the use of mass media that is explained by involvement in the direct effects model. Furthermore, a positive relationship between convenience behavior and mass media search appears. There is also a positive relationship between performance behavior and Internet-search that is again explained by involvement.

Finally there is a very small positive relationship between performance behavior and the use of retailers and a negative relationship between convenience behavior and use of retailers in the total effects model. With regard to the use of retailers, both the attitude and behavior models explain the concept very poorly.

## Conclusions

The results show that the size of the attitude–behavior gap varies per construct. It is possible that the differences are due to the clustering procedure, but the still widely held belief that environmental choices involve certain sacrifices financially or in comfort or performance may also explain part of the large gap between environmental attitude and behavior.

The results imply policy measures for two target groups that result from the clustering procedure: (1) consumers with unfavorable attitudes and behaviors towards the environment, (2) consumers with favorable attitudes but unfavorable behaviors towards the environment.

With regard to the first group: the attitude models reveal that there is no positive relationship between environmental attitude and a particular search channel. There is a strong relationship between the performance constructs and the use of mass media channels and the Web. Sending tailored information through these channels about new technical developments that improve environmental performance while maintaining car performance can help to promote positive attitudes toward such new developments.

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26 This is possibly because performance attitude is positively related to environmental behavior. Since performance attitude is also positively related to involvement, this could explain the relationship between involvement and environmental behavior. However, an additional analysis that controlled for this aspect revealed that this is not the case.

With regard to the second group: We find that people who translate their environmentally friendly attitude into environmentally friendly behavior are more involved and therefore do know more about cars. This indicates that in order to stimulate people to translate their attitudes into behavior, it is important to get the public both involved with car technology and informed about environmental problems.



## 7 Conclusion and Implications

In the introduction of this thesis it was claimed that innovation is recognized as an important factor for future economic growth. Many actors are involved in the development and successful diffusion of innovations, but the field of innovation studies is currently dominated by studies that attempt to understand the supply side of innovation. It was argued that in order to fully understand the innovation process it is crucial to also take into account the demand side of innovation. This thesis viewed the demand side from a consumer perspective. Consumers are important in the innovation process, because they use the innovative products when introduced to the market, and more indirectly, they eventually experience the consequences of many technological innovations.

As bounded rational agents, consumers face many uncertainties during the process of innovation adoption. The consumers who face most uncertainties are the ones that first adopt new products. These so-called 'innovators' are important for the innovation diffusion process. They take the risks for others by adopting early, they partly test the products' functionality, they contribute to further improvement of the product, they familiarize others with the product and they can contribute to the build-up of sufficient critical mass for the diffusion process to become self sustaining.

To reduce the uncertainties that are attached to innovation adoption, consumers engage in a search for information prior to adoption. When searching, consumers can consult multiple information sources. Since innovative individuals are the ones who first take the risk of innovating, it is crucial to understand how their information search patterns using various channels differ from other individuals.

Until now the link between innovativeness and the use of information sources was only poorly understood. To improve this understanding, this thesis added a series of papers that investigate the relationship between two different approximations of consumer innovativeness and the use of information sources in two product domains. Two phases of information search were identified, *internal* and *external search* (Blackwell, Miniard et al. 2001). An internal search is an internal memory scan by the consumer for decision-relevant knowledge that can be used in the purchase process. External search is defined as: "the degree of attention, perception and effort directed toward obtaining environmental information associated with consumption related objects, regardless of whether the consumption objects are related to a specific purchase under consideration (Schmidt and Spreng 1996)"

In this thesis two approximations for innovativeness were used. The first approximation of innovativeness, called actualized innovativeness, is defined as the time of adoption of an innovation compared to other potential adopters (Midgley and Dowling 1978; Rogers 2003). It is a behavioural measure of innovativeness. A second approximation is enduring involvement, which is: "independent of purchase situations and is motivated by the

degree to which the product relates to the self and/or the hedonic pleasure received from the product” (Richins and Bloch 1986,p. 280), and is an attitudinal measure. The two approximations of innovativeness were related to use of information search channels. This was done by developing the following research question:

*RQ: What is the relationship between innovativeness and the use of different information search channels by consumers in the domains of consumer electronics and automobiles?*

Next to the main research question, five sub-questions were identified, answering these sub-questions leads to the answer of the main research question:

*SQ1: To what extent can the domain of consumer electronics be considered as a single product domain?*

*SQ2: What is the relationship between the different approximations of innovativeness?*

*SQ3: What is the relationship between innovativeness and the use of different information search channels by consumers in the two product domains?*

*SQ4: What is the influence of other variables, such as socio demographics, experience with communication channels and consumer preferences, on innovativeness and search?*

*SQ5: How do the relationships between innovativeness and the use of information search channels by consumers differ between the two product domains?*

Using the datasets described in the introduction, five studies were conducted to address these questions. Each question is answered in the following sections. Afterwards the implications of the results of the thesis are discussed.

## Research questions

### **SQ1: To what extent can the domain of consumer electronics be considered as a single product domain?**

Chapters two and three dealt with this question. The consumer electronics category can be considered as a single product domain if a large number of the products that it contains are perceived to be related to each other and if these products are also owned in combination with each other. Chapter two investigated the relationship between perceived technology clusters and patterns in ownership for a group of 16 consumer electronic products. Perceived technology clusters indicate whether consumers perceive technologies to be related, it is thus a subjective self-reported measure for clustering. Four distinct perceived clusters based on functional linkages were found: a ‘television cluster’, a ‘computer cluster’,

a 'communication cluster' and a 'music cluster'. Further, the exact number of perceived linkages was determined by the number of products previously adopted.

Patterns in ownership of products stem from displayed consumer behaviour. It was found that widely diffused technologies are more likely to be owned in combination with each other. Consumers tend to acquire first a set of 'base' technologies such as a TV or computer, before adopting 'peripheral' technologies that are functionally dependent on these base technologies, examples are DVD-players or webcams.

From this study it can thus be concluded that although different technology clusters are perceived, base technologies are likely to be owned in combination with each other. Peripheral technologies are usually owned in combination with their corresponding base technologies, but are not strongly related in ownership themselves. Because the base technologies are strongly related in ownership, but the 'peripheral' technologies are distributed quite randomly in ownership across consumers, it can be concluded that actualized innovativeness can be viewed as a domain specific measure.

In chapter three we found that consumer trendiness as measure of enduring involvement had a high internal consistency. Further, it predicted actualized innovativeness better on the domain specific level than on the cluster specific level; this indicates that it is a valid scale for involvement that captures the consumer electronics as a single domain.

Based on chapters 2 and 3 it can be concluded that consumer electronics can be analysed as a single product domain, both in terms of actualized innovativeness and involvement.

### **SQ2: What is the relationship between the different approximations of innovativeness?**

Chapters three and four offer insights to provide an answer to this question. In chapter three, one measure of involvement and two different measures of actualized innovativeness were discussed. One measure of actualized innovativeness enquired about the number of products a respondent owned at the moment of surveying. The second measure enquired about the specific moment in time a consumer adopted a certain product. Involvement, captured by trendiness, was found to be a strong predictor of the first measure of actualized innovativeness. Further, involvement was also predictive for actualized innovativeness on the cluster specific level, and to a lesser extent, the product specific level. Chapter four examined the difference in relationships between actualized innovativeness, involvement and use of search channels. Both measures of innovativeness were found to be positively related to each other. Further, the lower the actualized innovativeness, the more people tend to overestimate their level of involvement, and the higher the actualized innovativeness, the more people tend to underestimate their level of involvement.

### **SQ3: What is the relationship between innovativeness and the use of different information search channels by consumers in the two product domains?**

Insights to answer the question are provided in chapters four, five and six. Chapter four examined the difference in relationships between the two measures of innovativeness and use of search channels in the domain of consumer electronics. It was found that both measures were positively related to internal search. These measures were related through an inverted U-shape to the use of interpersonal channels and the World Wide Web. The main difference between the two approximations was that actualized innovativeness was linearly related to mass media, while involvement was related through an inverted U-shape.

However, the turning point of this relationship was at a rather high value of involvement, which casts doubt about this non-linearity. The explanation for the difference between the two measures given in the chapter was the under- and overestimation of knowledge by the respondents. Additionally, this difference might also be partly explained by the existence of a gap between innovative attitude and behaviour.

In chapters five and six, involvement was related to the use of different information search channels in the automobile domain. No measure of actualized innovativeness was used, because the automobile domain consists of a single product and only car owners were surveyed. It was found that involvement was positively linearly related to all search channels. Involvement was most strongly related to internal search, mass media, and World Wide Web. Involvement was much more weakly related to interpersonal search and retailer search. It was concluded that low involved consumers mainly rely on interpersonal channels and retailers to find information, while high involved consumers rely on all channels to about the same extent.

#### **SQ4: What is the influence of other variables, such as socio demographics, experience with communication channels and consumer preferences, on innovativeness and search?**

Chapters three, five and six dealt with this question. In chapter three, socio-demographic variables were used to predict actualized innovativeness in the domain of consumer electronics. Age, being male and socio-economic level were positively related to domain-specific innovativeness. In chapter five socio-demographics were used to predict involvement in the automobile domain. Age and education level, and the amount of inhabitants, turn out to be negatively related to involvement, while males are more likely to be involved with cars. This shows that the socio-demographic profiles of innovators differ between the two product domains.

In chapter five variables capturing experience with communication channels were added as controls. Though these variables in combination with socio-demographic variables explain 43% of the variance of involvement and between 4% and 29% of the variance of search channel use, the strong effect of involvement on search was maintained. Independent of the control variable, involvement thus has its own effect on search channel use.

Finally in chapter six, consumer preferences were added to the automobile model. Both attitudinal and behavioural measures of preferences were used to predict involvement and search channel use. The three attitudinal preferences that were identified explain 48 % of involvement, most of this variance is due to preferences about high performance cars. Further, attitudinal preferences explained between 2% and 30 % of the search channel variables. The behavioural preferences explained only 16% of the involvement construct and between 1% and 15% of the variance of the search channel variables. From this study it can be concluded that much of the variance explained by preferences is also captured by involvement, notable are the effects from performance preferences. Consumers that claim to be highly involved in cars are thus mainly interested in car performance.

**SQ5: How do the relationships between innovativeness and the use of information search channels by consumers differ between the two product domains?**

When comparing the results of the two product domains, some notable similarities and differences are observed.

The first similarity is that in both product domains, all measures of innovativeness are positively related to internal search; also in both domains internal search is used more than other channels. Generally, people rely on their own experience to a great extent.

The second similarity is that high-innovative consumers tend to make more use of media with specialized content, such as mass media channels and the World Wide Web. This might be because their higher degree of knowledge and interest in the product allows them understand the content of these channels better than other consumers.

The first main difference between the two domains is that involvement explains search channel use better in the automobile domain than in the consumer electronics domain. A possible reason for this might be that automobiles are a single product domain, while the consumer electronics domain consists of multiple products. Although consumer electronics can be regarded as a valid product domain for analysis, it consists of multiple products making it by definition more heterogeneous than the automobile domain. This heterogeneity causes more random noise in the measures and therefore the explained variances are generally lower.

The second difference between the domains is in the shape of the relationships found. In the consumer electronics domain many inverted U-shaped relationships were found between the measures of innovativeness and search channel use. This finding is in line with earlier claims by Johnson and Russo (1984), who made similar observations about the relationship between familiarity and search. Further, in consumer electronics, innovative consumers search more specialized channels, such as the World Wide Web and mass media. This confirms earlier observations made by Katz and Lazarsfeld (1964) and Rogers (2003) in the innovation literature. From the field of marketing, explanatory mechanisms have been added to these observations.

The findings in the automobile domain are not in line with earlier empirical observations. In this high risk product category there is a positive linear relationship between innovativeness and total search effort instead of an inverted U-shape<sup>27</sup>. Further, highly innovative consumers balance their search effort much more among the channels than low innovative consumers. For high innovative consumers all channels are roughly equally important when searching. This means that the role of innovators in high risk product diffusion differs from conventional understandings in innovation adoption theory, which does not take into account the moderating role of risk.

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27 In the automobile models also the quadratic effects were tested, but this did not yield any significant result.

## Discussion

As stated in the introduction, the contribution of this thesis consists of two parts: first it contributes to theories about search, second it adds to a further understanding of the role of innovators in innovation diffusion and demand oriented innovation development processes. In this section both contributions are discussed. The first part is oriented at explaining why there is a relationship between innovativeness and search. This is done by discussing theoretical generalizations that are based on the overall results of the previous chapters. The second part aims at understanding the implications of the relationship between innovativeness and search for innovation diffusion and demand oriented innovation processes.

### Generalizations about the relationship between innovativeness and search

This sub-section aims, based on the theoretical concepts from the literature and on the results found in the two product domains, to discuss generalizations that explain the relationship between innovativeness and the use of information sources by consumers. The generalizations follow the model displayed in figure 7.1. This model is similar to the model in chapter 1, but some variables have been left out, which are discussed separately in the next subsection. The model does not take into account the difference between ongoing and goal directed search, because in none of the product domains both types of search were investigated at the same time. Investigating both types of search is problematic, because they are difficult to separate for respondents (Bloch, Sherrell et al. 1986), but it remains a challenge for future research.

It is acknowledged that the theoretical generalizations are derived from studies in only two product domains. Further, the results are based on cross-sectional survey data, which means that it was not possible to test for causal relationships. Therefore the findings in this thesis are indicative with regard to broader theoretical generalizations. Additional studies in multiple product domains, using research methods such as controlled experiments and longitudinal surveys are required to further formalize the theory.

First, the explanatory mechanisms are discussed, next the relationship between innovativeness and search effort is considered. Finally, the moderating influence of perceived risk is discussed. For each of these elements avenues for further research are indicated.

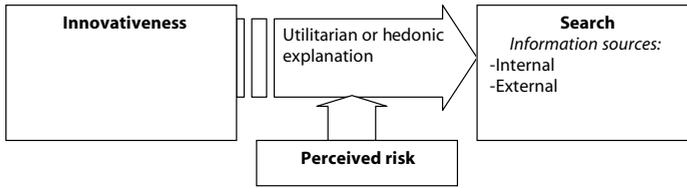


Figure 7.1: The conceptual model explaining search effort.

### Explanatory mechanisms

In order to generalize our findings to a theory that explains search channel use, we start from the assumptions made earlier in the thesis based on existing literature. These assumptions are now used to formulate a mechanism that explains the relationship between innovativeness and search.

Bounded rational agents (Simon 1955; Wilde 1980; Tversky and Kahneman 1986; Bettman, Luce et al. 1998) search for information to reduce perceived uncertainties about innovations (Blackwell, Miniard et al. 2001), and for leisure (Bloch, Sherrell et al. 1986; Babin, Darden et al. 1994; Sands, Oppewal et al. 2008). The explanation of the relationship between innovativeness and search is therefore comprised of a utilitarian component based on prior knowledge base, and a hedonic component based on motivational factors. The utilitarian explanation for search proposed in the thesis stemmed from the economics of information (EI) perspective (Stigler 1961), with additional insights based on absorptive capacity arguments (Cohen and Levinthal 1990). Agents search as long as the marginal gains are perceived to be larger than the costs of search, or until the problem at hand is sufficiently solved (Dowling and Staelin 1994; Knudsen and Levinthal 2007). In addition to the EI perspective: a larger knowledge base leads to a better ability to search and absorb information (Johnson and Russo 1984; Cohen and Levinthal 1990; Moorthy, Ratchford et al. 1997). Therefore, all expected relationships have in common an initial positive relationship between the prior knowledge base, (and therefore innovativeness) and search effort. It is acknowledged that the utilitarian view is not entirely complete, but it is proposed as a starting point to further understand search. The hedonic motivation (agents searching for fun or leisure) implies that agents might search longer than is strictly required from the utilitarian perspective and that they may use search channels that are not always the most efficient or reliable information providers.

Agents have multiple channels they can use to find information. Each search channel is assumed to have its own specific content and costs in terms of resources to retrieve information. For consumers these resources can be time, money, cognitive effort, reputation etc (Borgatti and Cross 2003). For other agents such as organizations, resources can be expressed in terms of tangible resources such as money, manpower, equipment or material, or intangible resources, such as reputation or tacit knowledge (Del Canto and Gonzalez 1999).

In the literature, much research has already been conducted to confirm these mechanisms (see Schmidt and Spreng 1996 for an overview). However, the exact role these mechanisms play in the relationship between innovativeness and search channel use is unclear. In

chapter 4 relationships were found that support a utilitarian explanation, while in chapter 5 hypotheses based on a hedonic explanation fitted the results better.

Future research should aim at not only testing the relationships between the concepts, but also the explanatory mechanisms. This can be done by adding mediating constructs to the models that take into account the absorptive capacity, utilitarian cost-benefit aspects and the hedonic factors explanatory mechanism. Mediating constructs could be perceived costs, accessibility of the information, potential uncertainties about the results, content of the channels, comprehensibility of the information and experienced leisure. The addition of these potentially mediating constructs will give more insights into under what conditions which mechanism plays a role.

### **Innovativeness and information sources**

Based on the explanatory mechanisms, relationships between innovativeness and search can be formulated. Agents are likely not to consult a single information source, but rather a set of sources. As mentioned above, each source has its own information content and costs attached to retrieve the information. These sources can be categorized as internal and external. In consumer literature it is claimed that to determine what is already known, an internal search precedes the external search (Punj and Staelin 1983), because internal search is more efficient than external search. The larger the existing knowledge base, the more likely it is that a solution to the problem is found internally, and the less need there is for an external search. In line with the results of chapter 4 and 5 we expect a positive relationship between innovativeness and internal search.

In case of external search, an agent with no prior knowledge base will first use the external source that demands the lowest amount of resources and that also provides knowledge that is novel to the agent, but that also can be comprehended given the limited *absorptive capacity*; we call this source “A”. Using source A is the most effective way to initially enlarge the knowledge base, therefore all resources are devoted to source A. As the absorptive capacity grows along with the knowledge base, the search gets more efficient and the search effort in source A initially increases. The search effort in source A continues to grow until either: (1) the problem is sufficiently solved, (2) or if the search becomes too costly or (3) when the absorptive capacity becomes large enough to comprehend other sources that contain additional knowledge, for example source “B”. In the latter case, the agent can divide the search effort over two sources.

For consumers dividing search effort across different channels could mean a combination of browsing through electronics shops, reading magazines about consumer electronics and perhaps checking the Internet. If the total search effort is limited, an increase in use of source B implies a decrease in use of source A. External information source use is thus related to innovativeness though a relationship that resembles an inverted U-shape. The precise turning point of the curve for each source will depend on the cost-benefit ratio of gaining additional information from a given source compared to the cost-benefit ratio of retrieving the information from another external information source.

The relationships described here were found in chapter 4 for the domain of consumer electronics. To confirm if these relationships are applicable to comparable product domains, other domains need to be investigated, such as groceries or small household appliances.

### **The moderating role of high risk**

Perceived risk for consumers is determined by expected (monetary) losses of purchasing, perceived benefits and personal perceptions about risk (Dowling and Staelin 1994). An increase in risk implies that there are more uncertainties with regard to the outcome of search process, which leads to an increase in search effort (both internal and external) to reduce these uncertainties (Taylor 1974; Dowling and Staelin 1994).

During low risk (goal-directed) search, the agent searches in the most efficient manner the set of external channels available until the problem is solved or the expected benefits of searching have become smaller than the costs. The additional resources invested into the search as a result of an increase in risk change this relationship. Agents can now search through multiple channels to decrease the level of risk. Consulting multiple channels is a method to increase the reliability of the information retrieved, and therefore an additional manner to reduce risk. Because of the higher risk, the relationship between innovativeness and use of search channels resemble a linear form instead of an inverted U-shape. The strength of the relationship for each channel depends on the perceived costs, benefits and hedonic motivations the consumer has. These effects are also described in chapter 5.

The moderating role of risk in the automobile domain was based on theoretical grounds. However, it remains unclear whether risk is the only important moderating factor that explains the differences between the domains, or if other factors also have a moderating effect. Future studies need to aim at gaining more insights on this topic by investigating more product domains that are characterized based on their measured degree of perceived risk. Further qualitative research with consumers could help to indentify more moderating factors.

## **Implications for the demand side of innovation**

Next to contributing to the literature on consumer search channel use, this thesis also adds to a further understanding of the role that information search plays in the diffusion of innovations and in demand driven innovation processes. In this section the implications for both are discussed. Further, avenues for future research and policy implications are given for policy makers and producers of innovations.

### **Innovativeness and search channel use in innovation diffusion**

First, the main mechanism indentified in a low risk domain is that innovative consumers get their information from outside a social system through specialized channels. Some of these innovative consumers can serve as opinion leaders to further inform the population about the product, thereby being used as an interpersonal source (Katz and Lazarsfeld 1964; Flynn, Goldsmith et al. 1996).

Instead, the balanced use of information search channels by innovators in high risk domains such as automobiles implies that producers cannot only use specialized content, but that they have to take into account the full set of channels that innovative consumers might consider to find information. Mass media and the World Wide Web are the easiest to use when promoting a product, but they account for only half the search effort by innovative consumers. Marketers have to consider strategies to target innovative consumers also using

personal channels. An example is to more actively promote membership of automobile clubs that are affiliated to the brands that are promoted. Making use of interactive channels based on interpersonal contacts not only enables producers to effectively bind consumers to their brands, but can also serve as a platform to improve existing products and develop new ones (see Lüthje 2004).

Second, it is well established in literature that innovativeness is domain specific (Goldsmith, Freiden et al. 1995), consumers that are innovative in one domain, are not necessarily innovative in another domain. Also our results indicate that different (socio-demographic) characteristics are associated with innovativeness in different product domains. There are some weak correlates between domain-specific innovativeness and innovativeness as a personality trait (see chapter 3). Marketers that wish to identify innovators in a certain domain can better take into account domain specific innovativeness and socio-demographic characteristics rather than innovativeness as a personality trait.

### **Preferences, innovators and demand oriented innovation processes**

The final set of variables discussed in this thesis are consumer preferences<sup>28</sup>. In markets where innovation is driven by consumer demand, preferences influence the direction of innovation processes (Von Hippel 2005; Windrum, Ciarli et al. 2009); following consumer preferences enhances the quality of the outcome of the innovation process, can be considered to be more “democratic”, and is likely to lead to more profitable innovations. However, there are some challenges related to demand oriented innovation processes. First of all, consumers often lack the knowledge to formulate their own preferences. When asked for their opinion, consumers usually ‘construct’ their preferences instantaneously, based on what they do know about the topic and situational aspects (Payne, Bettman et al. 1999). Second, consumers often want too much. For example: chapter 6 showed that consumers find it important that (1) their car is high performing, (2) is not too damaging to the environment, and (3) has a high convenience. These characteristics should all be present in a car that is, preferably, not too expensive. Since no car has all these features, consumers are forced to make a trade-off between these aspects (Windrum, Ciarli et al. 2009; Windrum, Ciarli et al. 2009). Each consumer makes his own individual choice, which leads to different segments of the market. Some of these different market segments provide opportunities for innovation, but only if they are of sufficient size.

Third, over time consumer preferences are dynamic, rather than static (Aversi, Dosi et al. 1999). Attributes of technologies that are considered to be important today, might well be considered to be obsolete in the near future. Producers of innovations need to take into account dynamics of preferences in order to develop profitable innovations. Though dynamic preferences offer opportunities for innovation, they also make the path of technological development more difficult to predict. Using communication strategies to target certain segments of the market can influence these preferences and thereby help steering the direction of technological development.

Finally, innovators as lead-users are the consumers who influence the innovation process even more than other users (Lüthje 2004; Von Hippel 2005). This thesis has shown that

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<sup>28</sup> Experience with communication channels only served as a control variable, no direct implications for the demand side of innovation are given here.

innovators make more use of specialized channels that are interactive (such as the World Wide Web). These channels can also be used by the innovators to provide feedback to the producer of the innovation, enabling them to further improve the innovation (see Franke and Piller 2004). Therefore, the preferences of this group can strongly influence the direction of technological development (Von Hippel 1986). Innovators do have the knowledge base to formulate their preferences in a fairly stable and coherent manner (Payne, Bettman et al. 1999), but these preferences are not necessarily representative for the preferences of the rest of the user-population (Van Rijnsoever, Faber et al. Forthcoming) or the demands of society as a whole. Chapter 6 for example showed that involved consumers have a stronger preference for performance and value environmental and convenience aspects less. If these preferences are used as a guide for technological development, then the outcome of the innovation process might be unsatisfactory for society as a whole. In other words: using innovator or lead-user preferences as a guide for technological development can also lead to less democratic outcomes of the innovation process.

Overall, it can be stated that although following consumer preferences when innovating certainly leads to opportunities for innovation, it does not necessarily lead to outcomes that are considered to be beneficial to society as a whole.

From this dilemma, multiple areas of further research emerge. First, more attention should be paid to the measurement of stated preferences (see Payne, Bettman et al. 1999). Explicit attention should be paid to the dynamics of preferences. For example: do public preferences converge towards a single opinion over time or do they become more diverse? Finally research should focus on how the entire changing set of preferences in different market segments (innovator vs. non innovators for instance) can best be taken into account in the development process of new innovations.

## Concluding remarks

The field of innovation studies has traditionally been dominated by studies that look at the supply side of innovation. However, in an increasingly demand oriented economy it is important to understand the role of consumers as end-users in the process of innovation development and diffusion. The present work has added to this understanding by looking at the relationship between consumer innovativeness and the use of search channels. Explicit attention was paid to how risk might influence the use of information search channels. Generalizations about search have been given and implications for demand oriented innovation development and diffusion processes were discussed.

The insights that result from the current thesis assist producers and policy makers in formulating strategies for communication about innovations that enhance diffusion and enable more demand oriented innovation development. As a result, a larger percentage of the sums that are annually invested in Europe on R&D projects might be transformed into successfully diffused innovations.

This work is concluded with three remarks.

First, in this thesis the only respondents were consumers and the arguments used mostly came from the marketing and innovation studies literature. This resulted in relatively

general mechanisms that might not only be applied to consumers, but also to other types of bounded rational actors who are confronted with the uncertainties entailed by the innovation process, such as innovating firms. Testing these mechanisms on other types of actors contributes to the generality of a theory that explains search, and also enables scholars from both strands of literature to learn from each other.

Second, the final implication of the previous section was that letting the preferences of innovative consumers be a guideline for innovation development, does not need to be beneficial for society as a whole, because the preferences of innovators do not necessarily represent societal demand. How to deal with this pessimistic issue is largely an ethical dilemma. However, history has shown that resistance to technical change is often temporarily. After a while, people often learn to live with new situations and sometimes even learn to appreciate them. Also, most of the innovations fitting only the preferences of innovators may be unsuccessful.

Finally the author would like to end with a historical note to put things into perspective. In this thesis consumers could choose between five types of search channels: internal search, interpersonal channels, mass media, the World Wide Web, and retailers. This is a division that has grown historically. For the longest part that the world has known some kind of economy, people mainly relied on internal search, interpersonal channels and retailers for information. With the invention of printing in the 15<sup>th</sup> century<sup>29</sup>, it became possible for Europeans to make use of codified mass media (Davies 1998). The use of mass media really took off in the 19<sup>th</sup> and especially the 20<sup>th</sup> century, when people became more literate. In 1991 a new source of information became available to the public, called the World Wide Web, which has revolutionized how we deal with information (Biswas 2004). In the past, the problem with searching was very often a shortage of information, nowadays, the problem increasingly becomes an overload of information. This requires a different manner for consumers to deal with information, and a different approach for marketers to provide information. Yet, in an era that has been labelled the information age, new developments can be expected. New information channels are likely to be added to the existing set of sources to be considered and the division between the old channels could be broken down. Also new products domains are introduced continuously, each with its own characteristics and its own set of innovators. These developments make research into consumer information search more relevant than ever, even though much research has already been done. With new technological developments, new information sources are likely to emerge. The general mechanisms provided in this thesis can aid in future research endeavours dealing with consumer information search.

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29 It is left undecided here who actually invented printing.

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# Summary

Innovation is recognized as an important factor for future economic growth. Many actors are involved in the development and successful diffusion of innovations, but the field of innovation studies is currently dominated by studies that attempt to understand the supply side of innovation. In order to fully understand the innovation process it is crucial to also take into account the demand side of innovation. This thesis views the demand side from a consumer perspective. Consumers are important in the innovation process, because they use the innovative products when introduced to the market, and more indirectly, they eventually experience the consequences of many technological innovations.

As bounded rational agents, consumers face many uncertainties during the process of innovation adoption. The consumers that face most uncertainties are the ones that first adopt new products. These so-called 'innovators' are important for the innovation diffusion process. They take the risks for others by adopting early, they partly test the products' functionality, they contribute to further improvement of the product, they familiarize others with the product and they can contribute to the build-up of sufficient critical mass for the diffusion process to become self sustaining.

To reduce the uncertainties that are attached to innovation adoption, consumers engage in a search for information prior to adoption. When searching, consumers can consult multiple information sources. Since innovative individuals are the ones that first take the risk of innovating, it is crucial to understand how their information search patterns using various channels differ from other individuals.

Until now the link between innovativeness and the use of information sources was only poorly understood. To improve this understanding, this thesis adds a series of papers that investigate the relationship between two different approximations of consumer innovativeness and the use of information sources in two product domains. Two phases of information search can be identified, *internal* and *external search*. An internal search is an internal memory scan by the consumer for decision-relevant knowledge that can be used in the purchase process. External search is defined as: "the degree of attention, perception and effort directed toward obtaining environmental information associated with consumption related objects, regardless of whether the consumption objects are related to a specific purchase under consideration (Schmidt and Spreng 1996)"

In this thesis two approximations for innovativeness are used. The first approximation of innovativeness, called actualized innovativeness, is defined as the time of adoption of an innovation compared to other potential adopters (Midgley and Dowling 1978; Rogers 2003). It is a behavioural measure of innovativeness. A second approximation is enduring involvement, which is: "independent of purchase situations and is motivated by the degree to which the product relates to the self and/or the hedonic pleasure received from the product" (Richins and Bloch 1986, p. 280), and is an attitudinal measure.

The two approximations of innovativeness were related to use of information search channels. The following research question is posed:

*RQ: What is the relationship between innovativeness and the use of different information search channels by consumers in the domains of consumer electronics and automobiles?*

In order to answer the main research question, five sub-questions are identified, each question is answered in the following section. Five studies (described in chapters two to six) were conducted to answer these sub-questions. This leads to the answer of the main research question. Afterwards the implications of the results of the thesis are discussed.

## **Answer to research questions**

### **SQ1: To what extent can the domain of consumer electronics be considered as a single product domain?**

Chapters two and three dealt with this question. The consumer electronics category can be considered as a single product domain if a large number of the products that it contains are perceived to be related to each other and if these products are also owned in combination with each other. Chapter two investigated the relationship between perceived technology clusters and patterns in ownership for a group of 16 consumer electronic products. Perceived technology clusters indicate whether consumers perceive technologies to be related, it is thus a subjective self-reported measure for clustering. Four distinct perceived clusters based on functional linkages were found: a 'television cluster', a 'computer cluster', a 'communication cluster' and a 'music cluster'. Further, the exact number of perceived linkages was determined by the number of products previously adopted.

Patterns in ownership of products stem from displayed consumer behaviour. It was found that widely diffused technologies are more likely to be owned in combination with each other. Consumers tend to acquire first a set of 'base' technologies such as a TV or computer, before adopting 'peripheral' technologies that are functionally dependent on these base technologies, examples are DVD-players or webcams.

From this study it can thus be concluded that although different technology clusters are perceived, base technologies are likely to be owned in combination with each other. Peripheral technologies are usually owned in combination with their corresponding base technologies, but are not strongly related in ownership themselves. Because the base technologies are strongly related in ownership, but the 'peripheral' technologies are distributed quite randomly in ownership across consumers, it can be concluded that actualized innovativeness can be viewed as a domain specific measure.

In chapter three we found that consumer trendiness as measure of enduring involvement had a high internal consistency. Further, it predicted actualized innovativeness better on the domain specific level than on the cluster specific level; this indicates that it is a valid scale for involvement that captures the consumer electronics as a single domain.

Based on chapters 2 and 3 it can be concluded that consumer electronics can be analysed as a single product domain, both in terms of actualized innovativeness and involvement.

**SQ2: What is the relationship between the different approximations of innovativeness?**

Chapters three and four offer insights to provide an answer to this question. In chapter three, one measure of involvement and two different measures of actualized innovativeness were discussed. One measure of actualized innovativeness enquired about the number of products a respondent owned at the moment of surveying. The second measure enquired about the specific moment in time a consumer adopted a certain product. Involvement, captured by trendiness, was found to be a strong predictor of the first measure of actualized innovativeness. Further, involvement was also predictive for actualized innovativeness on the cluster specific level, and to a lesser extent, the product specific level. Chapter four examined the difference in relationships between actualized innovativeness, involvement and use of search channels. Both measures of innovativeness were found to be positively related to each other. Further, the lower the actualized innovativeness, the more people tend to overestimate their level of involvement, and the higher the actualized innovativeness, the more people tend to underestimate their level of involvement.

**SQ3: What is the relationship between innovativeness and the use of different information search channels by consumers in the two product domains?**

Insights to answer the question are provided in chapters four, five and six. Chapter four examined the difference in relationships between the two measures of innovativeness and use of search channels in the domain of consumer electronics. It was found that both measures were positively related to internal search. These measures were related through an inverted U-shape to the use of interpersonal channels and the World Wide Web. The main difference between the two approximations was that actualized innovativeness was linearly related to mass media, while involvement was related through an inverted U-shape. However, the turning point of this relationship was at a rather high value of involvement, which casts doubt about this non-linearity. The explanation for the difference between the two measures given in the chapter was the under- and overestimation of knowledge by the respondents. Additionally, this difference might also be partly explained by the existence of a gap between innovative attitude and behaviour.

In chapters five and six, involvement was related to the use of different information search channels in the automobile domain. No measure of actualized innovativeness was used, because the automobile domain consists of a single product and only car owners were surveyed. It was found that involvement was positively linearly related to all search channels. Involvement was most strongly related to internal search, mass media, and World Wide Web. Involvement was much more weakly related to interpersonal search and retailer search. It was concluded that low involved consumers mainly rely on interpersonal channels and retailers to find information, while high involved consumers rely on all channels to about the same extent.

**SQ4: What is the influence of other variables, such as socio demographics, experience with communication channels and consumer preferences, on innovativeness and search?**

Chapters three, five and six dealt with this question. In chapter three, socio-demographic variables were used to predict actualized innovativeness in the domain of consumer electronics. Age, being male and socio-economic level were positively related to domain-specific innovativeness. In chapter five socio-demographics were used to predict involvement in the automobile domain. Age and education level, and the amount of inhabitants, turn out to be negatively related to involvement, while males are more likely to be involved with cars. This shows that the socio-demographic profiles of innovators differ between the two product domains.

In chapter five variables capturing experience with communication channels were added as controls. Though these variables in combination with socio-demographic variables explain 43% of the variance of involvement and between 4% and 29% of the variance of search channel use, the strong effect of involvement on search was maintained. Independent of the control variable, involvement thus has its own effect on search channel use.

Finally in chapter six, consumer preferences were added to the automobile model. Both attitudinal and behavioural measures of preferences were used to predict involvement and search channel use. The three attitudinal preferences that were identified explain 48 % of involvement, most of this variance is due to preferences about high performance cars. Further, attitudinal preferences explained between 2% and 30 % of the search channel variables. The behavioural preferences explained only 16% of the involvement construct and between 1% and 15% of the variance of the search channel variables. From this study it can be concluded that much of the variance explained by preferences is also captured by involvement, notable are the effects from performance preferences. Consumers that claim to be highly involved in cars are thus mainly interested in car performance.

**SQ5: How do the relationships between innovativeness and the use of information search channels by consumers differ between the two product domains?**

When comparing the results of the two product domains, some notable similarities and differences are observed.

The first similarity is that in both product domains, all measures of innovativeness are positively related to internal search; also in both domains internal search is used more than other channels. Generally, people rely on their own experience to a great extent.

The second similarity is that high-innovative consumers tend to make more use of media with specialized content, such as mass media channels and the World Wide Web. This might be because their higher degree of knowledge and interest in the product allows them understanding the content of these channels better than other consumers.

The first main difference between the two domains is that involvement explains search channel use better in the automobile domain than in the consumer electronics domain. A possible reason for this might be that automobiles are a single product domain, while the consumer electronics domain consists of multiple products. Although consumer electronics can be regarded as a valid product domain for analysis, it consists of multiple products making it by definition more heterogeneous than the automobile domain. This

heterogeneity causes more random noise in the measures and therefore the explained variances are generally lower.

The second difference between the domains is in the shape of the relationships found. In the consumer electronics domain many inverted U-shaped relationships were found between the measures of innovativeness and search channel use, which is in line with earlier claims. The findings in the automobile domain are not in line with earlier empirical observations. In this high risk product category there is a positive linear relationship between innovativeness and total search effort instead of an inverted U-shape. Further, highly innovative consumers balance their search effort much more among the channels than low innovative consumers. For high innovative consumers all channels are roughly equally important when searching. This means that the role of innovators in high risk product diffusion differs from conventional understandings in innovation adoption theory, which does not take into account the moderating role of risk.

## Implications

Based on the answers to these questions, the following implications were discussed.

First, the main mechanism identified in a low risk domain is that innovative consumers get their information from outside a social system through specialized channels. Some of these innovative consumers can serve as opinion leaders to further inform the population about the product. Instead, the balanced use of information search channels by innovators in high risk domains such as automobiles implies that producers cannot only use specialized content, but that they have to take into account the full set of channels that innovative consumers might consider finding information. Mass media and the World Wide Web are the easiest to use when promoting a product, but they account for only half the search effort by innovative consumers. Marketers have to consider strategies to target innovative consumers also using personal channels.

Second, it is well established in literature that innovativeness is domain specific, consumers that are innovative in one domain, are not necessarily innovative in another domain. Also our results indicate that different (socio-demographic) characteristics are associated with innovativeness in different product domains. There are some weak correlates between domain-specific innovativeness and innovativeness as a personality trait. Marketers that wish to identify innovators in a certain domain can better take into account domain specific innovativeness and socio-demographic characteristics rather than innovativeness as a personality trait.

Third, in markets where innovation is driven by consumer demand, preferences influence the direction of innovation processes; following consumer preferences enhances the quality of the outcome of the innovation process, can be considered to be more “democratic”, and is likely to lead to more profitable innovations.

However, there are some challenges related to demand oriented innovation processes:

- When asked for their opinion, consumers usually ‘construct’ their preferences instantaneously, based on what they do know about the topic and situational aspects.

- Consumers often desire more from a technology at a certain cost, than can be reasonably expected.
- Over time consumer preferences are dynamic, rather than static. Producers of innovations need to take into account dynamics of preferences in order to develop profitable innovations..
- Innovators as lead-users are the consumers that influence the innovation process even more than other users, but these preferences are not necessarily representative for the preferences of the rest of the user-population or the demands of society as a whole. If innovator preferences are used as a guide for technological development, then the outcome of the innovation process might be unsatisfactory for society as a whole.

# Samenvatting

Innovatie wordt vaak gezien als een belangrijke voorwaarde voor toekomstige economische groei. Veel spelers zijn betrokken bij de ontwikkeling en succesvolle verspreiding van innovaties. Een belangrijke speler in het innovatieproces is de consument. Consumenten zijn de eindgebruikers van nieuwe producten op de markt, zij ervaren uiteindelijk de gevolgen van veel technologische innovaties.

De aanschaf van nieuwe innovatieve producten gaat gepaard met veel onzekerheid, omdat er vaak nog weinig bekend is over het product. Dit geldt zeker voor de consumenten die als eerste deze producten aanschaffen. Deze zogenaamde 'innovatoren' zijn belangrijk, zij nemen de grootste risico's, zij testen gedeeltelijk de functionaliteit van het product, zij dragen bij aan verdere verbetering van de innovatie en zij brengen anderen in aanraking met het product zodat de verdere verspreiding van de innovatie wordt bevorderd.

Om de onzekerheden die gepaard gaan met de aanschaf van een innovatie te verkleinen, zoeken consumenten naar informatie alvorens tot aanschaf over te gaan. Hiertoe kan men meerdere bronnen raadplegen. Omdat innovatoren de eerste zijn die een product aanschaffen, is het belangrijk om te begrijpen hoe het gebruik van informatiebronnen door deze groep afwijkt van andere consumenten.

Dit proefschrift onderzoekt de relatie tussen hoe innovatief een consument is en het gebruik van informatiebronnen om meer informatie te verkrijgen over nieuwe producten. De volgende informatiebronnen worden onderzocht: massa media (TV, advertenties, radio, ect.), het Internet, persoonlijke kanalen (vrienden en familie) en verkopers (in winkels). Het onderzoek is uitgevoerd in twee productdomeinen: consumentenelektronica en auto's. Het eerste domein wordt gezien als een domein waarbij de consument relatief weinig risico loopt bij de aanschaf van nieuwe producten, het tweede domein wordt beschouwd als een hoog risico domein. De volgende onderzoeksvraag is gesteld:

*Wat is de relatie tussen innovativiteit en het gebruik van verschillende informatiebronnen door consumenten voor de productdomeinen consumentenelektronica en auto's?*

Vijf studies (hoofdstuk twee tot zes) zijn uitgevoerd om deze vraag te beantwoorden. Hieronder volgen de belangrijkste bevindingen. Naderhand zullen de implicaties van resultaten worden bediscussieerd.

## Belangrijkste bevindingen

Een belangrijk verschil tussen beide productdomeinen is dat het consumenten elektronica domein uit meerdere producten bestaat, terwijl het autodomein slechts één product bevat. Hieruit volgt de vraag in hoeverre dit verschil van belang is in een vergelijking? In

hoofdstuk twee en drie is daarom eerst vastgesteld dat consumentenelektronica als één product domein geanalyseerd kan worden. Daarnaast is in deze hoofdstukken onderzocht wat goede manieren zijn om innovativiteit te meten in dit productdomein.

In hoofdstuk vier wordt de relatie onderzocht tussen innovativiteit en het gebruik van verschillende informatiebronnen in het consumentenelektronica domein. Dit op basis van representatieve steekproef bestaande uit ongeveer 2000 respondenten. De resultaten laten zien dat er een omgekeerd U-vormige relatie bestaat tussen innovativiteit en het gebruik van verschillende informatiekanalen. Mensen die minder innovatief zijn zoeken, over het algemeen minder informatie. Daarnaast maken zij vooral gebruik van persoonlijke kanalen. Innovatieve consumenten zoeken meer in totaal, en richten zich vooral op het Internet en massa media.

Hoofdstuk vijf onderzoekt de relatie tussen innovativiteit en het gebruik van verschillende informatiebronnen bij de aanschaf van een nieuwe auto. Dit op basis van een representatieve steekproef bestaande uit ongeveer 1400 autobezitters. De resultaten laten een positieve relatie zien tussen innovativiteit en het gebruik van verschillende informatiekanalen. Deze relatie is het sterkst voor het gebruik van massa media en Internet, en zwakker voor persoonlijke kanalen in het gebruik van verkopers. Minder innovatieve consumenten richten zich bij de aankoop van een nieuwe auto vooral op verkopers en persoonlijke kanalen. Innovatieve consumenten gebruiken alle kanalen ongeveer even veel.

In hoofdstuk zes wordt het model dat de relatie tussen innovativiteit en het gebruik van verschillende informatiebronnen bij de aanschaf van een nieuwe auto beschrijft, uitgebreid met voorkeuren voor bepaalde kenmerken van nieuwe auto's. Drie kenmerken worden gevonden: een voorkeur voor een hogere prestatie van de auto, een voorkeur voor milieuvriendelijke eigenschappen en een voorkeur voor een hoger comfort. Deze voorkeuren zijn in het model gekoppeld aan innovativiteit en het gebruik van informatiekanalen. Hieruit blijkt dat mensen met een sterke voorkeur voor een hoge prestatie ook over het algemeen innovatiever zijn. Mensen met een uitgesproken voorkeur voor milieuvriendelijke of comforteigenschappen zijn juist minder innovatief binnen het productdomein. Daarnaast blijkt een voorkeur voor hoge prestaties ook het sterkst gerelateerd te zijn aan het gebruik van informatiekanalen. Ten slotte blijkt dat er een groot verschil bestaat tussen de gestelde voorkeuren voor milieuvriendelijke auto's en of men daadwerkelijk ook een milieuvriendelijke auto bezit.

## Implicaties

Deze resultaten hebben de volgende implicaties:

In een laag risico productdomein als consumentenelektronica brengen de innovatieve consumenten informatie binnen in een sociaal systeem via massa media en Internet. Een aantal van deze innovatoren verpreiden de informatie verder via persoonlijke kanalen. Dit is in lijn met eerdere onderzoeken. In een hoog risico domein zoals auto's maken innovatieve consumenten gebruik van een bredere set van kanalen. Massa media en Internet

zijn voor producenten de meest eenvoudige kanalen om consumenten te benaderen, maar de zoektocht van naar informatie bestaat maar voor de helft uit het gebruiken van deze kanalen voor innovatieve autoconsumenten. Voor minder innovatieve consumenten in dit domein is dit nog lager. Dit vraagt om nieuwe informatievoorzieningstrategieën die meer gebruik maken van andere kanalen.

Tevens, in markten waar innovatie vooral gedreven wordt door de wensen van consumenten hebben de voorkeuren van gebruikers een grote invloed op de richting van het innovatieproces. Het volgen van de wensen van consumenten vergroot de kwaliteit van de innovatie, kan gezien worden als meer 'democratisch', en zal waarschijnlijk leiden tot meer winstgevende innovaties. Een groot probleem hierbij is echter dat innovatoren als belangrijkste gebruikers betrokken worden bij de ontwikkeling van het product. Hoofdstuk zes heeft laten zien dat de wensen van innovatieve consumenten niet noodzakelijk overeenkomen met de wensen van de rest van de bevolking. Dit kan leiden tot een onwenselijke uitkomst van het innovatieproces.



# Dankwoord

Geen enkel geschreven woord doet volledig recht aan de mensen om mij heen die ik dank verschuldigd ben. Velen hebben bewust of onbewust bijgedragen aan de totstandkoming van dit proefschrift. Ik noem niet iedereen bij naam, mijn dank gaat uit naar iedereen die de afgelopen jaren een positieve rol heeft gespeeld in mijn leven. Of dit nu op het werk was, in de kroeg, op vakantie, feestjes, etentjes, tijdens het klaverjassen of elders in de privésfeer. Dank voor jullie vriendschap en (vaak) wijze, humoristische woorden.

De mensen die ik bij deze expliciet wil bedanken zijn de directe begeleiders van mijn proefschrift:

Carolina Castaldi, Martin Dijst en Rogier Donders.

Mijn paranifmen voor hun betrokkenheid de afgelopen jaren tot aan de promotie toe:

Arieke en Maarten

Tenslotte bedank ik mijn ouders die altijd klaar staan voor mij:

Ted en Lydia

Dank...

Frank van Rijnsoever  
Utrecht, januari 2010



# Curriculum Vitae

Frank van Rijnsoever was born in Leerdam on Februari 26th 1981. After attending the Koningin Wilhelmina College te Culemborg, he went on to study Science and Innovation Management at Utrecht University in 1999. After his graduation in 2005 he was employed at the Department of Innovation and Environmental Sciences of Utrecht University as junior lecturer. In October 2006 he started his part-time PhD project there. Next to teaching several courses on research methodology and organizational innovation he is also responsible for the departmental honours programme. From November 2008 until April 2009 he was a guest researcher at the Department of Marketing at Monash University, Melbourne. He attended several conferences and has published the following publications:

## Peer reviewed journal papers

Van Rijnsoever, F. J., Hessels, L. K., & Vandeberg, R. L. J. (2008). A resource-based view on the interactions of university researchers. *Research Policy*, 37(8), 1255-1266.

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## Conference papers

Van Rijnsoever, F. J., Farla, J., & Dijst, M. J. (2008). *In Top Gear towards Sustainable Mobility: Consumer Car Preferences and Information Search Channels*. Paper presented at the DIME 2008 conference: "Innovation, sustainability and policy", Bordeaux.

Van Rijnsoever, F. J. (2009). *The role of knowledge in consumer and organizational search: towards a broader theory* Paper presented at the EMAEE Conference, Jena.

Van Rijnsoever, F. J., & Oppewal, H. (2009). *Successive early adoption of technology generations: the case of video players* Paper presented at the Proceedings of the Australian & New Zealand Marketing Academy Conference, Melbourne