DESIGN OF A PERSUASIVE RECOMMENDATION AGENT TO PROMOTE ENVIRONMENTALLY FRIENDLY PRODUCTS

by

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Abstract

This study focuses on designing a product recommendation agent (PRA) that would persuade its users to purchase environmentally preferable products. To develop such a PRA, the literature on subjects including "green" consumption, persuasion, and persuasive technology is reviewed.

After considering the challenges to inducing "green" behaviours and leveraging many persuasive technologies, we employ the attributes trade-offs transparency tool to facilitate users' understanding of "green" products. We also utilize the conditioning mechanism through the associative or propositional process in the persuasive design. This mechanism aims to elicit users' implicit or explicit "green" attitudes, which generate "green" behaviours.

An experiment with 180 participants was conducted to test the effectiveness of the conditioning mechanism of the persuasive design. The participants were asked to perform a shopping task and give feedback on their experience. Their preferred product attributes, product choices, and "green" attitudes were recorded. The experiment showed that the conditioning mechanism greatly predisposed the participants toward "greenness" through the associative process. As a result, it successfully persuaded them to have a "greener" attitude and choose "greener" products, whether the purchasing task required a sustainable product or not. In addition, participants indicated higher perceptions on PRAs with the persuasive design.

Preface

The research described in this dissertation received approval from the Behavioural Research Ethics Board of the University of British Columbia (Certificate number: H12-00169).

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Acknowledgements

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To my parents

.

Chapter 1: Introduction

Environmental degradation is a problem that has drawn and is still drawing much attention from all segments of society, including governments, companies and communities. To prevent further damage, researchers are making efforts to contribute to environmental sustainability. Among others, Nemetz (2003) asserts that promoting "green" purchasing, or buying products that are environmentally friendly, is a very effective way to help the environment. But how do we persuade people to make "greener" purchases?

Persuasion has traditionally been limited to human communication: person to person. However, the increasing sophistication of the Web and similar media has created opportunities for technology to be a source of persuasive interaction. Compared to old-fashioned human-to-human communication, these new media are advantageous in both efficiency and effectiveness. For example, in an online shopping context, a product recommendation agent (PRA) can facilitate customers' decision making by eliciting their needs and recommending products according to their preferences. In this process, a PRA can adopt a human role and influence customers, much as would a salesperson or an assistant. In this paper, we attempt to use persuasive technologies in a PRA to promote "green" purchasing.

Our study aims to design a persuasive PRA and to test it in terms of people's "green" purchasing behaviours. In order to achieve effective persuasion, we discuss the challenges to promoting environmentally friendly actions so our design can address them specifically. We also review the literature on persuasive technology design to most effectively leverage the power technologies can offer. Furthermore, we build a theoretical model of how people are influenced by the persuasive design to perform "green" behaviours. We then conduct an experiment to partially test this model. In our experiment, participants need to pick a washing machine for a hypothetical friend. They have access to the persuasive PRA. We evaluate the effectiveness of the persuasive PRA by analyzing the "greenness" of the washing machines they choose. Their perceptions of the PRA are also measured.

This paper will answer the following questions:

- What are the challenges to promoting “green” purchasing?
- What is persuasive technology? What is a persuasive PRA?
- How can a persuasive PRA be designed to promote “green” purchasing effectively?
- How can the conditioning mechanism influence people’s “green” attitudes and behaviours?
- How do users perceive the persuasive PRA?

Chapter 2: Literature Review

2.1 Importance of Environmental Issues

2.1.1 Environmental Sustainability

In 2004, a movie called *The Day After Tomorrow* received great acclaim. It predicts the end of the world due to severe human-generated environmental crises. This, along with many other well-received films, has raised awareness of our environmental responsibility. Thanks to the efforts of various parties, such as governments, organizations, communities and researchers, people now understand the urgency and severity of environmental problems (*China Daily*, 2006). However, in spite of this increased understanding, these issues are far from being resolved.

Environmental degradation is one of the challenges the world faces today. The term "sustainable development" emerged at a conference held by the World Commission on Environment and Development in 1987, and is defined as "meeting the needs of the present without compromising the ability of future generations to meet their own needs" (p. 8). To achieve such sustainability, we must all take immediate action.

2.1.2 Purchasing "Green"

One factor that affects environmental sustainability is product purchasing. Hence, governments made the public purchasing of green products and services a policy agenda to reduce environmental degradation (OECD, 2000). For example, the Canadian Government committed to increasing its "green" procurement as part of its 2007–2009 sustainable development strategy (SDS).

A study by the U.S. department of Commerce (shown in Figure 1) reveals that households can have a significant impact on energy conservation. Therefore, parallel to the efforts to increase "green" public purchasing, governments have been attempting to promote individual "green" behaviours. Encouragingly, consumers are becoming more sensitive to environmental sustainability issues and are therefore trying to engage in "green" behaviours.

Hence, pressure on the business community to implement environmental sustainability in their practices is also increasing (Nemetz, 2003). This has driven the emergence of various types of "green" products and services in the past several years.

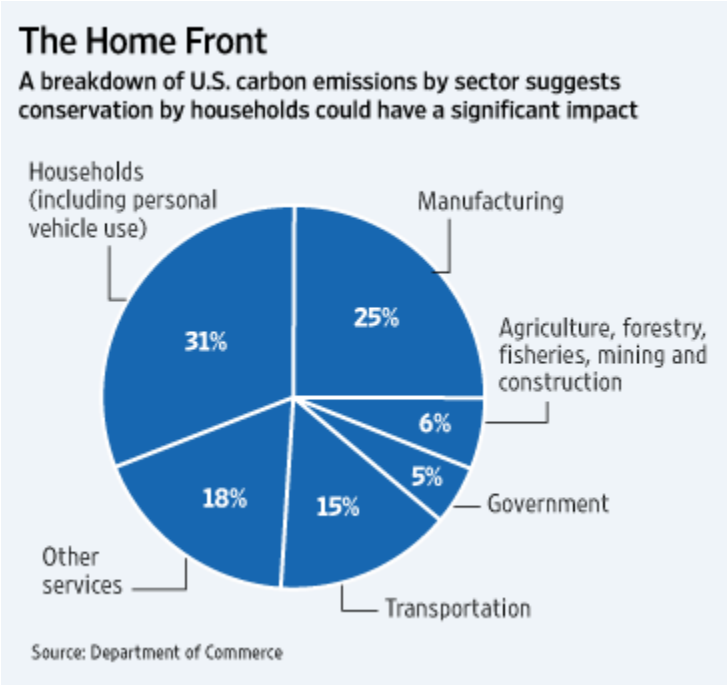

Figure 1 U.S Carbon Emissions by Sector

In spite of the promising future of "green" campaigns, people have difficulty clarifying what are "green" actions, since "greenness" can cover a broad scope. There are different types of "green" behaviours. Take energy saving, for instance. People can either adjust their lifestyle (e.g., carpool to work) or choose to buy an eco-car in a fuel-efficient model. Figure 2 lists the different ways to save energy.

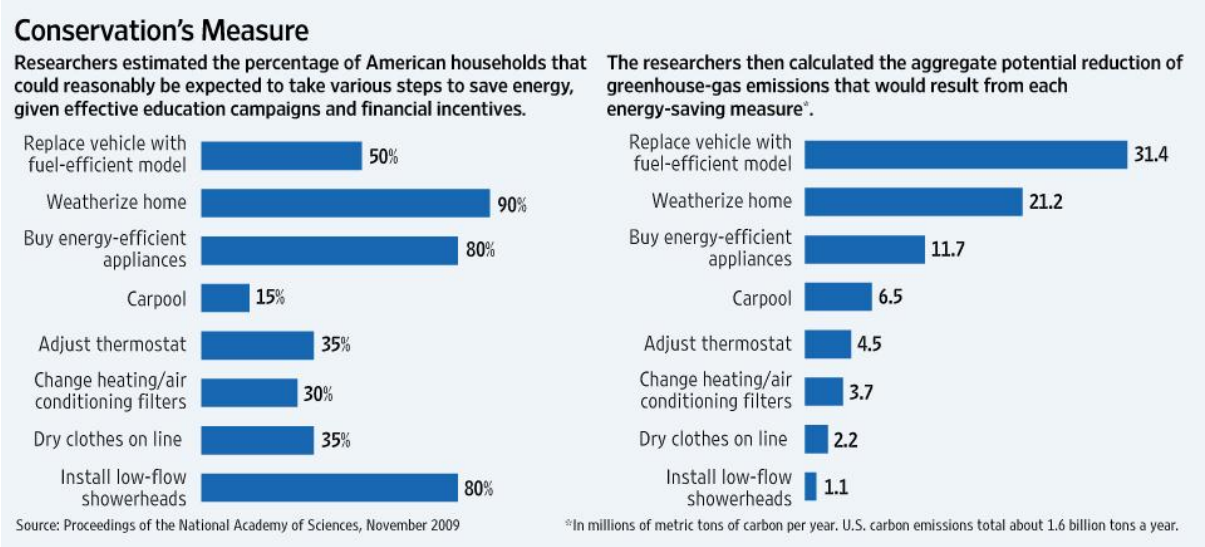

Figure 2 Ways to Save Energy

It is not an easy task to identify "green" products or services either. These are defined as "products or services that have a lesser or reduced effect on human health and the environment when compared with competing products or services that serve the same purpose." This comparison may consider raw materials, acquisition, production, manufacturing, packaging, distribution, reuse, operation, maintenance, or disposal of the product or service"(Executive Order 13101, 1998). From this definition, we can see that "green" may be a relative term and that it is therefore not easy for customers to understand a specific "green" product fully.

To reduce customers' difficulties, governments and organizations assume the responsibility of investigating products, and recognize the "green" ones by clarifying criteria or labeling them. According to Walton and Galea (2006), an environmentally preferable product can be identified by examining its re-usable and organic content, harmful chemical and material usage for production, packaging waste, recyclability, remanufacturability and emission level during production. For example, an online shopping website, buygreen.com, lists four stages at which a product might affect the environment: its source material, manufacturing, use, and disposal. It provides detailed information about the environmental impact of the product at these stages to its online shoppers. In this study, we determine the "greenness" of products by their "EnerGuide rating," which is the official Government of Canada mark associated with

the labeling and rating of the energy consumption or efficiency of specific products. EnerGuide labeling is commonly seen for appliances, heating and cooling equipment, houses and vehicles (Wikipedia contributors, 2012).

2.1.3 "Green" Consumers

Hines et al. (1987) found that green consumers are mainly young, female, well educated, wealthy, and liberal. Gilg et al. (2005) confirmed most of these characteristics, though they found that these customers tended to be in older age groups. Shrum et al. (1995) identified green consumers as information seekers, opinion leaders, and careful shoppers, and as paying attention to price and not prone to impulse shopping. Recent consumer segmentation studies concluded that a very small group of shoppers place a very high level of importance on a product's environmental and social benefits. This environmentally responsible consumer group represents 5–8% of the population. Moreover, 45–50% of consumers will buy environmentally friendly products only if they meet their needs in terms of quality, performance, convenience and price (WBCSD, 2008).

Contrary to these findings, according to the Canalys 2007[1] survey, 55% of consumers stated they were willing to pay a 10% premium for products that were manufactured more sustainably. This survey also showed that except for age demographics, there is little variation across gender or income. Moreover, according to the *Wall Street Journal*, about two-thirds of Americans are active in or sympathetic to the environmental movement. We believe that engaging in "green" causes should be the responsibility of all of us. Therefore, everyone should be a "green" consumer.

Bearing these results in mind, we chose our study participants from a broad range rather than from a specific group. We selected participants aged 19 to 77 with an equal number in each gender. They have different education and income levels. They are randomly assigned to

[1] Canalys. (May 6, 2010). Which consumers will pay for greener products. http://www.canalys.com/pr/2007/r2007062.html

different treatments. We will describe the specific demographics in a later section, and more detailed information can be found in Appendix A.

2.1.4 Challenges to Promoting "Greenness"

According to the *Wall Street Journal*[2], even though about two-thirds of Americans tell pollsters they are active in or sympathetic to the environmental movement, it has been proven to be tough to get the average consumer to make even relatively simple changes, like using energy-efficient light bulbs or caulking drafty windows. Promoting "green" faces great challenges nowadays. Even though "green" campaigns receive positive feedback and encourage people's spirit, few actually engage in "green" practices. We generalize two crucial problems in promoting "greenness" below.

First, people lack the ability and knowledge to identify and practice "green" behaviours. As we mentioned before, one of the greatest challenges regarding "green"-related studies is that there is no agreement on the definitions of either green consumerism or ecologically responsible consumption (Moisander, 2007). In addition, Moisander (2007) argues that green consumerism may mean different things for different groups. For instance, one group may think that it entails choosing products or services that are least harmful to the environment, whereas another may think it involves reducing the number of purchases to a minimum level. Since people have different views on green consumption, they take different actions to achieve it. Additionally, there is little agreement on the criteria that make a product or service environmentally sustainable. Besides, the information about ecologically safe products and services is complex (OECD, 2000). As a result of the increasing volume and complexity of this information (OECD, 2001), consumers must make difficult value judgments when considering green products and services.

Moreover, even though consumers may wish to buy green products, they may lack the knowledge or expertise to do so. If they do not know whether or not a product is "green,"

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[2] Stephanie Simon. (October 17, 2010). The secret to turning consumers green. http://online.wsj.com/article/SB10001424052748704575304575296243891721972.html

they may give up their good intentions altogether and pay more attention to non-green attributes, of which they are usually better judges. Thus, increasing people's ability to identify and understand "greenness" is essential to promoting environmentally friendly products.

Another challenge relates to the gap between consumers' attitudes and behaviours regarding ecologically responsible consumption (Nyborg et al., 2006; Moisander, 2007; Thogersen, 2006). For example, although many private households said they would be willing to pay a premium to buy electricity produced by renewable energy sources, significantly fewer of them actually purchased that type of electricity (Roe et al., 2001). This example clearly shows the complexity of environmentally responsible consumption. Many sales strategies still focus on explaining the benefits and urgency of using green products to motivate customers to buy them. However, while these practices have increased the public's interest in sustainability and consumers' positive attitudes toward green purchasing, they have not translated into behavioural changes. Specifically, when "eco meets economy," , people still fail to purchase "green," in spite of the fact that they all reveal their positive attitude towards it (Kurutz, 2011).

In light of this situation, many old practices to promote "green" products are not effective. In most cases, marketing campaigns try to introduce the benefits of "green" products and create a positive attitude toward "green." However, these attempts do not contribute much to people's "green" purchasing actions. To improve these ineffective attempts to promote green products, we need to change our traditional approach and bridge the gap between people's attitudes and behaviours. We therefore present a theoretical model of how to influence people's "green" behaviours in Section 3.

In this study, we seek to leverage the persuasive power of technology to handle these challenges. We will now review the literature on persuasive technology and PRAs to design a PRA that can influence individual consumers' purchasing of environmentally sustainable products. Our persuasive design aims to address the existing problems in promoting "green" By giving customers the knowledge and expertise they need. In addition, the design focuses

on influencing people's "green" behaviours, which means it should minimize the gap between people's attitudes and actions.

2.2 The Growing Importance of Persuasive Technology

Persuasion has played an important role throughout history. It occurs in different contexts and between different groups, such as politicians, salespersons, parents and friends. Google Scholar contains more than 400,000 documents on the subject, some of which date back over four hundred years.

Persuasion has been given different definitions and therefore has several levels of meaning. According to Simons (2001), it is "human communication designed to influence the autonomous judgments and actions of others." From this definition, we can see that persuasion has been the purview of human communication, person to person. However, the definition of persuasion has become broader with the development of technologies. Gass and Seiter (2010) generalize it as "the influence of beliefs, attitudes, intentions, motivations, or behaviours." Finally, according to the business dictionary[3], persuasion is a process aimed at changing a person's (or group's) attitude or behaviour toward some event, idea, object, or other person(s), by using written or spoken words to convey information, feelings, reasoning, or a combination of them.

From these definitions we can see that persuasion is a form of influence in the sense that it seeks to alter the way others think, feel, or act. A few decades ago, this was usually accomplished verbally. For instance, a salesperson could talk a customer into buying a product just through skillful conversation. Recently, however, persuasion can take different forms, many of which do not even involve words.

With the development of computers, the Web and other modern technologies, opportunities have arisen for technology to be a source of persuasive interaction. In fact, various

[3] Business Dictionary. (2012). http://www.businessdictionary.com/definition/persuasion.html

technologies can serve as sources of influence, replacing the person-to-person communication seen before. Consequently, salespersons can be superceded by, for example, an intelligent machine. Fogg has coined the new term "persuasive technology" to describe this phenomenon and has initiated a wave of research into this area. "Persuasive technology" can be broadly defined as "technology that is designed to change the attitudes or behaviours of its users through persuasion and social influence, but not through coercion" (Fogg, 1999).

Harjumaa & Oinas-Kukkonen (2007) further clarify this definition by distinguishing between three types of persuasion: interpersonal persuasion, computer-mediated persuasion and human-computer persuasion. *Interpersonal persuasion* is the traditional form and occurs when two or more people interact with each other. *Computer-mediated persuasion* takes place via technology, including discussion forums, e-mail, instant messages, blogs, or social networks. *Human-computer persuasion* differs from the two types above in that it is the computer (system, technology, etc.) that makes the persuasion appeal directly. As computers do not have intentions of their own, it is not always clear who the persuader is. But since those who create, distribute, or convince others to adopt the technology are the ones who seek to affect someone's attitudes or behaviour, we usually assume that the person or company who has designed the system is the persuader (Fogg, 2003).

In this paper, we look at the third type of persuasion: human-computer persuasion. Most self-identified persuasive technology research focuses on interactive, computational technologies, including desktop computers, Internet services, video games, and mobile devices (Oinas-Kukkonen & Harjumaa, 2008). In 1996, B. J. Fogg derived the term "captology" from the acronym CAPT (computers as persuasive technologies). Captology includes the design, research, and analysis of interactive computing products (computers, mobile phones, websites, wireless technologies, mobile applications, video games, etc.) created for the purpose of changing people's attitudes or behaviours (Fogg, 1999). Although computers cannot communicate in the same manner as humans, recent studies suggest that some patterns of interaction similar to social communication may be utilized in human-computer interaction (Nass et al., 1995). In this paper, we will explore this interactive, persuasive technology and its applications to Internet services.

2.3 Persuasive Technology Framework

2.3.1 Fogg and Persuasive Technology

Fogg (2003) discusses how to influence people when they are interacting with computer technology. According to his persuasive technology framework, computers can serve as tools, mediums, and social actors, and designers can leverage each of these capacities to influence users.

In their role as tools, the goal of computing products is to make activities easier or more efficient, or to accomplish tasks that would be virtually impossible without them. Fogg lists seven ways that persuasive technologies can affect users as tools: reduction (persuading through simplifying), tunneling (guided persuasion), tailoring (persuasion through customization), suggestion (intervening at the right time), self-monitoring (tracking), surveillance (persuasion through observation) and conditioning (reinforcing target behaviours).

Moreover, computers can function as both symbolic and sensory media. On one hand, they serve as symbolic media when they use symbols to convey information (e.g., text, graphics, charts and icons). On the other, they function as sensory media when they provide sensations like audio, video, smell or touch. Recent forays into virtual reality fit into this category. Especially, computers can provide simulations and interactive experiences that can greatly motivate and persuade customers.

Computers can also operate as social actors or living entities. When they are perceived vividly, they can exert greater power over users. They always employ different kinds of social cues to achieve this, including physical (attractiveness), psychological (similarity), language (praise), social dynamics (reciprocity) and social roles (authority).

In this study, we use computers as tools by employing the conditioning mechanism in the persuasive design. By Fogg's definition, a conditioning technology is a computerized system that uses principles of operant conditioning to change behaviours. Operant conditioning is a

method that utilizes positive reinforcement or rewards to increase the instances of an action or to shape complex behaviours. It may also involve the use of punishments to decrease the instances of an unwanted behaviour. The most classic example of operant conditioning is training a dog by giving it food to do tricks. Fogg uses conditioning technology in his study of the "Telecycle," a bicycle connected to a TV. People are asked to pedal at a target speed. When they pedal either slower or faster, the TV pictures will become fuzzy, almost worthless to watch. As the speed gets closer to the target, the TV screen will become clearer.

Our conditioning mechanism is an application of this technology. We give positive reinforcements (smiley faces or green nature pictures) to "greener" products, and punishments (sad faces or non-environmentally friendly nature pictures) to less "green" ones. In this way, customers will be predisposed to prefer products with low energy consumption.

2.3.2 Oinas-Kukkonen and Harjumaa and Persuasion System Development

The Fogg model utilizes a conceptualization of persuasive technology to classify system designs. Oinas-Kukkonen and Harjumaa argue that one weakness of this model is that it does not explain how these suggested design principles can and should be transformed into software requirements and further implemented as actual system features. As a result, they recategorized persuasive designs from a system development view. They listed designs that can be used for primary tasks, dialogue support, system credibility and social support (Oinas-Kukkonen & Harjumaa, 2008).

Principles in the *primary task* category achieve persuasion by supporting the performance of the user's primary task. These include reduction, tunneling, tailoring, personalization, self-monitoring, simulation, and rehearsal.

Principles in the *dialogue support* category aim to persuade users by giving some degree of system feedback, potentially via verbal information or other kinds of summaries. Several design principles are related to implementing computer-human dialogue support in a manner that helps users keep moving towards their goal or target behaviour. Such principles include praise, rewards, reminders, suggestions, similarity, liking, and social roles.

The principles in the *system credibility* category describe how to design a system so that it is more credible and thus more persuasive. This category encompasses trustworthiness, expertise, surface credibility, real-world feel, authority, third-party endorsements, and verifiability.

The *social support* category entails designing a system that leverages social influence to motivate users. The design principles that belong to this category are social facilitation, social comparison, normative influence, social learning, cooperation, competition, and recognition.

In the design proposed in our research, the trade-off conditioning tool supports the carrying out of the user's primary task. It can facilitate the task and promote targeted behaviours. By integrating it into a PRA, it helps customers to understand product attributes and thus eases product selection. It also enhances "green" attributes and adds value to environmentally friendly products.

2.3.3 Lockton and Design with Intent Toolkit

Lockton found that little work has been done to build a framework of design techniques that link principles to practical applications. Thus, he developed the Design with Intent (DwI) toolkit for designers, which provides "design intended to influence or result in certain user behaviours." He listed persuasion methods according to the way people can be influenced to achieve targeted actions. According to him, there are three major strategies to change user's behaviours practically: constraints, facilitation and motivation (Lockton, 2012). Constraints limit possible behaviours and exclude unwanted ones; facilitation eases the translation of the user's intentions into actions and habits; and motivation elicits a tangential drive to perform the behaviour.

In our case, the trade-off conditioning tool influences users by facilitating the targeted behaviour of purchasing "green" products. The trade-off transparency tool facilitates the understanding of product attributes. The conditioning mechanism elicits people's implicit

green attitude to induce automatic green behaviours. In addition, it can also elicit people's explicit green attitude to give them a justification to act "greenly." Both ways make buying "green" easier.

2.4 Persuasive Product Recommendation Agents

2.4.1 Product Recommendation Agents

Product recommendation agents (PRAs) are software agents that elicit the interests or preferences of individual users for products, either explicitly or implicitly, and make recommendations accordingly (Xiao & Benbasat, 2007). Due to their nature, PRAs can exert great influence on people's product choices and can thus improve the effectiveness and efficiency of customers' decision making in purchasing (Häubl & Trifts, 2000). In the context of e-commerce, a distinction can be made between PRAs involved in product brokering (i.e., finding the best suited product) and merchant brokering (i.e., finding the best suited vendor) (Spiekermann & Paraschiv, 2002). In this paper, we focus on e-commerce product brokering PRAs for supporting product search and evaluation.

Usually, PRAs can be divided into three stages: input, process and output (Xiao & Benbasat, 2007). *Input* is the stage where users' preferences are elicited. PRAs ask customers to give the requirements of the products they are seeking, and then rank them according to the user's requirements. *Process* is the stage where recommendations are generated. PRAs can employ different algorithms to provide these recommendations. For example, they can eliminate the products that fail to meet the user's requirements. They can also consider all attributes together, calculate an overall score and recommend products accordingly. *Output* is the stage where PRAs present their recommendations to users in different ways. We can see that across the three stages, PRAs play a significant role in guiding customers' decision making. Furthermore, they are flexible in design so they can influence users in a suitable and thus effective way. Therefore, PRAs can serve as a powerful platform to exert influence on customers from multiple perspectives in all stages of the decision-making process.

The design of our persuasive PRA focuses on the input stage, in which people indicate their attribute preferences. We want to influence these preferences in a way that encourages users to purchase the products that we want to promote. In this way, the products to be promoted will be strongly recommended and listed at the top, thus increasing the chances they will be chosen by customers.

2.4.2 Persuasive PRA

As a special type of decision support system (DSS) (Xiao & Benbasat, 2007), PRAs can exert great influence on their users throughout the decision-making process, making them great platforms to persuade customers. Thus, we investigate the role of persuasion in the context of product recommendation agents (PRAs). It has been argued that recommenders always persuade when they are recommending (Gretzel & Fesenmaier, 2006). This interpretation is based on the fact that recommenders successfully support the effective identification of alternatives that otherwise would not have been found by the customer and that have consequently not been purchased. This is one kind of influence that PRAs exert. However, human minds are subtle and vulnerable. Persuasion can influence human decision making in different situations through different strategies. In this paper, we will explore a PRA that can persuade during the purchasing process. Its influence is more than that exerted just by recommending products to its users by calculating, ranking and presenting them.

What is a persuasive PRA? Persuasion can be easily confused with deception, and former studies have examined the potential of PRAs to deceive customers (Xiao & Benbasat, 2011). To make the distinction clear, Yu et al. (2011) classified PRAs into three types: *neutral*, *deceptive* and *persuasive*. They used four characteristics: the existence of targeted products, the focus of attitude manipulation, the misuse of information, and mutual beneficial relationships with customers.

In this classification, persuasive PRAs are different from neutral PRAs in that they have pre-determined products as targets. Hence, they have already favoured certain types of products for customers to choose in the database.

Persuasive PRAs are also more difficult to design, considering that they aim to change people. Harjumaa and Oinas-Kukkonen (2007) define persuasive systems as "computerized software or information designed to reinforce, change or shape attitudes or behaviours or both without using coercion or deception." According to this definition, there are three potentially successful outcomes for a persuasive system: the voluntary *reinforcement*, *change* or *shaping* of attitudes and/or behaviours. A *reinforcing* outcome involves "the reinforcement of current attitudes, making them more resistant to change." A *changing* outcome means "changes in a person's response to an issue, e.g., to social questions." *Shaping* means "the formulation of a pattern for a situation when one does not exist beforehand." Persuasion ideally induces individuals to abandon one set of behaviours to adopt another (Miller, 2002). Moreover, a persuasive recommendation agent also differs from a neutral one in that it focuses on changing one's attitude instead of forming it. In many cases, communication that results in shaping an outcome may have a higher likelihood of success than communication that aims at changing an outcome (Lerbinger, 1972). Therefore, a persuasive PRA faces more challenges than a traditional neutral PRA. In our study, we measured participants' "green" attitudes before they used the PRA. We wanted to change these already shaped perspectives. In the end, we found their attitudes after using the PRA to be significantly different from those they had before, which shows that we have successfully changed their "green" beliefs.

A persuasive PRA can also be differentiated from a deceptive PRA by checking whether it misuses information and fosters long-term relationships with customers. Xiao and Benbasat (2011) have summarized three ways of misusing information: (1) *concealment*: to withhold, omit, or disguise relevant information; (2) *equivocation*: to present information vaguely and or ambiguously; and (3) *falsification*: to present false or exaggerated information. A persuasive PRA will not conceal, equivocate or falsify data during the whole recommendation process. All information must be authentic. Besides, persuasive PRAs are also different from deceptive PRAs in that they can form long-term relationships with customers. Customers are aware that the product information is authentic and make their decisions voluntarily. As a result, the relationships between persuasive PRAs and customers are mutually beneficial.

2.4.3 Functioning Principles of Persuasive PRAs

A central function of PRAs is to capture consumer product attribute preferences, which allows the identification of products appropriate to a consumer's interests (Xiao & Benbasat, 2007). Because of the conflicting values of product attributes, trade-offs are inherent in many purchasing choices. For example, a laptop with a faster processor comes with a higher price, and a larger screen size results in a heavier weight (Xu et al., forthcoming). Conflicts of this kind are very common in product selection. It is difficult to find a particular option that is best in terms of all desired attributes. Therefore, people must make judgments on these attributes by weighing their importance. In other words, they need to sacrifice some features for other, more important ones.

The basic functioning principle that a persuasive PRA works with is influencing the trade-off evaluation of product attributes. For example, if a customer wants to buy a laptop, he may experience a conflict between comfort and convenience. To be specific, laptops with large screens will offer a more enjoyable and comfortable user experience. However, they are usually heavier and thus result in less convenience. In this situation, the customer must choose between the trade-off of screen size and computer weight. Persuasive recommendation agents come into play by changing the weight of product attributes and trying to persuade customers to value more of the attributes that the targeted products possess. For example, a customer may simultaneously value a large screen size and a light weight. If the designer of the PRA wants to promote larger-screened computers, in the course of using the agent, customers may find that the screen size attribute is relatively more important and may therefore favour it in the trade-off comparison. As a result of the user assigning more weight to the screen size attribute, his final choice of computer may have a larger screen.

In this paper, we wish to promote "green" products (e.g., those that consume less energy and resources) by influencing users' attribute preferences. There exists a trade-off between green and non-green attributes. For example, "green" machines are good at saving energy on the one hand, but may have a higher price or less efficiency on the other. If we persuade customers to place more weight on green attributes at the expense of price or other non-green characteristics, they will have a higher tendency to choose a "green" machine in the end.

Chapter 3: Theoretical Framework

3.1 Theory of Planned Behaviour

The theory of planned behaviour (TPB), which is one of the most predictive persuasion theories, serves as the foundation for our research framework. It is a theory that links attitudes to behaviours. While attitudes do not lead to behaviours directly, the TPB states that attitudes toward behaviour, subjective norms, and perceived behavioural control together shape an individual's behavioural intentions and further affect resulting behaviours. To elaborate, perceived behavioural control is the perceived ease or difficulty of performing a particular behaviour (Ajzen, 1988). This is determined by an individual's total set of accessible control beliefs, which are beliefs about the presence of factors that may facilitate or impede the performance of the behaviour (Ajzen, 2001).

We build on TPB to understand the reasons for people's green purchasing beliefs. In the case of promoting green, it is very important that customers can identify green behaviours. This is closely related to one's control beliefs. What practitioners usually do to promote "green" products is to influence people's "green" attitudes. However, they do not give them enough behavioural control. We solve this problem by enabling people to identify and evaluate "green" products.

3.2 Trade-off Transparency Tool and Behavioural Control

Xu found that a product trade-off transparency tool can supply customers with great product diagnosticity (Xu et al., forthcoming). It can interactively demonstrate the trade-offs among product attributes. For example, when picking a laptop, when you specify your requirement for the screen size to be large, the tool can show automatically the increase in weight. Customers reported not only a more enjoyable user experience, but also a better understanding of attribute trade-offs with the trade-off manipulation tool. We expect that showing trade-offs among product attributes can enable customers to understand "green" products to a greater extent, giving them the confidence to choose the right sustainable option. They will also have a greater intention to purchase "green" products if they feel they have

sufficient knowledge and ability to do so. Therefore, we utilize the trade-off transparency tool in our design to strengthen people's control beliefs on purchasing "green".

In this study, the trade-off tool revealed relationships between green and non-green attributes. Each attribute was linked with an EnerGuide Rating, meaning customers would know how the level of each influenced "greenness." Therefore, consumers could tell clearly which attributes contributed to "greenness" and thus what types of products are environmentally friendly.

3.3 Explicit and Implicit Attitudes

For many decades, people have attempted to persuade others by influencing their attitudes about performing actions. For example, in the attempt to promote the purchase and use of environmentally friendly products, many practices focus on explaining their benefits and urgency to motivate customers to buy them. These practices can increase public interest in sustainability and can form positive consumer attitudes toward green purchasing. However, buyers' behavioural patterns are not necessarily consistent with their attitudes. Indeed, Ajzen discovered this gap between attitudes and behaviour in 1977.

Recent research has found that the construct of "attitude" is more complicated than we thought. A widely accepted definition of the term is a psychological tendency to evaluate a given entity with some degree of favour or disfavour (Eagly & Chaiken, 1993; Zanna & Rempel, 1988). Besides the "explicit" attitudes that we usually measure, people also have "implicit" attitudes (Greenwald & Banaji, 1995). Greenwald and Banaji define the latter as "introspectively unidentified (or inaccurately identified) traces of past experience" (p. 5) that mediate overt responses. Explicit attitudes are usually equated with deliberative and self-reported evaluations, while implicit attitudes are typically inferred from people's performance on response latency measures, such as the Implicit Association Test (IAT) (Greenwald et al., 1998).

Gawronski and Bodenhausen (2006) argue that implicit and explicit attitudes should be understood in terms of their underlying mechanisms, which can be described as associative processes for implicit attitudes and propositional processes for explicit attitudes. They characterize associative evaluations as "automatic affective reactions resulting from the particular associations that are activated automatically when one encounters a relevant stimulus." Such activations do not require much cognitive capacity or the intention to evaluate an object (Cunningham et al., 2004). By contrast, propositional processes are described as “evaluative judgments that are based on syllogistic inferences derived from any kind of propositional information that is considered relevant for a given judgment.”

Contemporary models of persuasion have been very successful in explaining the influence of different kinds of message cues on self-reported explicit attitudes (see Visser & Cooper, 2003). However, changes in implicit attitudes are still largely unexplained. Explicit attitudes come from one’s deliberate evaluative judgments, while implicit attitudes come from one’s automatic evaluative reactions. What we usually measure is an individual’s self-reported attitude, his or her conscious thinking through of an issue. However, individuals also have a subconscious attitude that can play a great role in guiding their behaviour. They often do not initially have access to this type of judgment. It is formed automatically and so cannot be consciously controlled. The association between implicit attitudes and behaviours is thus stronger than that between explicit attitudes and behaviours.

Past research has mainly focused on influencing the effect of an individual’s explicit attitudes on his/her deliberate actions (Bhattacherjee & Premkumar, 2004;Yang & Yoo, 2004;Barki & Hartwick, 1994). In this study, we will lead people through associative or propositional processes to elicit their implicit and explicit attitudes. We expect to find that an individual’s implicit attitudes can motivate spontaneous behaviours and thus bridge the gap between beliefs and actions.

3.4 Conditioning and Attitude Formation

The prototypical case for implicit attitude changes resulting from changes in associative structure is evaluative conditioning (see De Houwer et al., 2005). Generally speaking, conditioning involves connecting the target unconditioned stimulus (US) with a conditioned stimulus (CS). Because of this association, people may develop attitudes toward the neutral US because of their attitudes about the CS. Evaluative conditioning (EC) refers to the changes in affection towards a stimulus that are due to the fact that it has been paired with other positive or negative stimuli (De Houwer, 2001). In EC studies, a neutral stimulus is usually paired with an affective stimulus, and changes in the valence of the neutral stimulus are measured. Several researchers have demonstrated that changes in implicit attitudes can result from repeated pairings of an attitude object with positive or negative stimuli (Dijksterhuis, 2004; Baccus et al., 2004).

Evaluative conditioning can also influence explicit attitudes if participants are aware of the relationships between the CS and US and can accurately report them. A regular finding in conditioning research is that with repeated exposure to a CS/US combination, subjects learn that presentation of a particular US is contingent on the presence of a specific CS. This recognition of the CS/US pairing pattern is referred to as "contingency awareness" (Allen & Janiszewski, 1989). Kim et al. (1996) studied the effect of the conditioning procedure on attitudes through both affective and cognitive mechanisms, which refer to direct effect transfer and inferential belief formation, respectively. Their mechanism corresponds to the formation of implicit and explicit attitudes.

In this paper, we integrate this evaluative conditioning mechanism to transform explicit and implicit attitudes through different processes. The US in the study is the extent of “green” attributes. We wish to condition people’s reactions to high and low energy consumption. In one condition, we associate unpleasant natural scenery with high energy consumption and beautiful scenery with low energy consumption. Since “greenness” is closely related to nature, people can guess the relationship and thus be aware of the contingency between the CS and US. In this fashion, their explicit attitudes will be elicited. Similarly, we associate happy faces with low energy consumption and sad faces with high energy consumption.

According to the pretest, people find it hard to guess the relationship between greenness and faces. Thus, this mechanism will elicit their implicit attitudes.

3.5 Combination of the Trade-off Tool and Conditioning Mechanism

We combine the trade-off transparency tool with the conditioning mechanism in our persuasive design. Customers are asked to give their preferred level for each product attribute by moving the button left or right (as shown in Figure 3 below). Each time they move the attribute level, the other related attribute levels change accordingly. Each attribute is also related to price and energy usage. Their levels will automatically adjust because of the trade-off relationships, which are calculated according to real product data. As stated before, "greenness" (Energy Usage) is our US. We put the CS (the picture stimulus) beside the attribute bars. When the level of "greenness" changes, the pictures also change to perform conditioning.

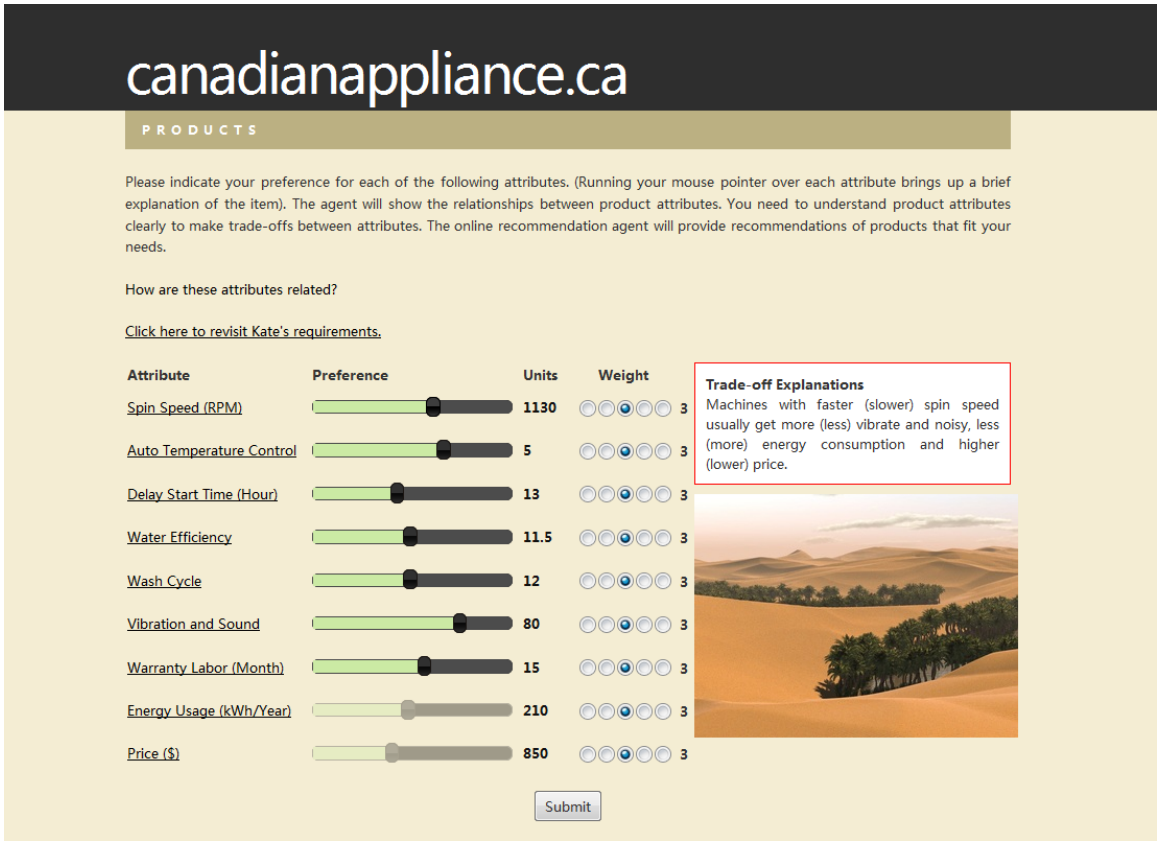

Figure 3 Interface of the Persuasive Design

We have made our persuasive design a combination of the trade-off transparency tool and the conditioning mechanism for the following reasons:

1. The trade-off tool allows customers to reconstruct their attribute preferences.

When this PRA interactively demonstrates the trade-offs among product attributes, it informs customers of all their possible choices. When buyers realize that their original preference may be unrealistic or cost too much, they will reconsider the actual options and weigh the importance of each attribute again. Customers actively initiate this reconstructing process, allowing the PRA to exert persuasive influence on their product preferences through the conditioning mechanism.

2. The trade-off transparency and conditioning mechanisms have great power to affect targeted behaviours.

As stated previously, the trade-off tool enhances customers' understanding of both green and other product attributes. This greatly strengthens their perceived behavioural control over purchasing "green" products and therefore contributes to their "green" purchasing intentions. We also influence their attitudes to purchasing green with the conditioning mechanism. According to the theory of planned behaviour, both perceived behavioural control and attitude can change behavioural intentions and then targeted behaviours. Therefore, the combination of the two mechanisms will have great persuasive power.

3. The trade-off tool is a perfect platform for conditioning.

As previously stated, conditioning is pairing a US with a CS. People must have iterative exposures to both stimuli to form the association. In our trade-off tool, customers slide the attribute level left and right to show a continuous change. Different CS can be combined with different attribute levels. When customers try to specify their preferences by moving the attribute levels, they will be exposed to CS (nature or face pictures) continuously and iteratively. Therefore, this serves as an ideal platform for conditioning.

In summary, we combine the trade-off transparency tool with the conditioning mechanism in the PRA to: 1. create the opportunity to let customers reconsider and reconstruct their preferences; 2. strengthen their behaviour change; and 3. serve as a platform for the conditioning mechanism.

3.6 Theoretical Model

We propose a research model that explains a customer's green purchasing behaviour. It is based on the Stimulus-Organism-Response (S-O-R) model in environmental psychology (Mehrabian & Russell, 1974), along with the theory of planned behaviour (Ajzen, 1991) and theories on implicit and explicit attitudes (Gawronski & Bodenhausen, 2006).
The S-O-R model posits that the various stimuli in a shopping environment will influence a consumer's organism (e.g., cognitive and affective processes), which in turn determines his or her responses.

Stimuli are cues external to the customers that rouse or incite them (Belk 1975), and may have different forms. In the context of online purchasing, stimuli pertain to the design features of the product websites with which consumers interact (Eroglu et al., 2003), such as visual appeal (Parboteeah et al., 2009) and interactivity (Jiang et al., 2010). In our case, the trade-off tool and the conditioning mechanism are the design features of the website.
The organism refers to the intervening processes (e.g., cognitive and emotive systems) between the stimuli and the reaction of the consumer (Bagozzi, 1986). In our study, we focus on the question of how people shape their "green" attitudes and intentions so they can perform "greenly." We are also interested in the response, which refers to behavioural responses (Jacob, 2002, p. 55), of people's choices of "green" products.

Since our research model is based on the TPB, we imported some of its constructs into the context of green purchasing. TPB does not distinguish between implicit and explicit attitudes, but treats attitudes as a unitary construct. In contrast, we make a distinction between the two types. According to the definition of implicit attitude, it will lead to automatic behaviours. Therefore, it will directly link to people's behaviours, while explicit attitude still functions by

inducing people's intentions first. Hence, people's "green" intentions will lead to "green" behaviours.

On the other hand, the trade-off transparency tool can greatly add to people's perceived control. In our case, it will facilitate customers' understanding of "green" products and thus strengthen their expertise and ability to purchase them. This can increase their "green" intentions or contribute to their "green" behaviours directly (See Figure 4 for the theoretical model).

We form the following hypotheses in the context of "green" purchasing behaviours:

Proposition 1: *A conditioning mechanism will influence one's implicit "green" attitude through the associative process.*

Proposition 2: *A conditioning mechanism will influence one's explicit "green" attitude through the propositional process.*

Proposition 3: *One's implicit "green" attitude will influence one's "green" purchasing behaviours directly.*

Proposition 4: *One's explicit "green" attitude will influence one's "green" purchase intentions directly.*

Proposition 5: *The trade-off transparency tool can strengthen people's expertise and ability to purchase "green" products.*

Proposition 6: *One's expertise and ability to purchase "green" products will lead to "green" purchasing intentions.*

Proposition 7: *One's expertise and ability to purchase "green" products will lead to "green" purchasing behaviour directly.*

Proposition 8: *The subjective norms on "green" purchasing will lead to "green" purchasing intentions.*

Proposition 9: *One's "green" purchasing intentions will lead to "green" purchasing behaviour directly.*

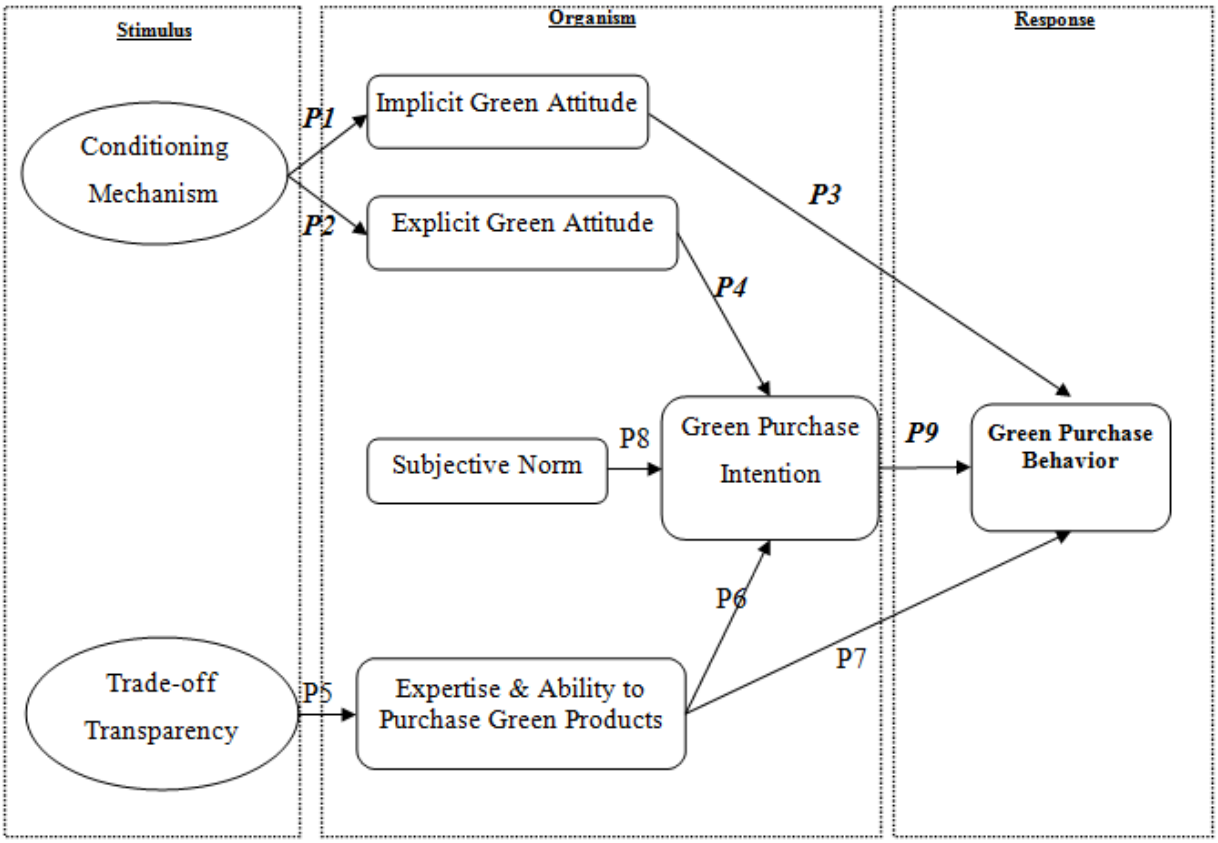

Figure 4 Theoretical Model

In this study, we wish to test the upper part of the theoretical model empirically (P1, P2, P3, P4, P9). Specifically, we want to see whether the conditioning mechanism can persuade customers successfully. In the experiment designed to test this, participants will be involved in a purchasing task online. The control group will experience the PRA without the conditioning mechanism. Others will be exposed to the PRA with our persuasive features (conditioning mechanism). We will also use the conditioning mechanism to elicit implicit and explicit attitudes and compare which is more effective in provoking "green" behaviour.

We are also interested in exploring the effects of the trade-off transparency tool in our future research. Can it indeed increase people's behavioural control and thus strengthen "green" intentions and actions? To study this, we will compare the results obtained from a control group using the PRA without the trade-off tool with those from users in the trade-off tool condition.

Chapter 4: Design of the Experimental Platform

4.1 Choice of a "Green" Product

When deciding which kinds of products to purchase online, we considered the following three aspects related to "greenness":

1. Whether or not it is a recognized "green" product

Different types of products will vary in their degree of impact on the environment. As a result, some products may prime the environmentally responsible attitude/behaviour more than others, such as cars vs. mp3 players. We consider it more important to promote products whose use implies greater environmental responsibility. For example, washing machines are always highly relevant to the environment and related issues. They need to consume extensive resources for a single operation. Indeed, engineers have poured huge efforts into creating washing machines that can save water and electricity without compromising on performance.

2. Whether the product has a clear indicator of "greenness"

Environmentally preferable products or services are defined as those "that have a lesser or reduced effect on human health and the environment when compared with competing products or services that serve the same purpose." This is a relatively fuzzy definition that creates great difficulty for customers when identifying "green" products; neither does it help in measuring the effectiveness of persuasion. Washing machines, as electronic appliances, have "Energuide rating" scores that provide concrete indications of their annual energy consumption, and we use these as more reliable indicators of "greenness" in our study.

3. Whether or not trade-offs exist between product attributes

First, products must be complex enough to be suitable for our multi-attribute and multi-alternative preference choice tasks. Moreover, since one feature of our design is trade-off transparency, the products chosen should have attributes whose desirability is in conflict with that of other attributes. For example, a laptop with a bigger screen will suffer from a heavier weight. Apparently, the desirability of these attributes (screen size and product weight) is not

positively related. For this reason, a washing machine has many conflictingly related attributes. For instance, a machine with a higher spin speed will normally be noisier.

Considering the reasons above, washing machines are a good choice of product category to be purchased online for this study.

4.2 Trade- off Transparency Design

4.2.1 Trade-off Level and Relationships

Xu et al. (forthcoming) has discovered the association between the number of showed trade-offs and users' evaluation and experience of the system. They found a curvilinear relationship between perceived enjoyment and the number of trade-off relationships revealed. Furthermore, a similar curvilinear relationship exists between product diagnosticity and the trade-offs that were demonstrated. Both of these findings highlight that a certain number of trade-offs will advance system usage by adding fun as well as clarity. However, with the increase of trade-offs, there is also a danger of confusing customers by overwhelming them with too much information. Under high levels of trade-off transparency, consumers may become less interested in the website interface and may make poorer decisions. Thus, when designing an RA interface, practitioners should demonstrate a medium level of product trade-off relationships (Xu et al., forthcoming).

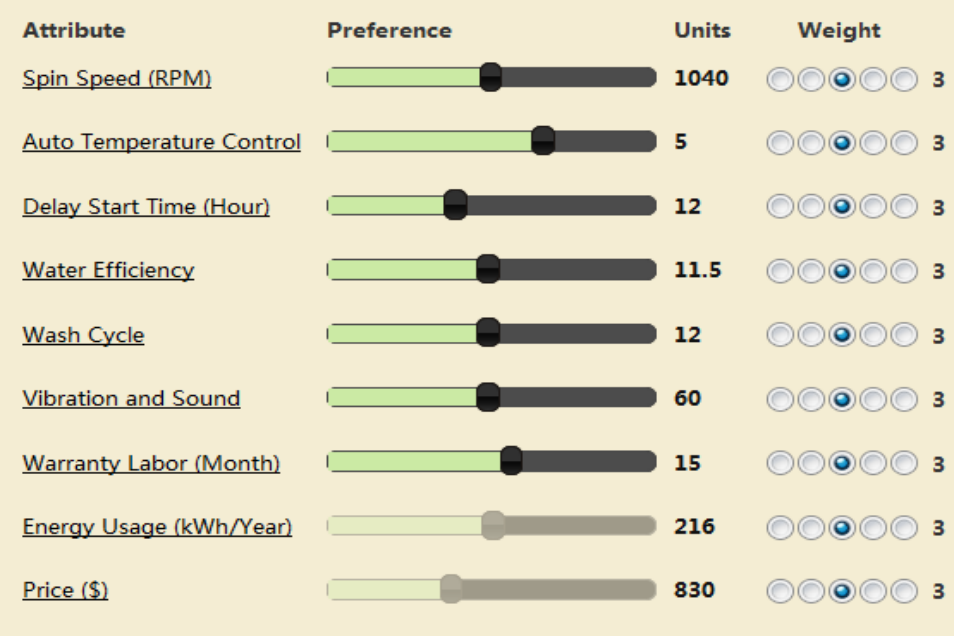

Figure 5 Demonstration of Trade-off Transparency Design

Consistently with the findings of Xu et al., in this study, the tool will demonstrate a medium level of trade-off transparency. Nine attributes of a washing machine will be given. As shown in Figure 5, people can select their desired levels of the input attributes. When they move the level indicator of an attribute left or right, its related output attribute levels will move simultaneously to show the trade-offs. For example, if people turn the spin speed level up (to the right), the energy usage level will decrease (go to the left), and the price and noise levels will rise. Energy Usage reflects the "estimated energy per year of machine use" and serves as the indicator of "greenness" for a machine. Since changing "greenness" and price will affect almost all attributes, we use them only as output attributes, meaning that changes in their levels are due to changes in other attributes' levels. Other than these two attributes (price and energy consumption), trade-off relationships also exist between "green" and "non-green" characteristics. Table 1 shows the trade-off relationships we reveal in the tool.

InputAttr / OutputAttr	Spin Speed	Auto Temp Control	Delay Start Time	Water Efficiency	Wash Cycle	Noise Level	Warranty Time
Energy Consumption	Related	Related	Related	Related	Related	Related	Related
Price	Related	Related	Related	Related	Related	Related	Related
Spin Speed						Related	
Auto Temp Control					Related		
Delay Start Time							Related
Water Efficiency							
Wash Cycle		Related					
Noise Level	Related						
Warranty Time			Related				

…..are output attributes (can only be changed according to input attributes)

…..are input green attributes

…..are input non-green attributes

Table 1 Attributes' Trade-off Relationships

4.2.2 Trade-off explanations

Since most study participants are not familiar with the attributes of a washing machine, we provide a detailed introduction before the experiment. This supplies them with knowledge of the relevant characteristics and the possible trade-offs between them (See Figure 6 for a screen shot).

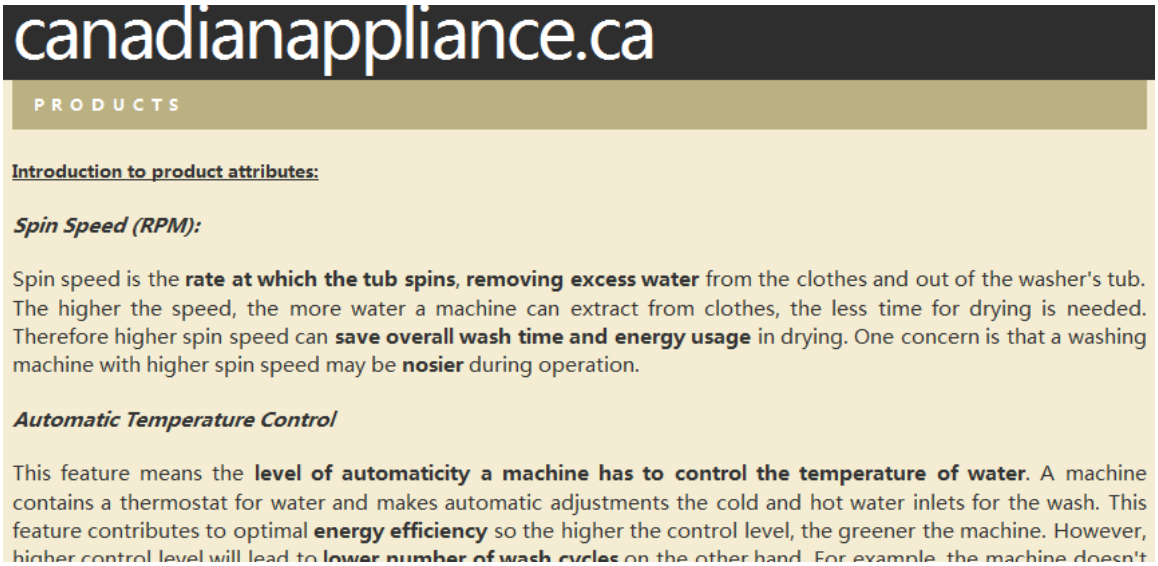

Figure 6 Introduction Page of Products Attributes

Each attribute is defined and its relationship to other attributes explained. For example, we introduce spin speed by giving its definition (the rate at which the tub spins, removing excess water from the clothes and out of the washer) and address its relationship with noise (a higher spin speed may create more noise during operation).

In case people forget the meaning of attributes from the introduction, we also provide brief explanations of them when participants interact with the PRA to express their product preference. When the mouse moves to each attribute, an explanation will show automatically (See Figure 7).

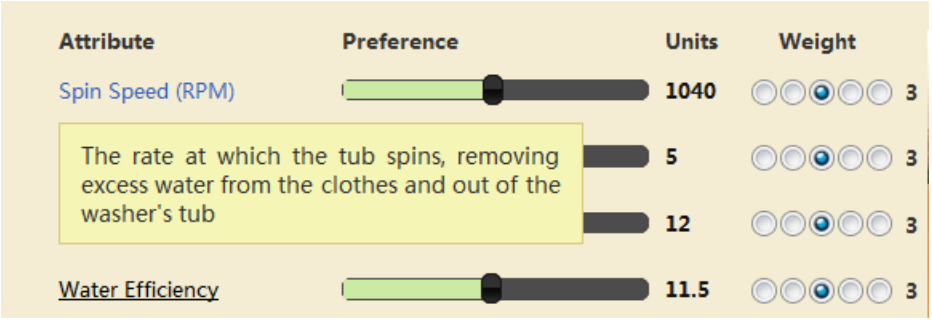

Figure 7 Trade-off Explanations – Attribute Explanations

Furthermore, we wished to make sure that customers trust the trade-off relationships we generated. In fact, we gathered 60 products' information from real online washing machine websites and calculated the trade-off relationships by running a regression of the data. We explained this process in case the participants wondered why and how the attributes were related as told. Again, when the mouse moves to the attribute, the explanation appears (See Figure 8).

Figure 8 Trade-off Explanations – Mechanism Explanations

Finally, we want the participants to understand each attribute's relationship to the others. To that end, we make sure that when they raise or lower the level of an attribute, they see explanations of how it affects the other attributes above the pictures (see the right side of Figure 9).

Figure 9 Trade-off Explanations – Relationship Explanations

4.3 Conditioning Stimulus Design

4.3.1 Framework of the Conditioning Design

As stated previously, the conditioning mechanism can influence explicit and implicit attitudes. When people understand the relationship between the US and the CS, they go through a propositional process, which is somewhat like a cognitive learning process, and then form explicit attitudes. On the other hand, when they do not know the relationship between the stimuli, they go through a process of association, which generates implicit attitudes.

The level of relevance between the US and the CS usually determines whether people can guess their relationship or not. If the stimuli are highly relevant to or are associated with each other, people can easily determine how they are related. For example, "greenness" (US) and trees (CS) are highly associated. In fact, when the "greenness" level hits zero, no tree is shown. However, when a user moves to one degree of "greenness", the stimulus will be one tree; two degrees corresponds to two trees, and so on. People will understand immediately

that more trees indicate a higher level of "greenness." They can even guess the underlying persuasive arguments: choosing a higher level of "greenness" contributes to more trees and a better environment.

On the other hand, if the US and CS are not associated with each other, it is difficult for people to understand why they are related, or to even realize they are related at all. Most of the time, they do not know why the CS is there or why it changes. They may not even realize that they are being influenced by the conditioning mechanism. Even though people are not conscious of the process, however, previous research has found that they may transfer their automatic reactions, such as assumptions, affects and emotions, to the US. For example, if we relate the degree of "greenness" with the attractiveness of animal pictures by associating animals like snakes and spiders with lower degrees of "greenness" and cute dogs and cats with higher levels, people's disgust or liking of the images can be transferred to the degree of "greenness" subliminally. People may also transfer inferences they have already made about the CS to the US. For instance, we relate products with high "greenness" with happy faces and "non-green" ones with sad faces. If someone is used to inferring good performance from happy faces and bad performance from sad faces, he or she may assume that "green" products perform better than "non-green" ones. Meanwhile, if a person habitually infers social recognition from happy faces and social rejection from sad faces, he or she may think buying "green" products will bring more approval from others.

In this study, we investigate different conditioned stimuli in the system. We wish to lead people through propositional or associating processes to see the persuasive effectiveness of the conditioning mechanism.

4.3.2 Conditioning Design

In the pre-study, we adopted two stimuli for each process, as illustrated in Table 2 below. After reviewing feedback from participants, we found that nature and face pictures are more effective in influencing behaviour. We therefore adopted these two stimuli in our conditioning design.

Evaluation Method	Aim	Awareness of US and CS Relationships	Relevance between CS and US	CS
Propositional Process	Try to influence customers' *explicit attitude* toward "green" attributes by cognitive learning.	Yes	High	Colour (colour box, background) **Nature pictures**
Associating Process	Try to influence customers' *implicit attitude* toward "green" attributes by affect transfer.	No	Low	Cat pictures **Face pictures**

Table 2 Conditioning Design

The Propositional Process:

The Colour Box or Background Condition

In the colour condition, when the degree of "greenness" moves higher, the system displays colours gradually changing from red to green. We tested two forms of colour manipulation. The first involves showing a colour in a box beside the attribute slide (Figure 10), while the second has the background colour and the page changing together. We think the colour change in the background may get more attention, but it may be easier for people to think of the colour box as a judging criterion Since it looks like an indicator or meter.

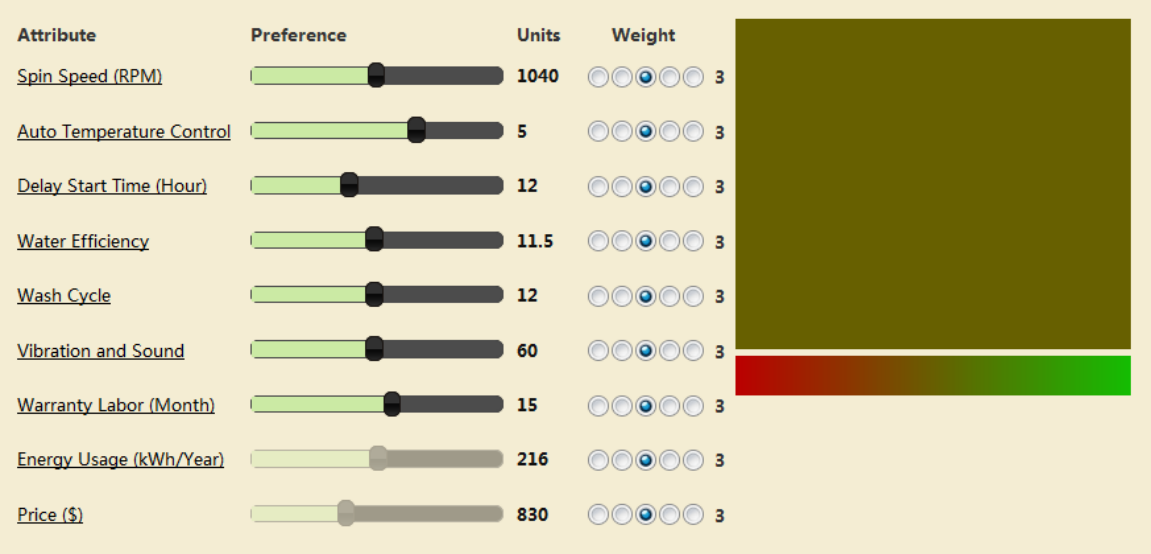

Figure 10 Conditioning Design – Colorbox

The Nature Condition

Firstly, we wished to link "greenness" with an image of the environment (Figure 11). When the "greenness" of a washing machine is low, the conditioned pictures will show a desolate desert. With an increase in "greenness," the pictures will gradually fill with trees and water. We selected 20 pictures that ensure coherent scenery and gradual change. We also interviewed three people for their opinions on the progression of the pictures and chose ten final candidate images. We created an online survey with the ten pictures and asked nine people to rank them from 1–10 (two pictures could receive the same rank). Based on their average rankings, we chose seven pictures from the ten. Each picture is at least 1.5 ranks away from its neighbour (see Appendix F for the ranking scores).

Figure 11 Conditioning Design – Nature Pictures

The Associating Process:

The Cat Condition

We wanted to link the "greenness" of washing machines to the cuteness of cats in pictures (Figure 12). The reason we chose cat pictures is twofold. First, cats are commonly seen in life. Because people are familiar with cats, their reactions may be more consistent across demographics compared to their reactions to other animals like pigs or bears. Second, cats can sometimes be annoying and repulsive. They can be unpleasant looking, making it easier to find pictures with discernible differences.

As we did with the nature images, we made a pretest to discriminate between the cat pictures. We chose 24 images to include in an online survey. We ask people to rate their affect feelings to the cats on a scale of 1 (dislike very much) to 10 (like very much). See Appendix F for the liking scores.

Figure 12 Conditioning Design – Cat Pictures

The Face Condition

In addition to the previous conditions, we also want to associate a washing machine's "greenness" with facial expressions (Figure 13). When "greenness" is at its lowest, there will be a crying face. As it increases, the face will gradually change from unhappy, to doubtful, to neutral, to gently agreeing, to smiling, to laughing. We chose faces as stimuli because they can convey feelings universally. They are always used in designs because facial expressions influence people easily, even in cartoon form. We took faces from a picture design company and adapted them using Illustrator. They were also pretested in five interviews to confirm their discernibility. People were asked to rank the face pictures in a way they could justify. Everyone arranged the faces in the same order according to their degree of happiness, and thus we use this ranking system in our experiment (see Appendix F). People in the pretest also indicated great empathy with the faces. For example, when the faces became happier, they said they also felt happier, and they felt sad when they saw the sad faces.

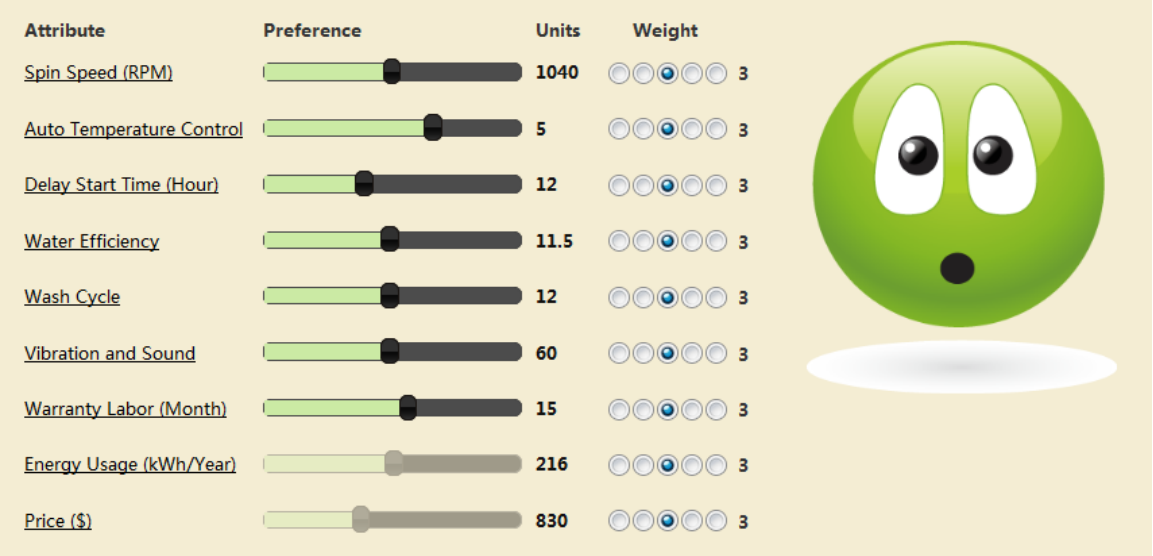

Figure 13 Conditioning Design – Face Pictures

Finally, we included a control group with no conditioning mechanism, and thus no CS (Figure 14).

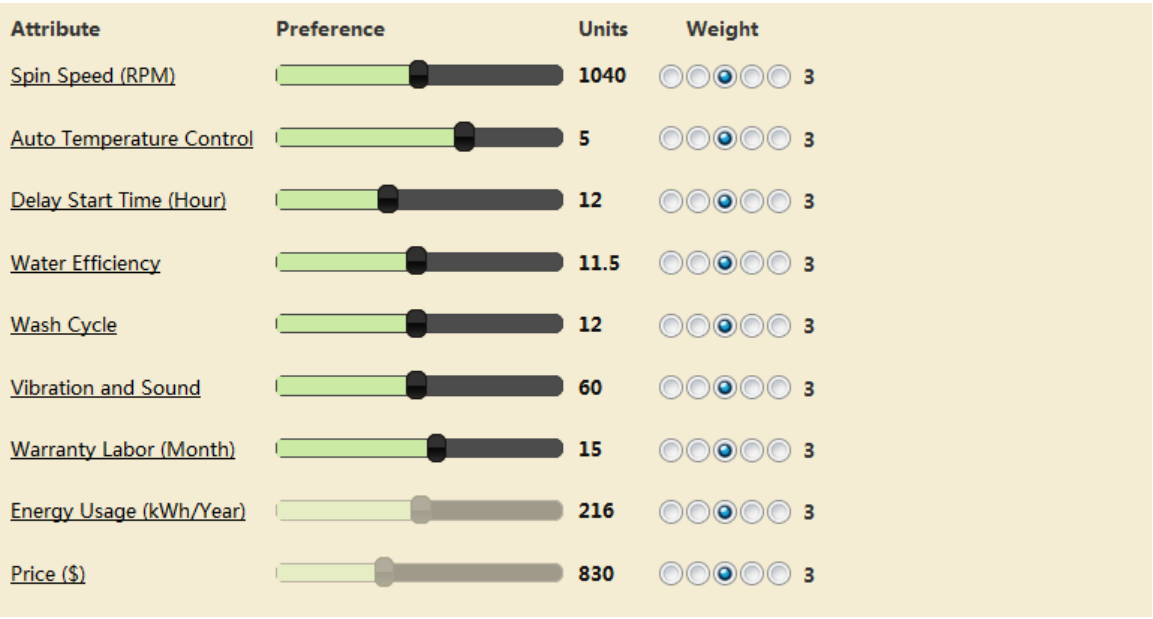

Figure 14 Conditioning Design – Control Condition

4.4 System Procedures

The first page participants see is the consent page. This is a basic introduction describing the study's purpose, procedures, remuneration, confidentiality and contacts for information or concerns about their rights. They are also informed that their participation in this study is entirely voluntary and that they may withdraw from it at any time. They must click the check box stating, "I consent to participate in this study and I am over nineteen years of age" to proceed.

After this, they are led to a pre-questionnaire. Along with some control questions, this part contains questions that measure their "green" attitude and demographics. All the questions are divided into seven-level Likert scales, with 1 being "strongly disagree" and 7 "strongly agree." They must provide demographic data on their gender and age, as well as on their experience using computers and purchasing products online.

After finishing the pre-questionnaire, the participants must read the study instructions. The instructions ask them to imagine a friend called Kate who is planning on buying a washing machine for her home and who asks for help (see Appendix C). They are told that they will be directed to a washing machine website to make a choice for Kate. They must put themselves in Kate's position and consider her requirements. They are advised to read the introduction explaining all the attributes of a washing machine carefully because trade-offs between product attributes always exist. It is essential to fully understand these product attributes to make an informed choice.

Kate has many requirements for a washing machine. However, these requirements are in conflict with each other. The participant must weigh each requirement and sometimes sacrifice the unimportant ones. We made the purchase scenario close to reality. It is assumed that a person would be more than happy to buy a "green" product if there is no additional cost involved. Realistically, though, a "green" product always suffers insufficiencies in some areas, a significant one being a higher price that many customers are unwilling to pay.

We next introduce information about washing machine attributes. After reading it, participants enter the preference elicitation page, which gives the requirements and weight for each attribute. It is on this page that we place our trade-off tool and conditioning stimuli. Participants are randomly assigned to different CS (colours, landscapes, cats or faces). After participants give their preferences, the system provides recommendations. The algorithm compares their elicitation with the product attribute information. The more different a product is from the elicited attribute level, the higher the misfit score it will get. The product with the lowest misfit score will be recommended first (see Appendix H for the algorithm).

The participants must choose from the 60 washing machines in the product database. Six products are presented on each page and there are ten pages in total. Each product has a picture, along with basic attribute information (Figure 15). The system also provides a fit percentage according to the user's elicited preferences (see Appendix H).

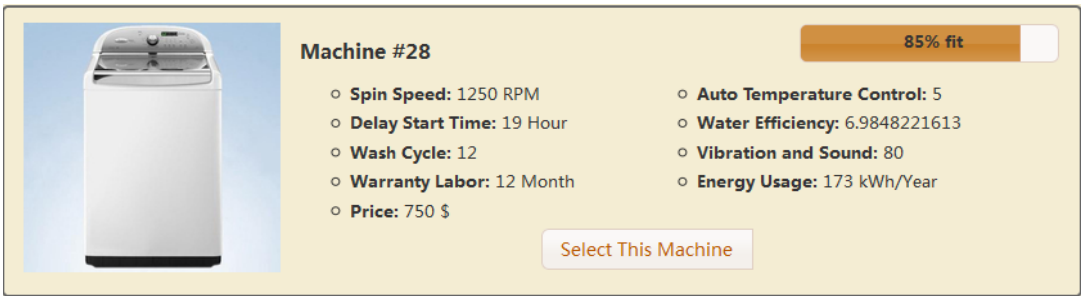

Figure 15 Product Presentation

After they make a final choice, participants are directed to post-questionnaires, which ask about their intentions to act "greenly," and elicit an evaluation of the system on perceived usefulness, enjoyment, trust, reuse intentions, and so on (see Appendix B for details). Figure 16 provides experimental procedures based on a change of computer interfaces.

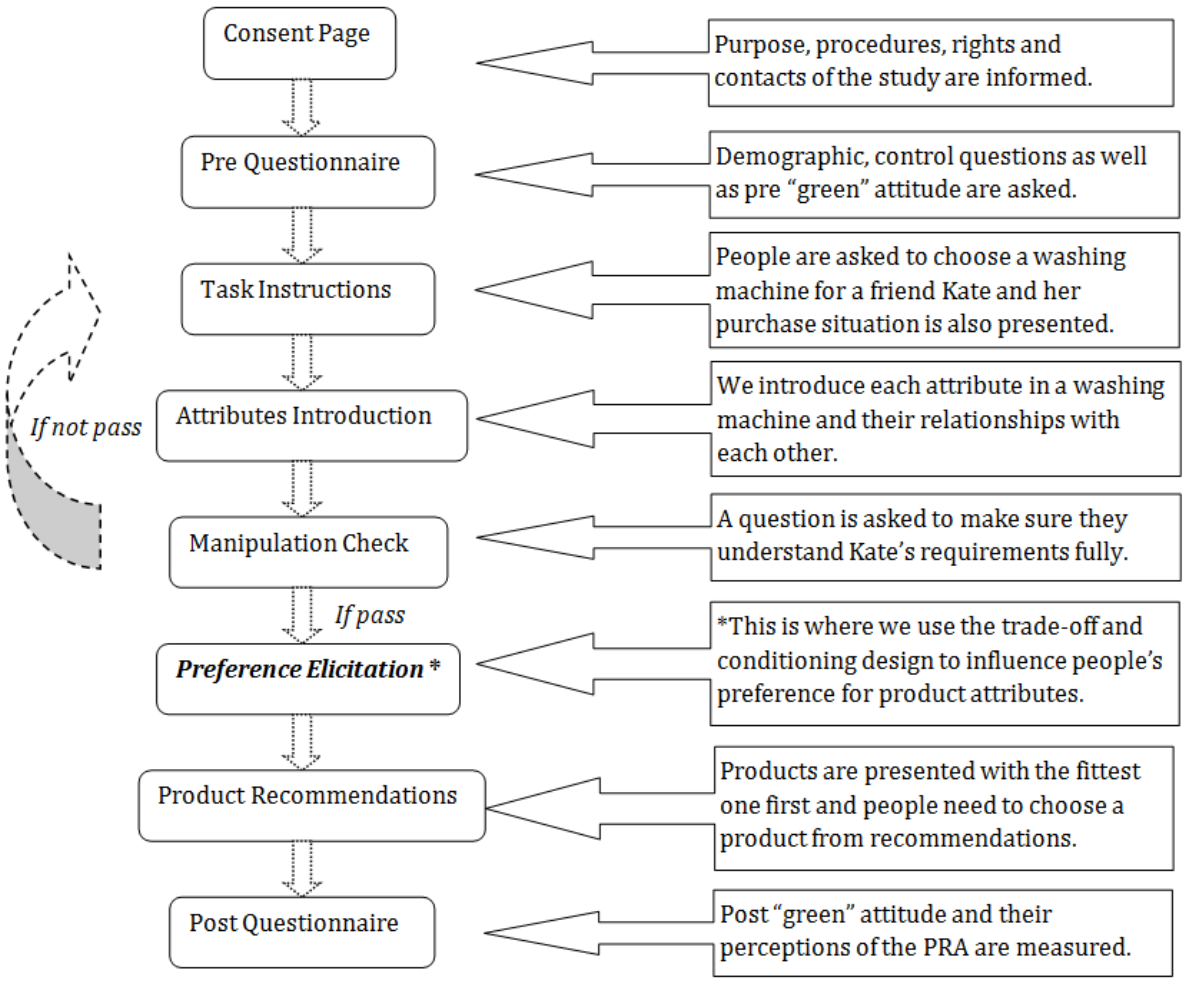

Figure 16 Flow Chart of Experiment Procedures

4.5 Pre-Study on Conditioning Design

A pre-study was done to test the effectiveness of the conditioning design. In it, participants were recruited by advertisements for an "online shopping study" posted on campus, and were asked to e-mail the researchers to participate. Respondents were asked to browse through products from a shopping website and then answer some questions about their experience. After the experiment, each person received a guaranteed $10 for her/his participation. The study was conducted at the MIS lab in the Henry Angus Building, located near the centre of the campus, and only took about 30 minutes per participant. Forty-five people contacted me through email, and 41 confirmed an experiment time. In the end, 39 participants completed the experiment.

In the pre-study, we sought to obtain a qualitative analysis of the system design. Participants were placed in front of a computer with the designed system. They were told to go through the system and follow its instructions. Upon reaching the end, the participant was instructed to inform the experimenter, who would then interview him or her to discover his/her opinions about the purchasing experience. The participants were also asked to inform the experimenter any time they had questions about system usage.

We looked at the variables "Attribute Level—Energy Consumption" and "Attribute Level—Price" when interviewing participants about "greenness." "Attribute Level—Energy Consumption" is customers' preferred level of energy use. "Attribute Level—Price" is the preferred price for the product. The purpose of selecting these two was to test whether customers are willing to sacrifice price for "greenness."

On the other hand, "Choice of Product—Energy Consumption" is the energy consumption level of their chosen product, while "Choice of Product—Price" is the cost. We use these two measures to see their actual "green" behaviours.

We also measured "Choice Satisfaction" (meaning satisfaction with the washing machines chosen for Kate at the shopping website) and "Choice Confidence" (or the confidence that Kate would like the chosen product).

	Control(2)	Cat(3)	Colour(2)	Colourbox(3)	Nature(15)	Face(12)
Attribute Level: Energy Consumption	224	218	215	205	198	197
Attribute Level: Price	940	987	980	990	1021	1032
Choice of Product: Energy Consumption	167	170	208	189	166	167
Choice of Product: Price	765	783	690	800	813	803
Choice Satisfaction	6	5	4.5	5.33	5.87	6
Choice Confidence	6	4.67	3.5	6	5.6	5.71

Table 3 Effectiveness of Conditioning Design from Pre-study

We performed an analysis of the data collected in the pre-study. The persuasiveness of each condition is listed in Table 3. We can see that, in the pre-study, the nature and face pictures were more effective in influencing people to choose a product with lower energy consumption. From interviews with participants, we also found that nature and face pictures were more appealing and held their attention better. They thus exerted a greater influence. Therefore, we adopt nature and face pictures as representative stimuli for the propositional and associative processes in our conditioning.

4.6 Research Method and Hypothesis

4.6.1 Hypothesis

We are interested in whether the conditioning mechanism can persuade customers successfully in our PRA. As discussed in our theoretical model, a conditioning mechanism can influence people's explicit or implicit attitudes, affecting behaviours directly or indirectly. Therefore, we propose that:

H1: *Compared to the PRA without a conditioning mechanism, PRAs with a conditioning mechanism can persuade customers to prefer and purchase "greener" products.*

Contingency awareness entails conscious recognition of the relational pattern between the conditioned and unconditioned stimuli used in a conditioning procedure. Argument about whether contingency awareness is beneficial to condition behaviours has never ceased. Traditionally, Pavlovian classical conditioning is commonly interpreted as implicating a non-cognitive learning mechanism without contingency awareness. Following this tradition, conditioning mechanisms are usually portrayed as automatic, non-volitional (Shimp, 1982), and even uninhibited by consciousness in market research (Kassarjian, 1986; Kroeber-Riel, 1979). However, Bandura (1974, P. 859) argues that "Conditioning is simply a descriptive term for learning through paired experiences, not an explanation of how the change comes about. Originally, conditioning was assumed to occur automatically. On closer examination it turned out to be cognitively mediated. People do not learn despite repetitive paired experiences unless they recognize that events are correlated." Much research has since emerged to support Bandura's inference (Perruchet, 1985). Allen and Janiszewski (1989) have found that contingency learning or awareness may be a requirement for successful attitudinal conditioning. Therefore, we expect that the contingency awareness in the conditioning design of our study should help customers perform the targeted behaviour. As stated before, when people see the nature pictures, they can guess that they are related to "greenness." Therefore, contingency awareness is created by conditioning through the images. On the other hand, since they do not know that face pictures are associated with "greenness," they experience no contingency awareness. We propose that:

H2: *Compared to the conditioning mechanism with face pictures, the mechanism with nature pictures can better persuade customers to prefer and purchase "greener" products.*

In the experiment, we give participants a purchasing situation confronted by Kate, a friend who asks their help to choose a washing machine. We ask them to put themselves in Kate's place. Moreover, we want to make sure that our description of Kate's requirements does not bias their choice. Therefore, we have two versions of her needs. In one condition, Kate cares about "greenness," while in the other, she does not. Generally speaking, when Kate does not require a "green" washing machine, we expect that participants will sacrifice "green" attributes for others. Therefore we propose:

H3: *In the control condition, participants will prefer and purchase "greener" products when Kate has "green" requirements.*

Similarly, when the conditioning mechanism functions through the propositional process, people will recognize that the nature pictures are related to "greenness." Even though the simulation of the environment may influence them, they bear Kate's requirements in mind and may choose to ignore the conditioning mechanism. However, when Kate wants a "green" washing machine, the pictures will serve as vivid indicators and may make them care more about the environment. Therefore, we propose:

H4: *The conditioning mechanism with the nature pictures has more persuasive power when Kate wants something "green."*

On the other hand, when the conditioning mechanism functions through the associative process, people are influenced implicitly. They do not know why the pictures are there. Therefore, whether or not Kate wants something "green," the mechanism will affect them. We propose:

H5: *The conditioning mechanism with face pictures has equal persuasive power whether Kate wants a "green" machine or not.*

4.6.2 Independent Variables, Dependent Variables and Sample

A 3 (conditioning stimulus: control, nature pictures, face pictures) X 2 (Kate's requirements: "green" or not) between-subjects experiment design was implemented to test the hypotheses. See Appendix F for the conditioning design and Appendix C for Kate's requirements.

As in the pre-study, we use the participants' elicitation of "energy consumption" and "price" to show their preferred "greenness." The "energy consumption" and "price" of their chosen products indicate their actual "green" behaviour.

Other than this, we are also interested in their perceptions of the PRA. Thus we measure their reuse intention and satisfaction, usefulness and ease of use, enjoyment and decision effort, and trust. See Appendix B for details.

In the formal study, we cooperate with an online panel company to find participants. Participants are given points provided by the company, as well as the chance to win an extra $20, which is awarded to the top 20 performers of the task (those whose chosen product best fits Kate's needs). The experiment's procedures are the same as those in the pre-study. The UBC Ethics Board approved this study in March, 2012. The certificate of approval—minimal risk from the Behavioural Research Ethics Board (BREB) is attached in Appendix G.

Chapter 5: DATA ANALYSES AND RESULTS

5.1 Sample Characteristics

The sample consists of 180 subjects from an online panel company. There are 30 participants in each of the six (2*3) cells.

Since we do not require specific demographic features, our participants encompass a wide range of people (see Appendix A). In terms of gender, 46.7% are male among the 180 participants. Each cell has similar percentages of females and males.

Our only requirement is that participants be over nineteen years old. Participants range from 19 to 77 (Figure 17). The mean of their ages is 48.5 years. Most participants are middle aged (47.2% are between 37–59 years old). This group of people has enough life experience that it should be easy for them to sympathize with Kate's requirements for convenience and affordability.

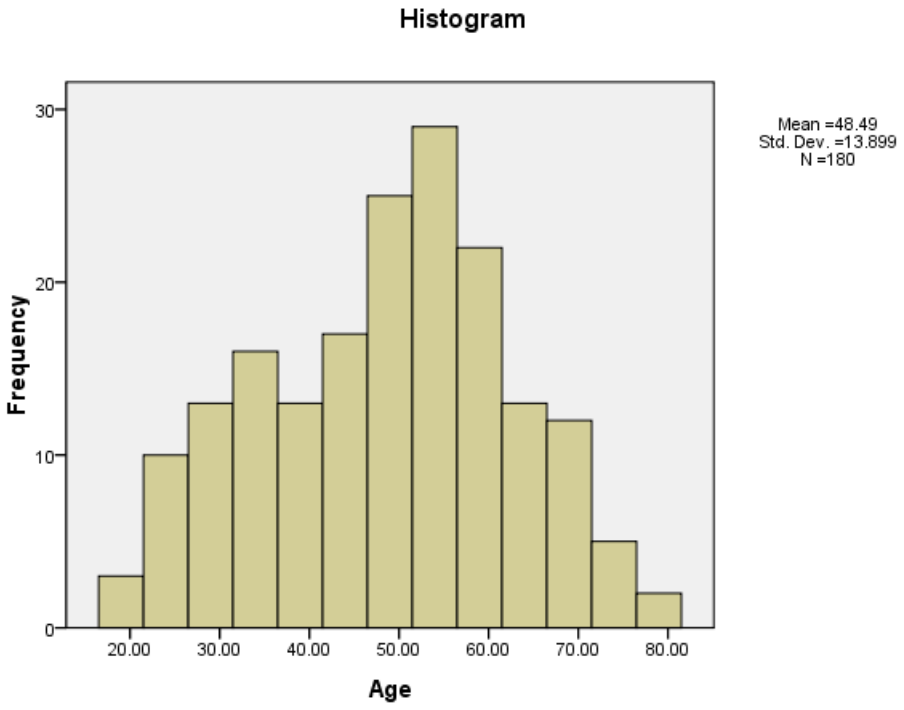

Figure 17 Bar Chart on Participants' Age

We also recorded participants' income, education and marital status. Most earn around $40,000 to $55,000 (the median and mode, respectively, of participants' yearly income). Thirty-four percent have an income below $30,000; 15% earn above $90,000; and the rest (51%) fall in the middle. We can infer from their income that most of our participants would consider the price of a washing machine as Kate does.

The median and mode of participants' level of education are both "some college, no degree.". Fifty-one percent have education below a bachelor's degree; 37% have a bachelor's degree; and the rest (12%) have more education. From this information we can see that they should have no problem understanding the definitions of washing machine attributes, tasks and questions.

Most of the participants (71.7%) are married or living with a significant other, which means they are more likely to have their own washing machine or be more experienced with these products than are single people, who may choose laundromats or services. They are the right group to be selecting a washing machine for their friend Kate.

We also measured their experience with the Internet and online shopping. On average, the subjects have been using the Internet for 14.5 years, spending over 25.2 hours online each week. Over 76.4% use the Internet for at least 15 hours weekly. Judging by this, we can see that the participants should not have difficulty using our recommendation system. Regarding their online purchasing experience, 94% have bought products online before. Of these, 24.3% have purchased one or two; 47.3% have shopped online several times; and the rest (28.4%) are highly experienced. On average, 49.1% of them took under 30 minutes each time to purchase products; 31.4% spent 30 minutes to an hour; and the rest (20%) spent more than an hour. Considering these data, we expect the shopping task in the experiment should not stress them or exceed their abilities.

As for their knowledge of washing machines, 76.7% of participants have purchased one before. Of these, 30.4% have bought a washing machine within the past two years; 21.7% within three to five years; and the remainder (47.8%) more than five years ago. We measure

their product knowledge using a likely scale as well (see Appendix B). The average reported level of product knowledge is 4.23/7.0. This result indicates that participants can understand the attributes of washing machines and are suitable for the shopping task.

5.2 Manipulation Checks

5.2.1 Manipulation Questions

To make sure that participants understand and remember Kate's purchasing requirements, we include a manipulation check question as shown below. They can thus review the purchasing situation. If a subject fails to answer the question, he/she will read a reminder and then be directed to review Kate's requirements again. Only when a participant answers the question correctly can he/she proceed to further steps. Participants can also revisit Kate's requirements while they are doing the task by indicating their preferred attribute levels.

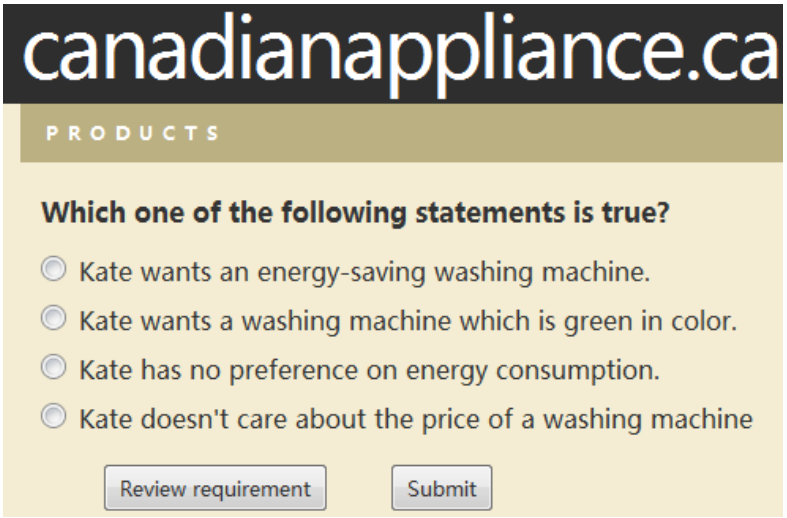

Figure 18 Manipulation Check Question

5.2.2 Open Questions and Inconsistency Check

Besides the manipulation question, there is an open question in the post-questionnaire as a check, asking about the factors people considered in their decision. Most indicated Kate's requirements as criteria. However, some people made the decision without considering her

situation. Examples of incorrect answers include, “I made the decision based on my personal taste” or “I chose the machine because I liked the picture.” In this case, the data are considered compromised and are removed from the analysis. (Six data sets were discarded out of 212 completes.) In addition, we also use the answer to this question to pick the 20 best performers.

Overall Completes	Eliminated from Open Questions	Eliminated from Inconsistency Check	Eliminated from Time Used	Eliminated from Sample size
212	6	12	14	180

Table 4 Data Elimination

We also checked the consistency of participants’ answers to ensure they responded to each question carefully, leading to twelve responses being eliminated from the analysis. Selecting the same choice for all the questions or answering similar questions very differently led to elimination.

5.2.3 Weight of Attributes

When participants interact with the system to indicate their level of preference for product attributes, we also ask them to give a weight to each (from 1 to 5). Giving more weight to an attribute means valuing it more highly. The weight they place on attributes can also show whether they understand Kate’s requirements and are making the decision from her perspective.

Kate’s requirements are shown in Appendix C. As we can see, she values price, spin speed, delay start time, noise and warranty. She values energy usage only in the “green” condition. Below is the summary of the weights (from 1–5) participants gave to each attribute:

Product Attributes	Conditions	
	Green Requirements	Non-Green Requirements
Energy Consumption	**3.58**	**2.95**
Price	3.31	3.42
Spin Speed	3.51	3.61
Temp Control	3.02	2.92
Delay Start	3.31	3.46
Water Efficiency	**3.5**	**3**
Wash Cycle	3.21	3.01
Noise Level	3.3	3.48
Warranty	3.29	3.49

Table 5 Manipulation Check (Weights Rated on Product Attributes)

From the table we can see that when Kate wants "green," participants' weights for energy consumption and water efficiency rise. The results differ significantly according to whether Kate does or does not have "green" requirements. For energy consumption, $t(2,178) = 5.076$, $p < 0.001$; for water efficiency, $t(2,178) = 4.146$, $p<0.001$. Furthermore, the weight difference for wash cycles is almost significant ($t = 1.977$, $p = 0.053$). All the other attributes do not vary significantly across the "green" and "non-green" conditions. Moreover, for attributes specified in Kate's requirements such as price, spin speed, delay start and so on, the rated weights are higher on average compared to those of attributes that have not been mentioned such as temperature and wash cycle. Therefore, we can see that people pay attention to Kate's purchasing requirements and try to make a good decision for her. Thus our manipulation of the requirements was successful.

5.2.4 Time Used in the Task

To ensure that people are making an effort, we also record the time they take to perform the task. This does not include time spent on the pre- and post-questionnaires. Table 24 in Appendix D provides descriptive statistics on the time used for the task in each condition. The average time used across conditions is 562.67 seconds, which is about nine to ten minutes. The standard deviation is as large as 430.39 seconds, or about seven minutes. Fourteen data sets were excluded from the analysis for unreasonable completion times (shorter than two minutes and longer than 30 minutes).

In Figure 28, we can see the time used in each condition. The requirements or conditioning stimulus have little effect on completion time. However, the interaction effect between the requirements and the stimulus is close to significant ($F = 2.880$, $p = 0.059$). The reason for this is the difference in time spent by the control group in the "green" and "non-green" conditions. For both the conditions using nature and face pictures, the time spent is close to the average of 562.67 seconds. In the control condition, however, the time used in the "green" and "non-green" contexts is significantly different ($F = 6.850$, $p = 0.011$). This is an interesting finding that deserves future exploration. We believe that adding a "green" requirement guides participants through the decision-making process by restricting their options. In the face or nature conditions, pictures already serve as guides or restrictions so the decision-making time is fairly stable.

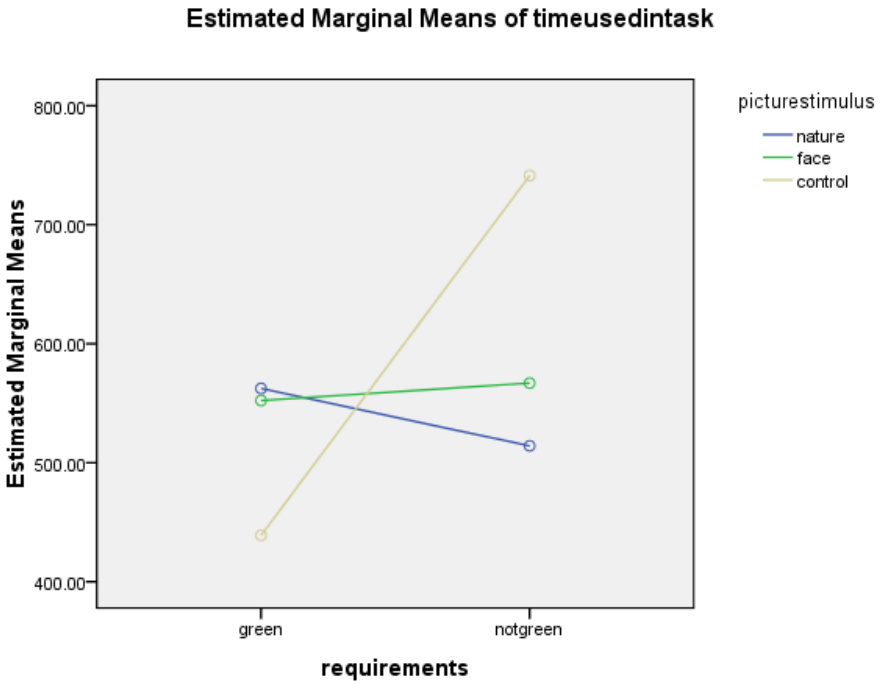

Figure 19 Effect of Conditioning Design and Requirements on Time Used in the Task

5.3 Persuasiveness

5.3.1 Preferred Energy Consumption Level and Price

When subjects are exposed to our conditioning mechanism, they are asked to give their preferred levels for attributes in a washing machine. From the introduction, they know that energy usage is an estimate of the electricity and water a washing machine consumes per year under normal circumstances. It indicates the "greenness" of a machine. Therefore people's preferences for this level indicate their preferences for "greenness." We do an ANOVA analysis on this measure to see the effectiveness of our design.

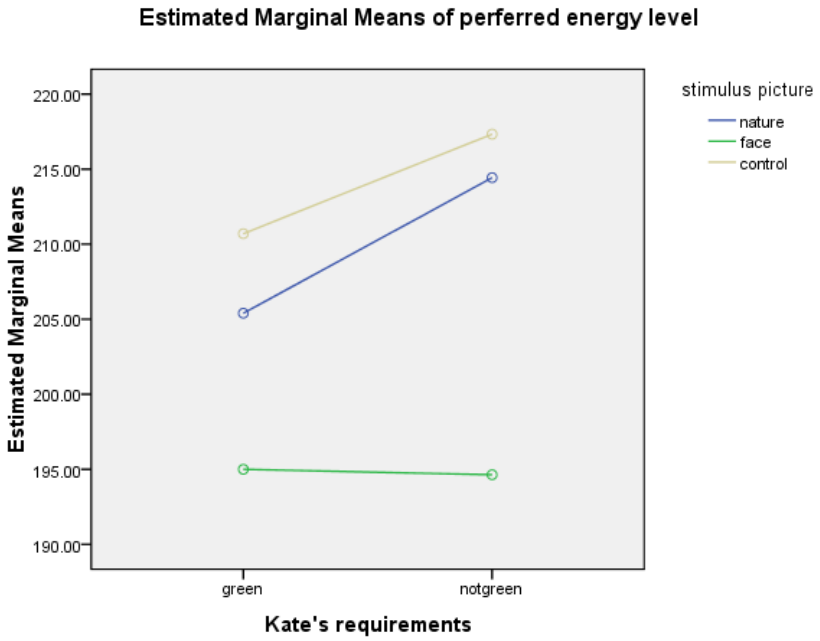

Figure 20 Effect of Conditioning Design and Requirements on Preferred Energy Level

From the data and the graph (Figure 20, see Appendix D for details), we can see that when participants are exposed to different stimulus pictures, their preferences for energy levels change ($F = 7.898$, $p < 0.001$). Specifically, in the control condition, when subjects see no pictures at all, they do not care about energy consumption much and are fine with high-consumption products ($M = 214$). If, however, they are presented with nature pictures, they want machines with lower energy consumption ($M = 209$), though not to a significant degree compared with the control group ($p = 0.421$). However, when they see face pictures, their

preferred level of energy consumption greatly decreases (M = 194). This is significantly different from the control ($p < 0.001$) and the nature ($p < 0.003$) conditions.

There is no main effect for Kate's requirements ($p = 0.231$). The interaction between the requirements and the picture stimulus is not significant ($p = 0.124$). However, when people are in the control and the nature conditions, the information that Kate wants something "green" makes them pursue lower energy levels on average. In contrast, in the face condition, indicating Kate's "green" desire actually does not much change their choice of energy consumption level.

Comparing the preferred energy levels across cells, we can see that in the "green" condition, the face pictures are most effective in reducing energy usage ($p = 0.034$, see Appendix E for ANOVA tables). In the "non-green" condition, the face pictures are also more effective than the control conditions ($p = 0.008$) and the nature pictures ($p = 0.007$).

Price is one of the greatest barriers to people purchasing "green." Most environmentally friendly products have a higher cost that prevents customers from buying them. In this task, our washing machines also have this trade-off between price and "greenness." We want to see how much more people are willing to pay for "greenness" in different conditions. Generally speaking, the more money they are willing to spend, the greater the possibility they will end up with a "green" machine.

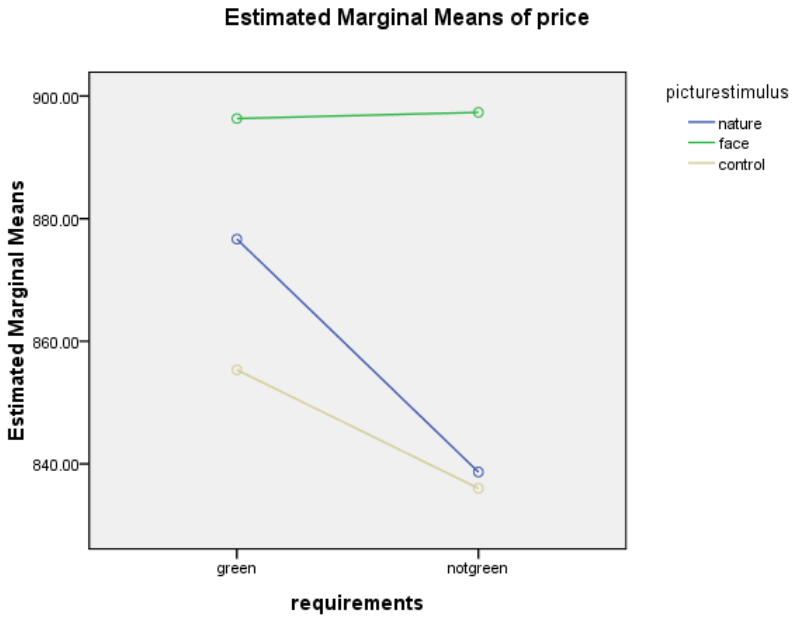

Figure 21 Effect of Conditioning Design and Requirements on Preferred Price

We can see that the pattern is very similar to that for energy consumption. The main effect of the picture stimulus is significant ($F = 4.087$, $p = 0.018$). People are willing to pay more for the product in the face condition than in the nature ($t = -2.095$, $p = 0.038$) or control ($t = 2.736$, $p = 0.007$) condition.

5.3.2 Product Energy Consumption and Price

Even though the conditioning mechanism effectively changes people's preferences for "green" products, only the possibility that they will purchase such products rises. It is unclear whether they will eventually choose a "greener" product in the task. Therefore, we also analyze data on the energy usage level of their chosen products.

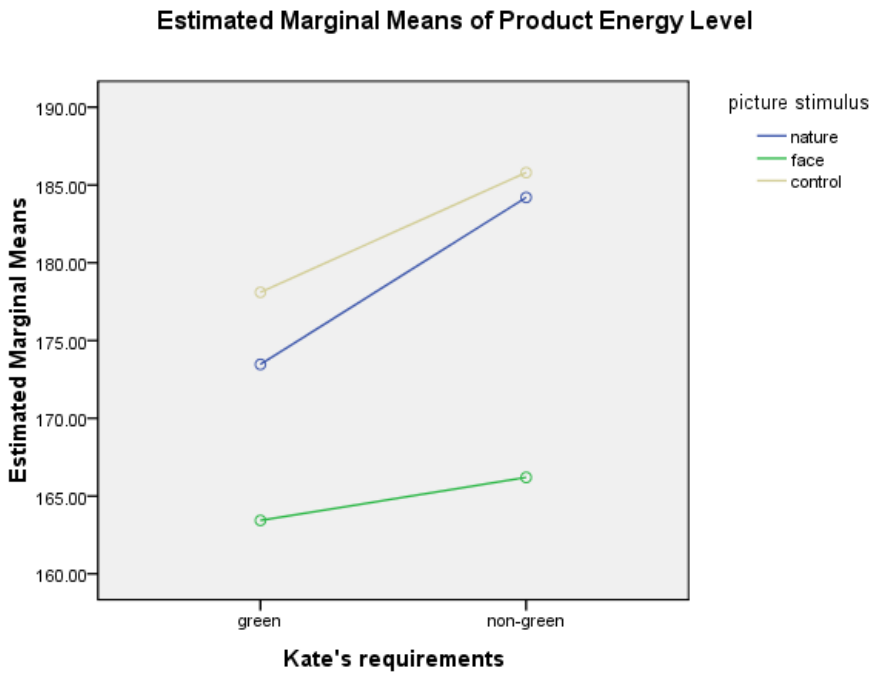

Figure 22 Effect of Conditioning Design and Requirements on Product Energy Level

The purchasing pattern is similar to that for their preferred energy levels, that is, the energy consumption levels vary with different picture stimuli ($F = 3.428$, $p = 0.035$). In the control condition, the energy consumption level of the product they choose is high ($M = 214$). In the nature condition, machines with lower energy consumption are preferred, but the result is not significant ($p = 0.654$, $M = 178$). In the face condition, the consumption level of the chosen product greatly decreases ($M = 164$). This is significantly different from the control ($t = -2.466$, $p = 0.015$) and the nature ($t = 2.017$, $p = 0.045$) conditions.

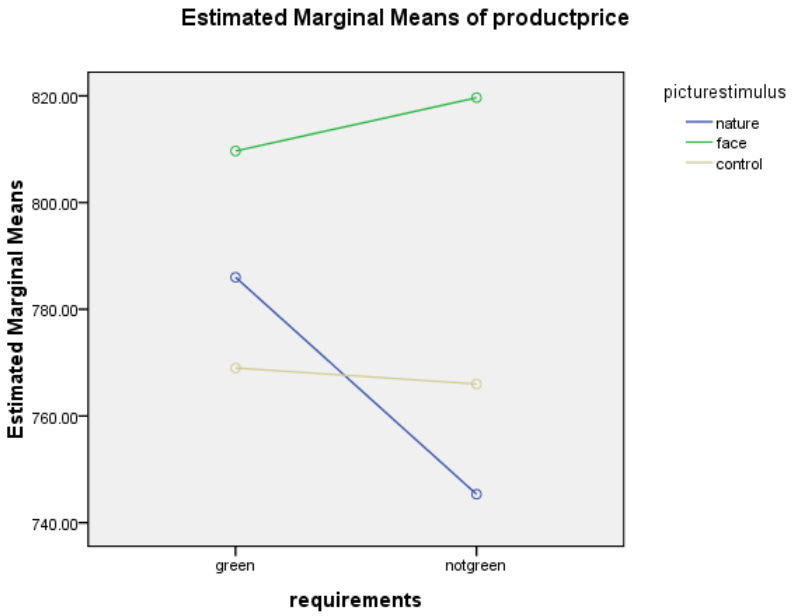

Figure 23 Effect of Conditioning Design and Requirements on Product Price

The main effect of the picture stimulus is also significant in terms of the purchase price ($F = 3.037$, $p = 0.050$). In the face condition, the selected products are significantly more expensive than in the nature ($t = -2.174$, $p = 0.031$) and control ($t = -2.093$, $p = 0.038$) conditions.

5.3.3 Rank of the Chosen Product in Recommendations

To determine the gap between people's preference for "green" products in the elicitation process and their actual "green" behaviour, we measure the rank of the chosen product in the recommendations. The system recommends products according to a reasonable algorithm that compares each one's fitness with users' attribute preference levels (appendix H).

Therefore, those that are recommended first should better suit people's wishes and have a higher chance of being selected. This measure is important because it reflects many problems. For example, we can see whether people's "green" preferences are sincere and stable. This measure may also influence people's trust and satisfaction with the system.

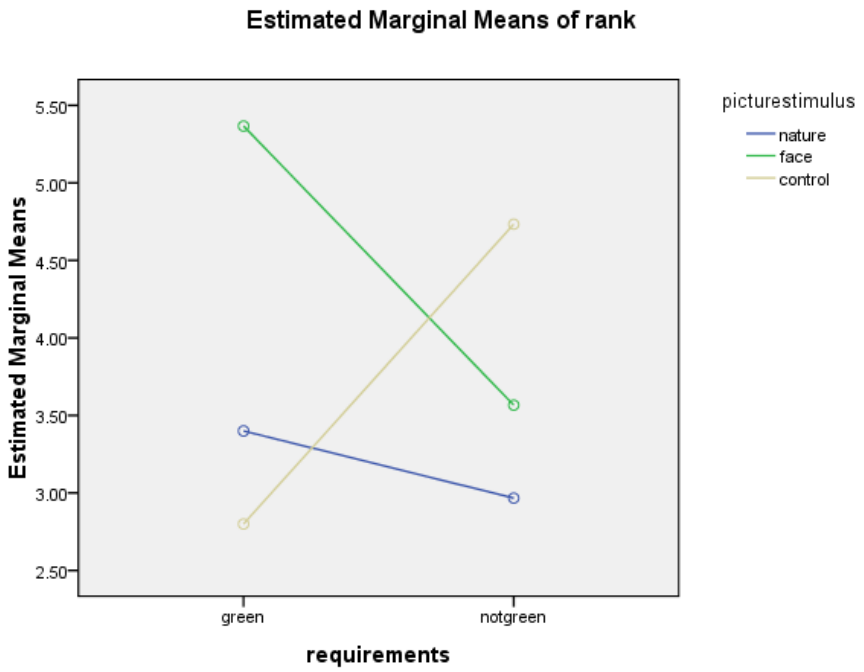

Figure 24 Effect of Conditioning Design and Requirements on Rank of the Chosen Product

Six products are recommended per Web page. Most people (89.4%) chose products on the first page. The deviation for rank is as high as 4.645. In addition, 31.7% of subjects chose the first product recommended, while the highest product rank is 36, which is on page 6.

The rank is close to significant according to Kate's different requirements ($p = 0.052$). People tend to choose products that appear first in the "non-green" condition. Note that the "green" condition with faces has the highest rank ($M = 5.37$, Figure 24). With the "green" requirement, people in the face condition also choose products with a significantly higher rank than in the control condition ($p = 0.026$). This means that those in this condition "dig deeper" and look further to find the best product. As previously shown, people manifest the "greenest" product preferences in the face-green condition. However, this is not as stable as the change in preferences in other conditions.

5.3.4 Change of "Green" Attitudes

Seven items on people's "green" attitudes are measured both before and after participants make the product decision. "I am willing to pay more money for 'green' products" and "I should care more about environmental problems" were deleted from the analysis because of a

low correlation with other items. The remaining five items are combined to construct users' "green" attitude (Cronbach's alpha = 0.936). Attitude change is calculated as post-"green" attitude minus pre-"green" attitude.

General "Green" attitude statements are: 1. I have a strong intention to engage in "green" practices. 2. I want to ask others to take part in protecting the environment. Attitudes to "green" products are shown by: 3. I have a strong intention to buy "green" products. 4. I am very interested in "green" products. 5. I am eager to gain more knowledge about "green" products.

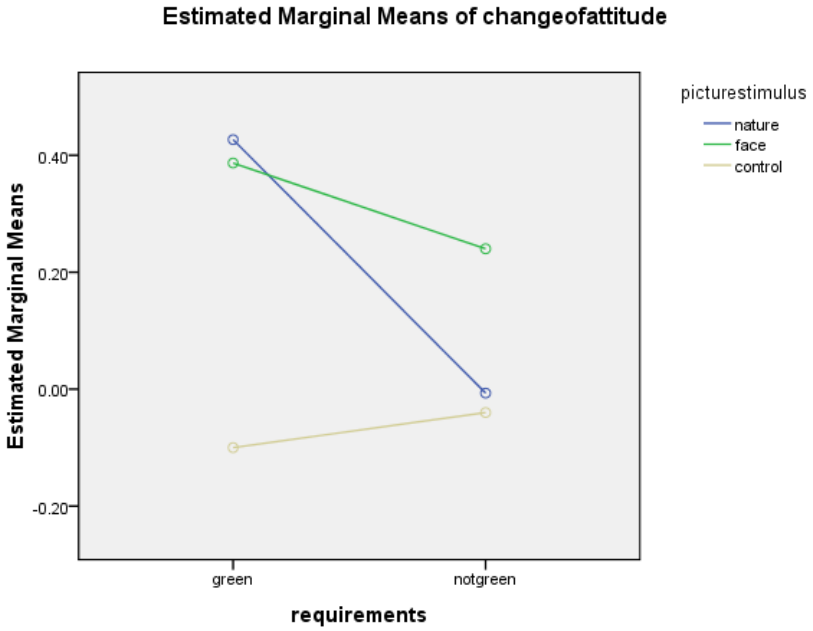

Figure 25 Effect of Conditioning Design and Requirements on Attitude Change

Comparing the stimuli alone, we deduce that the face and control conditions are significant (t = 2.158, p = 0.032), but the nature condition is not. Generally, the face condition is effective at changing people's "green" attitude. When we do ANOVA with each cell, we find that when Kate does not care about "greenness," nature pictures do not change participants' attitudes (p = 0.337). However, when she wants "green," nature pictures are as effective at changing people's perspective as the control condition (p = 0.049) and face pictures (p =

0.051). In the control condition, according to whichever requirements, people's "green" attitude does not change significantly.

5.3.5 Moderator Analysis

We also want to see whether some specific characteristics of people influence their "green" preferences. Since the patterns of preferred energy, preferred price, product energy and product price are quite similar, we only include our analysis of preferred energy level here. We looked at gender, age, income, education, marital status, knowledge of washing machines, Internet experience, and original "green" attitudes. These variables alone have no significant impact on people's preferred "greenness" according to our analysis. However, we observed some interesting effects.

First, gender has an interaction effect ($p = 0.037$) with the requirements (see Table 33 in Appendix E). As shown in Figure 26, when Kate cares about the "greenness" of a washing machine, women want to choose one with a low energy consumption level. However, the men's pattern is the opposite. They end by choosing a washing machine that uses more energy when Kate wants "green." We suspect that one reason for this is that since our hypothetical friend is female, women are more empathetic with her situation. Moreover, women may tend to consider every aspect when purchasing a product, while men may simplify the task by focusing on certain attributes, such as price and performance.

There are also interesting age-related effects. The interaction between age and the picture stimulus is not significant ($p = 0.868$, see Table 37 in Appendix). However, the main effect of age is significant ($p = 0.045$). People aged 19–49 are labeled as younger, while those aged 50–77 are labeled as older. As we can see from Figure 27, younger people choose machines with a lower energy level compared to older ones. We suspect this is because older people care more about price, which contradicts "greenness," and are harder to influence than younger people.

The interaction between age and requirements is significant ($p = 0.04$, see Table 35 in Appendix). The main effect of age is also significant ($p = 0.03$). From Figure 28, we can see

that younger people try to choose a product with lower energy consumption when Kate wants "green." However, older people's decisions remain the same. Older people may have more rigid, well-established criteria when they purchase; for example, they may care more about price and performance. These criteria have formed for years and can not be easily changed.

We also test whether those who care more about "greenness" will act differently than those who do not. We use their original "green" attitude to decide whether they are eco people (see Table 39). The main and interaction effects are not significant. As we see from the average in Figure 29, the only difference is that when Kate wants "green," eco people are more easily persuaded to comply.

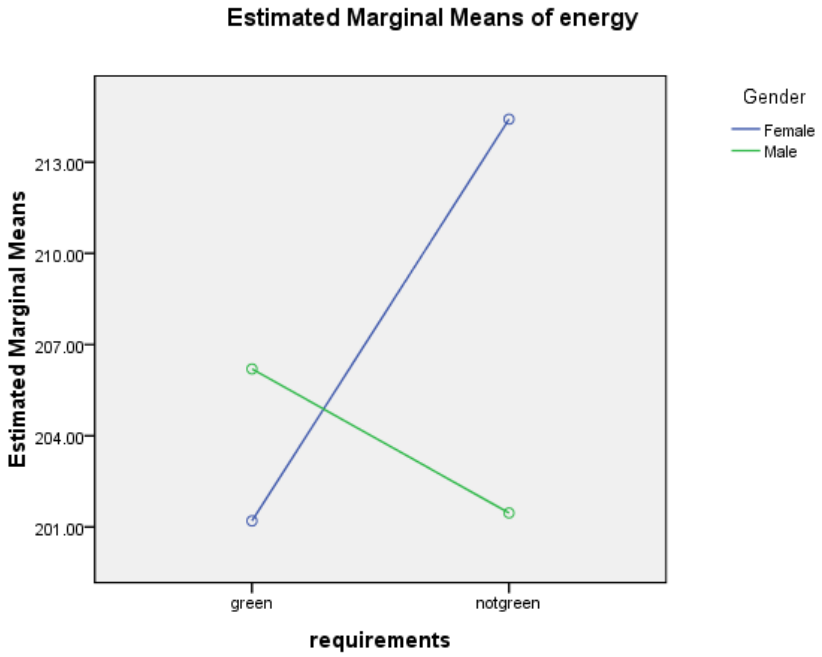

Figure 26 Moderator Analysis of Gender and Requirement

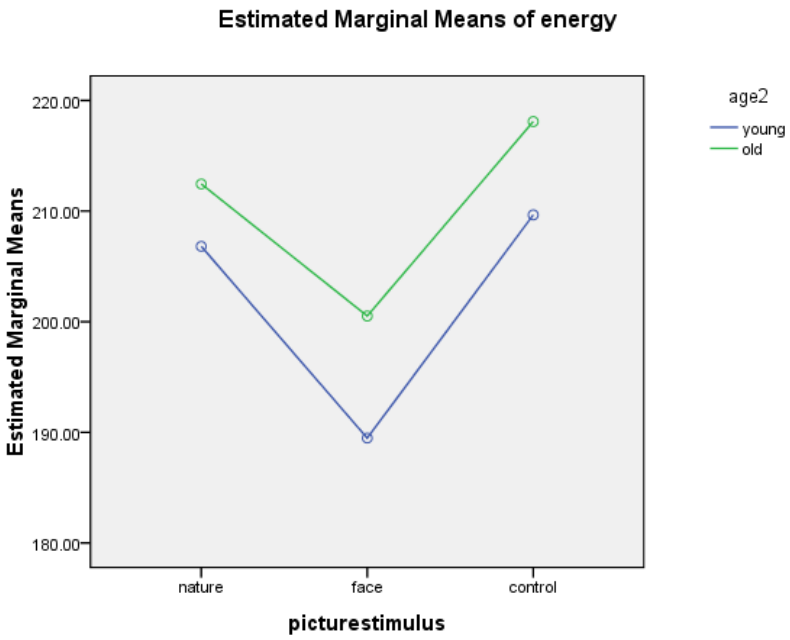

Figure 27 Moderator Analysis of Age and Picture Stimulus

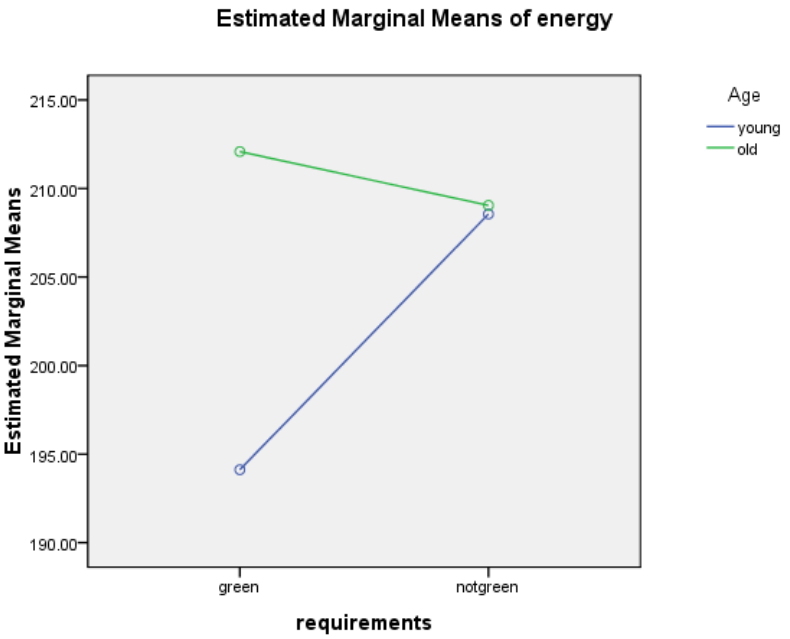

Figure 28 Moderator Analysis of Age and Requirement

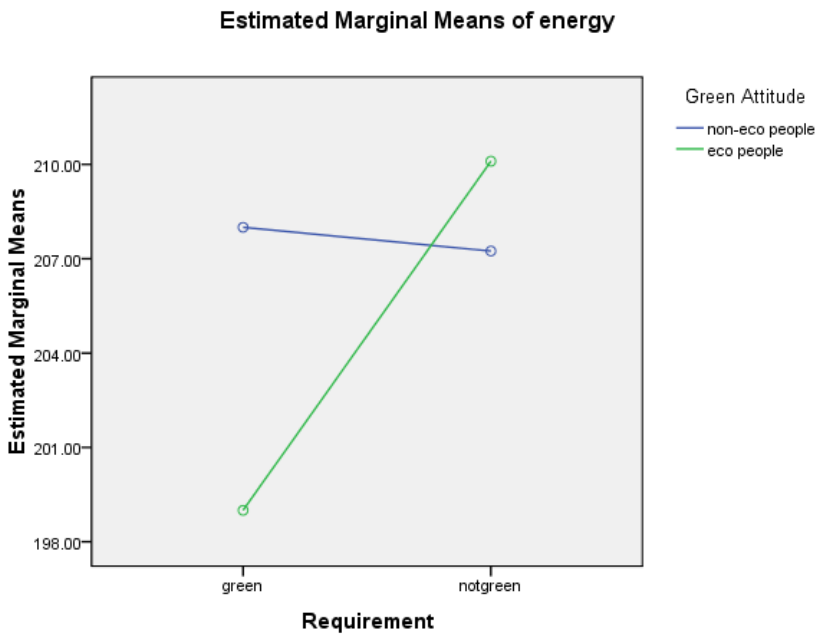

Figure 29 Moderator Analysis of Attitude and Requirement

5.4 Perceptions of the Persuasive PRA

Other than customers' product choices, we also care about their perceptions of our system. To a large extent, what they think about the PRA influences their purchasing experience and their repurchasing intentions.

5.4.1 Reuse Intentions and User Satisfaction

Do customers wish to use the recommendation agent again in the future? Out of seven, they gave a score of 5.31, which is rather high. The results are not significantly different across conditions. We can see from the average that the face-"green" condition receives the highest reuse intention while the face-non-green condition receives the lowest. This may be due to the different meanings faces have for people. In the "green" face condition, they can guess that the faces are related to "greenness." In the "non-green" face condition, however, they may infer other relationships for the faces. If they find that their guess is wrong, they may not be very happy.

Were customers satisfied with the recommendation agent? Out of seven, they gave a score of 5.3. The results are not significantly different across conditions. The same pattern occurs with user satisfaction. The "green"-face condition receives the most user satisfaction from customers while the "non-green" face condition receives the least. Moreover, the customers' evaluations of the system in the control condition are generally low.

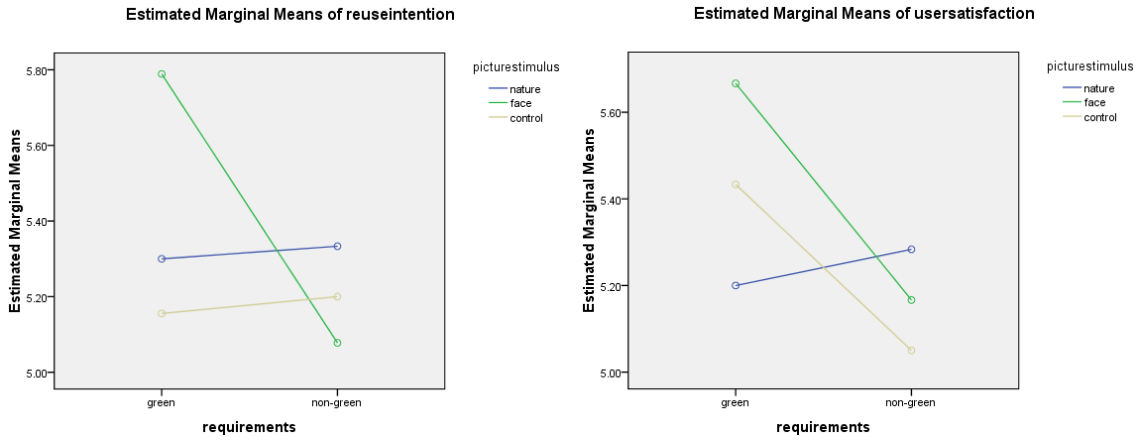

Figure 30 Effect of Conditioning Design and Requirements on Reuse Intention and User Satisfaction

5.4.2 Usefulness and Ease of Use

Do customers consider the agent useful? They give a score of 5.61 out of 7. This is not significantly different across conditions. Do they think the system is easy to use? They rate it 5.16 out of 7. Again, the results do not differ significantly across conditions. From the average, we can also see that the "green" face condition gets the highest ratings on usefulness and ease of use, but the "non-green" face condition receives the lowest. We must also pay attention to the ease of use in the nature condition. It turns out that customers do not think the agent with the nature pictures is as easy to use as other agents. Nature pictures and "greenness" are cognitively associated, while faces are heuristically related to it. People can therefore easily infer meanings from faces, while determining the meaning of nature pictures takes more effort.

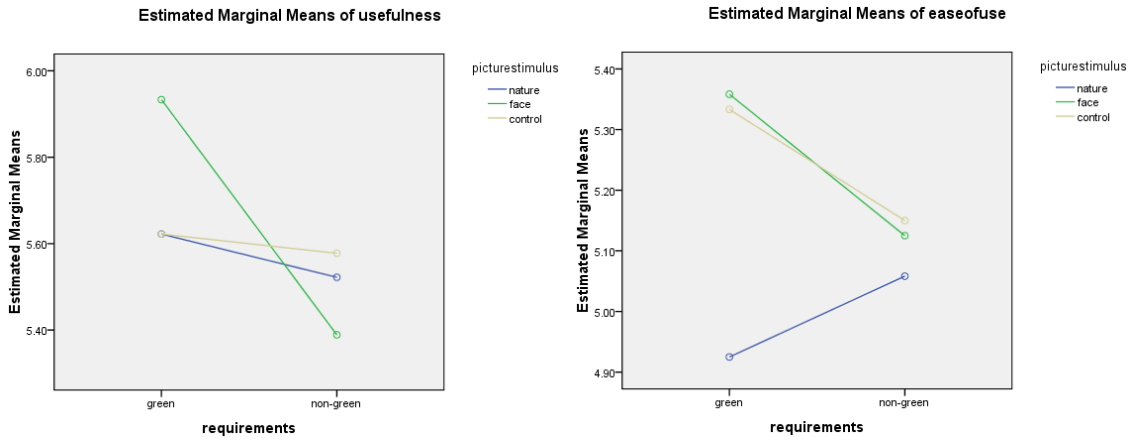

Figure 31 Effect of Conditioning Design and Requirements on Usefulness and Ease of Use

5.4.3 Enjoyment and Decision Effort

Do customers feel using the system is fun? Out of 7, the given score is 5.13, with no significant differences across conditions. We can see from the average that they feel more enjoyment when interacting with the agents with face pictures.

Do customers have difficulty using the agent? With 7 being the hardest, they gave a score of 2.88. The results are not significantly different across conditions. Comparatively, it may be more difficult to discriminate among the types of nature pictures than the face pictures.

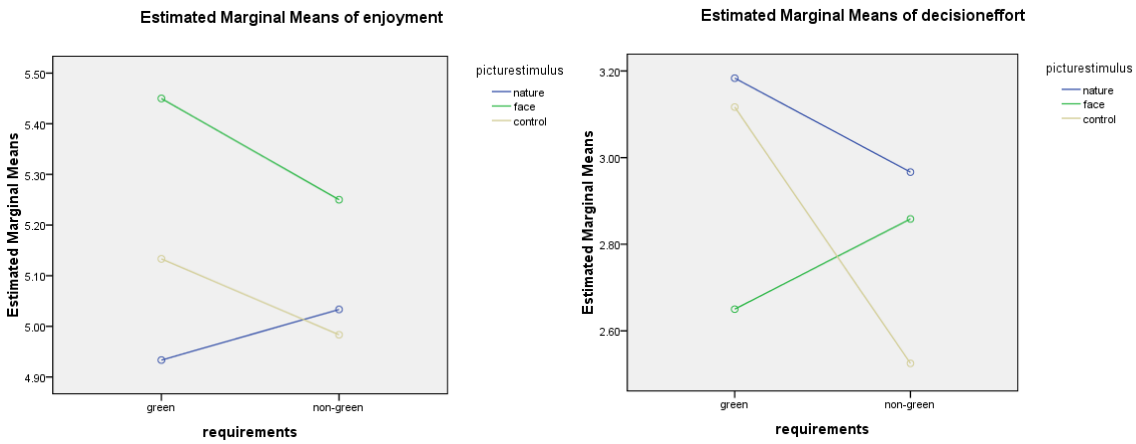

Figure 32 Effect of Conditioning Design and Requirements on Enjoyment and Decision Effort

5.4.4 Trust

Do customers trust the agent overall? The score is 4.94 out of 7, with no significant variations. This time we can see that the face and nature pictures both receive higher ratings than the control conditions. The agents in the control conditions are actually neutral PRAs. They do not promote targeted products. There is no persuasion at all. However, people tend to trust the PRAs with face and nature pictures more.

Do they consider the agent honest? On average, they give 5.17 to the agents on integrity out of 7. People also trust more in persuasive PRAs with faces and nature pictures on average.

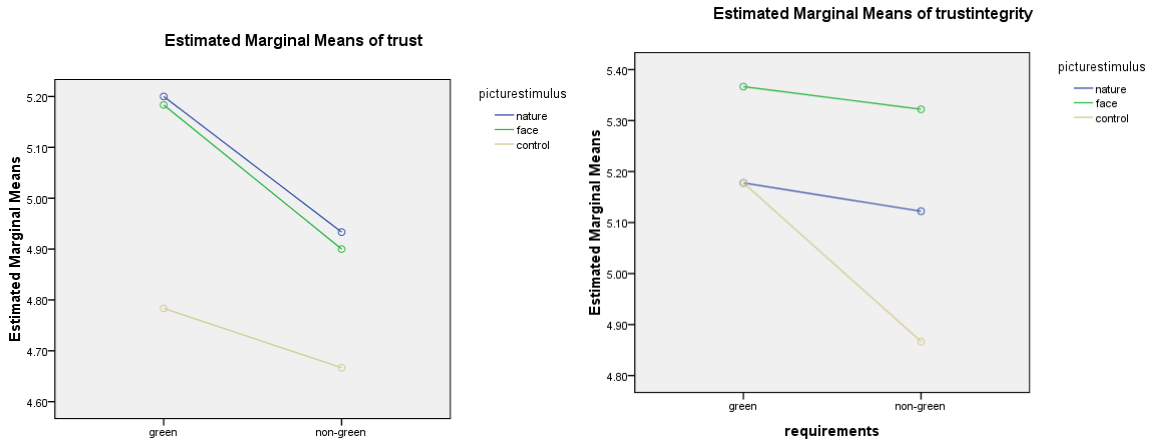

Figure 33 Effect of Conditioning Design and Requirements on Trust and Trust Integrity

Do they believe the agent is competent? On average, they give it 5.21 out of 7. We find the competence ratings in agents with face conditions significantly different from those in control conditions ($t = 2.135$, $p = 0.034$). This shows that people perceive the face conditions as more competent.

Do they trust the agent as benevolent? The average score is 5.31 out of 7. The results are not significantly different across conditions. Face conditions still receive higher ratings than nature and control conditions.

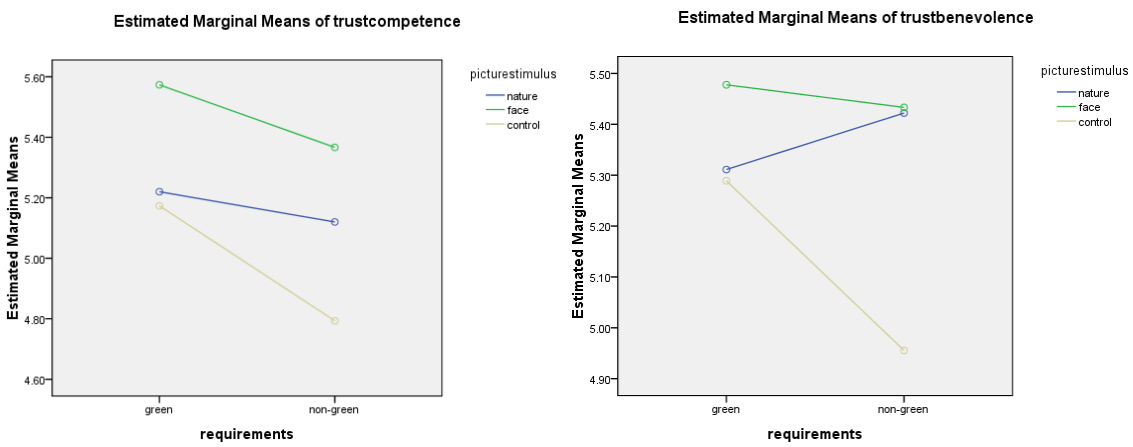

Figure 34 Effect of Conditioning Design and Requirements on Trust Competence and Trust Benevolence

Another interesting finding is that for each picture stimulus, people tend to trust the system more in the "green" than in the "non-green" condition. Even though Kate's requirements have no relationship with any system features, we believe that customers feel that "green" messages have stronger trust indications that they then relate to the agent.

From the above analysis, we claim that the conditioning mechanism through the associative process (face pictures) receives the best evaluation from customers. Notwithstanding our original concern that the faces might confuse people, they actually trust this conditioning mechanism the most.

Chapter 6: DISCUSSION, IMPLICATIONS AND FUTURE RESEARCH

6.1 Hypothesis Testing

Let us restate our hypotheses from the above analysis. First, we wish to check whether the conditioning design achieved satisfactory effects. The conditioning mechanism through the associative process (face stimulus) is very effective in persuading people to prefer and buy "greener" products compared with the control condition. However, those conditioned through the propositional process (nature stimulus) did not prefer or buy products that were significantly "greener." One reason we suspect that the nature pictures are not effective is that people may have difficulty distinguishing among the seven images. Usually, people move the attribute levels within a small range. Hence, most only see around three pictures. They may not understand the relationship between the nature pictures and "greenness" as we originally thought. Therefore, they may not experience the propositional process as intended. Hypothesis 1 is partly supported in that sense.

We can also see that the conditioning mechanism through the associative process (face stimulus) is much more effective than the conditioning mechanism through the propositional process (nature stimulus). This is contrary to what we expected. We find that even if people do not know what the smiling or sad faces are for, they will infer meanings from them because face pictures are fraught with strong heuristics. For example, some participants associate faces with the overall performance or impression of a machine, and thus try to make the faces happier, hoping to get a better product. Others may regard the smiley faces as signs of social recognition or Kate's satisfaction. Therefore they also try to make the faces happier to guaranty a good choice. Because of all these "misunderstandings," those who prefer or select a "greener" product may not do so because of its sustainability. They may just hope to get a good product. Moreover, their "green" choice may not be stable. We suspect that once we tell them that the happiness of the faces is only related to "greenness," the images will be less effective because participants will know that the faces are only indicators of one aspect of a product rather than an overall rating. Note that contingency awareness may harm the effectiveness of the conditioning mechanism through the associative process. Research also suggests that contingency awareness may reduce participants' trust in

the validity of their associative evaluations. However, even though the faces may not function as effectively as they do now, we suspect that they will still influence customers once they want a "green" washing machine. Once customers are aware of them, the faces will function through the propositional process like the nature pictures. The next step in our research is to find another stimulus that has fewer heuristics. It should have a strong impact on customers, but only result in their affect change. For example, we can combine a target product with a soothing sound to check whether the affect will be transferred from the CS to the US, and compare this affect transfer process with the propositional process.

We have not seen the main effect of the requirements in the control conditions, so Hypothesis 3 is not supported. People indeed try to put themselves in Kate's situation because the weights they provide vary according to her different requirements. However, even though they want to buy a "greener" machine, they may not be able to pick one because so many factors are involved. We can also learn a lesson from this: simply urging people to buy "green" is not effective at all. Even if the intention is there, they are still unable to pick a suitable product.

Since the nature stimulus is not effective in the two conditions, it is difficult to test Hypothesis 4. However, we find that the change in "green" attitudes is only significant in the "green" condition. This shows that only when people need to purchase "green" will the conditioning mechanisms through the propositional process work. When "green" is unimportant to them, they simply ignore the nature pictures. An original need or intention to purchase "green" is a prerequisite for this conditioning mechanism to function.

Hypothesis 5 is supported. Face pictures are effective in both requirement conditions. However, we find that they are more persuasive on average when Kate does not want something "green." As stated before, the possible reason is that customers can guess the relationship between face pictures and "greenness" more easily if we hint at Kate's "green" requirements. If we do not mention these, participants have a higher possibility of associating happier faces with other things such as overall performance. In pre-tests, we interviewed many people and they proved our assumptions.

Hypothesis	Conclusion
H1: Compared to the PRA without conditioning mechanism, PRAs with conditioning mechanism can persuade customers to prefer and purchase "greener" products.	Half supported
H2: Compared to the conditioning mechanism with face pictures, conditioning mechanism with nature pictures can persuade customers to prefer and purchase "greener" products.	Not Supported
H3: In the control condition, participants will prefer and purchase "greener" products when Kate has "green" requirements than not.	Not supported
H4: The conditioning mechanism with nature pictures has more persuasive power when Kate wants "green".	Partly supported
H5: The conditioning mechanism with face pictures has equal persuasive power whether Kate wants "green" or not.	Supported

Table 6 Hypothesis Testing

6.2 Summary

In this study, we, as e-commerce researchers, make our own effort to mitigate the severity of environmental issues. Especially, we contribute to promoting environmental sustainability by persuading people to buy energy-saving products. To ensure effective practices, we review the literature to discover the challenges to promoting "green." We find that most practices focus on influencing people's explicit attitudes to purchasing sustainable products. However, they do not give them the knowledge to buy "green." Moreover, a large gap exists between attitudes and behaviours.

To leverage the power of technologies to solve these challenges, we review the literature on persuasive technology. After examining the frameworks provided by Fogg, Lockton and others, we decided to use the trade-off transparency tool to empower customers to purchase "green" products. In addition, we aim to utilize conditioning to bridge the gap between attitudes and behaviours by eliciting implicit attitudes. We choose product recommendation agents (PRAs) as our platform to integrate the technologies, and differentiate our persuasive PRA from neutral and deceptive ones.

We also provide a theoretical model of how to use technologies to persuade people to purchase "green" successfully. Especially, we explore effective conditioning mechanisms empirically. We use a conditioning mechanism to influence people's implicit and explicit attitudes separately and discuss how this mechanism works.

6.3 Contributions

One key contribution of this paper is to identify the challenges to promoting "green" products and leverage technologies to ameliorate them. Rather than pushing "green" information to customers to affect their explicit "green" attitudes, we try to enhance their abilities and focus on behaviour change. The literature on persuasion and persuasive technology offers insights into the successful resolution of these two challenges. Our proposed theoretical model of how to incur "green" behaviour through technologies can offer much strategic value to practitioners who are seeking to encourage people to achieve target behaviours.

We add to the literature on behaviour change by introducing implicit attitudes into the well-known model of TPB. Contemporary models of persuasion have been very successful in explaining the influence of different kinds of message cues on self-reported explicit evaluations. However, changes in implicit attitudes are still largely unexplained. Our study provides a new view on changing people's behaviours. Our research also brings the application of TPB into a new context by examining customers' "green" purchasing behaviours.

This paper explores the promising field of "persuasive" PRAs. While most previous studies uncover the facilitating and deceptive features of PRAs (Xiao & Benbasat, 2011; Xu et al., forthcoming), few discuss their persuasive capabilities. This study seeks to understand the influence a decision support system as a PRA can exert on its users from a "persuasion" view. It also extends the existing literature by identifying the characteristics of different types of PRAs (neutral, persuasive and deceptive), such as target products and misuse of information. Moreover, the paper attempts to determine the functioning principle of a

persuasive PRA. The principle generalizes the key design for practitioners, creating a broad area for the application of persuasive PRAs. We also examine the features a persuasive PRA can include. Finally, the proposed theory suggests key issues to consider when building a persuasive PRA in a practical context. It also demonstrates the successful application of trade-off transparency design in a PRA. This design can improve product diagnosticity, as suggested by Xu et al. (forthcoming), strengthening customers' ability to purchase "green." We also find a way to integrate it with the conditioning mechanism. We measured people's perceptions of the "persuasive" PRA and found that they did not view it negatively compared to neutral PRAs. On the contrary, their trust in some aspects of the PRA such as competence actually increased with the addition of persuasive elements. This provides an example for practitioners of how to exert influence without arousing customers' suspicion or distrust.

Our findings also offer insights into HCI design. Specifically, our experiment explores the conditioning mechanism in greater depth. For human-computer interaction (HCI) researchers, this study increases the understanding of how to use cues or stimuli effectively to get people to achieve targeted behaviours. Conditioning opens the way to influencing people's implicit attitudes by using stimuli that are not directly related to the US. In our experiment, we find this method to be very effective, but recognize that it has some disadvantages. First, because people have no cognition about why they conduct certain behaviours, using this mechanism may appear to constitute "brutal force." Moreover, the targeted behaviours may not persist once they detect the subliminal mechanism that influences them. On the other hand, if we pair highly related cues or stimuli with the US to influence explicit attitudes, the resulting behaviours are fairly stable because people are conscious of how they originated. However, there are concerns about the effectiveness of this method. For example, if a person does not care at all about "greenness," he or she may choose to ignore the mechanism and will not undergo behavioural change. Put in another way, the conditioning mechanism through the propositional process can only function as an "amplifier" of targeted behaviours. In summary, we must look into specific situations where we can use certain cues to influence people through their implicit or explicit attitudes. We must also attempt to mitigate the consequences of conditioning or our efforts will be neither long lasting nor effective. For example, for operations involving cognition like financial

problems, we should target people's explicit attitudes. However, for publicly beneficial practices like turning off screens to save energy, we can change implicit attitudes through pairing the operation with queues such as soothing sounds.

This paper also contributes to behaviourism by exploring the necessity of contingency awareness in evaluative conditioning literature. It has been intensely debated for decades whether evaluative conditioning (EC) procedures can establish attitudinal effects without contingency awareness. This debate brings forward a wide variety of methodological difficulties. As stated previously, though early investigations often appeared to show evidence for the effectiveness of unaware conditioning, these results were criticized later. More recent methodologies have shown that evaluative conditioning effects are only evident when participants are contingency aware (De-donder et al., 2010; Pleyers et al., 2007; Stahl & Unkelbach, 2009;Stahl et al., 2009). Hütter et al. (2012) have recently shown that EC can produce attitudes without conscious awareness of the contingencies. Our study also supports this view. When people are unaware of the relationship between faces and "greenness," their "green" attitudes still change as much as when they see the nature pictures.

6.4 Limitations of the Study and Future Research Directions

This study is not without its limitations. A major concern for the manipulation of our conditioning mechanism is that the nature pictures do not have as much discernibility as the face pictures. In future studies, we will use more vivid presentations such as animations to simulate nature changing. Instead of using faces, we will employ a CS without strong heuristics to elicit implicit attitudes. For example, we can use music as a type of CS to ensure affect transfer.

Another limitation relates to our measurement of constructs. From the theoretical model, implicit attitude is a key construct. We did not measure this due to resource limitations. Research on implicit attitudes usually relies on a variety of specific measures, such as the Implicit Association Test (Greenwald et al., 1998), affective priming (Fazio et al., 1995), semantic priming (Wittenbrink et al., 1997), the go/no-go association task (Nosek & Banaji,

2001), the extrinsic affective Simon task (De Houwer, 2003a), and the affect misattribution paradigm (Payne et al., 2005). We wish to test whether people's implicit attitudes change due to our conditioning mechanism in future research. Other than testing the model more accurately, we also wish to test the other part of our theoretical model that proposes that a trade-off transparency tool can affect "green" behaviour.

Moreover, in this study, we are not always sure whether people used the associative or the propositional process. We tested participants in the pre-study and post-interviews to see whether they were aware of the relationships between the pictures and "greenness" to determine the processes they experienced. However, we have no check in the formal study. People in the nature condition may simply be influenced by their fondness for the pictures. People in the face condition may guess that the happiness of the faces is related to "greenness." The two processes may fall on a continuum and may not have a clear boundary, making it difficult for practitioners to design a mechanism that uses one or the other. In the future, we wish to include a manipulation check question. We also want to try to specify the contingency awareness to see its effects. For example, we would like to see whether the nature pictures are more effective if we tell customers that they are related to "greenness." On the other hand, we wish to know whether the face pictures are less effective if we specify the relationship.

A persuasive PRA is not limited to e-commerce. Its basic principles can be used in any situation in which people make decisions between alternatives. Each alternative usually has its trade-offs. In healthcare, for instance, a persuasive system in a hospital can be designed to encourage patience to compromise on flavour and choose a more balanced and healthier diet. In education, persuasive PRAs can enhance self-control by encouraging involvement in inspiring but challenging projects. Therefore, there are broad applications for persuasive PRAs and research into this area is promising.

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Appendices

Appendix A Sample Demographics

Table 7: Profiles of Responding Participants

	Frequency	Percentage
Gender		
Men	84	47
Women	96	53
Education Level		
Some High School No Diploma	14	7.8
High School Graduate	30	16.7
Some College No Degree	48	26.7
Associate Degree	23	12.8
Bachelor's Degree	44	24.4
Master's Degree	15	8.3
Professional Degree	6	3.3
Doctoral Degree	14	7.8
Income		
Under $10,000	17	9.4
$10,000 - $20,000	21	11.7
$20,000 - $30,000	24	13.3
$30,000 - $40,000	27	15.0
$40,000 - $55,000	29	16.1
$55,000 - $70,000	19	10.6
$70,000 - $90,000	16	8.9
$90,000 - $120,000	12	6.7
$120,000 - $150,000	5	2.8
$150,000 - $200,000	6	3.3
$200,000 or more	4	2.2
Marital Status		
Married	113	62.8
Living with Significant Other	16	8.9
Divorced	14	7.8
Single	36	20.0
Widowed	1	0.6
Have you ever purchase a washing machine before?		
Yes	138	76.7
No	42	23.3
If YES, how long ago is your last purchase of washing machine approximately?		
Within 6 months	12	6.7
Within a year	13	7.2

	Frequency	Percentage
Within 2 years	17	9.4
Within 3-5 years	30	16.7
More than 5 years	66	36.7
Do you have any experience purchasing things online?		
Yes	169	93.8
No	11	6.2
If YES, how many times have you actually purchased something online within the last year?		
Once	18	10.0
Twice	23	12.8
Several times	80	44.4
Many times	48	26.7
If YES, on average, how long do you usually spend each time you are online for shopping?		
0-30 minutes	83	46.1
30 minutes to 1 hour	53	29.4
1 hour to 2 hours	28	15.6
Longer than 2 hours	5	2.8
	Mean	**STD**
How many hours per week do you use a personal computer?	25.2	1.1

Appendix B Measurement Items

Table 8: Measurement Items

Items	Dimensions/ Questions	Source
	Likely Scale: 1. Strongly Disagree – 7. Strongly Agree	
PK	**Product Knowledge**	(Xiao & Benbasat, 2011)
	I feel I have sufficient knowledge about washing machines.	
	Compared to most other people, I know more about washing machines.	
	Have you ever purchased a washing machine before? YES or NO	
	If YES, how long ago is your last purchase of washing machine approximately?	
RI	**RA Reuse Intention**	(Xu, forthcoming) (Wang &Benbasat 2005)
	I intend to use the recommendation agent the next time I would consider buying a washing machine.	
	I would consult the recommendation agent the next time I plan to purchase a washing machine.	
	I would recommend the recommendation agent to others who wish to purchase washing machines.	
US	**User Satisfaction**	(Xiao & Benbasat, 2011)
	Overall, I felt satisfied about the recommendation agent for the washing machine selection task.	
	Overall, I felt delighted about the recommendation agent for the washing machine selection task.	
U	**Usefulness**	(Kamis & Davern, 2004)
	This recommendation agent was useful for me to evaluate the washing machines.	
	This recommendation agent was useful for me to understand the performance of the washing machine.	
	This recommendation agent was useful in familiarizing me with the washing machine.	
EOU	**Ease of Use**	(Kamis & Davern, 2004)
	I found it easy to get the recommendation agent to do what I want it to do.	
	My interaction with the recommendation agent was clear and understandable.	
	I found the recommendation agent to be flexible to interact with.	
	It was easy for me to become skillful at using the recommendation agent.	
	I found the recommendation agent easy to use.	

Items	Dimensions/ Questions	Source
PE	**Perceived Enjoyment**	(Xu, forthcoming)
	Using the recommendation agent to select a washing machine was engaging.	
	Using the recommendation agent to select a washing machine was fun.	
	Using the recommendation agent to select a washing machine was interesting.	
DE	**Decision Effort**	(Xu, forthcoming)
	The washing machine selection task using the recommendation agent was very frustrating.	
	The task of selecting a washing machine using the recommendation agent was too complex.	
	Selecting a washing machine using the recommendation agent required too much effort.	
	The task of selecting a washing machine using the recommendation agent took too much time.	
T	**Trust**	(Wang & Benbasat, 2005)
	I trust the recommendation agent during the product selection task.	
	I would trust the recommendation agent to do the job right.	
TI	**Trust Integrity**	(Wang & Benbasat, 2005)
	This recommendation agent was truthful.	
	This recommendation agent provided unbiased product recommendations.	
	This recommendation agent was honest.	
TC	**Trust Competence**	(Wang & Benbasat, 2005)
	This recommendation agent is like a real expert in assessing washing machines.	
	This recommendation agent has the expertise to understand its users' needs and preferences about washing machines.	
	This recommendation agent has the ability to understand its users' needs and preferences about washing machines.	
	This recommendation agent has good knowledge about washing machines.	
	This recommendation agent considers its users' needs and all important attributes of washing machines.	
TB	**Trust Benevolence**	(Wang & Benbasat, 2005)
	This recommendation agent puts its users' interests first.	
	This recommendation agent keeps its users' interests in mind.	
	This recommendation agent wants to understand its users' needs and preferences.	

Appendix C Kate's Requirements

Kate wants to buy a washing machine for her family. According to her own situation, she values the following aspects in a washing machine most:

- She wants a washing machine of reasonable price.
- **She wants a machine to be green because she is an environmentally friendly person and "frugal" on energy expenses. For example, she recycles all the time, she uses bath water for gardening and closes lights as soon as she goes out of room to save energy.**

(This item is only shown in the green condition)

- She expects short wash time so she wants a machine with high spin speed to save the drying time.
- She wants the machine to have enough delay start time because she likes to soak clothes first and expects the machine to start automatically after she goes to sleep.
- She expects a quiet washing machine which won't disturb her sleep.
- She expects that the merchants can provide adequate after sale warranty time which can reduce her worries about machine problems and maintenance.

Appendix D Detailed Descriptive Statistics

Table 9: Descriptive Statistics (Preferred Energy Level)

Green Requirements	Picture Stimulus	Mean	Std. Deviation	N
Green	*Nature*	205.40	25.26	30
	Face	195.00	34.05	30
	Control	210.70	20.35	30
	Total	203.70	27.63	90
Non-Green	*Nature*	214.43	20.70	30
	Face	194.63	33.08	30
	Control	217.33	30.44	30
	Total	208.80	30.01	90
Total	*Nature*	209.92	23.34	60
	Face	194.82	33.28	60
	Control	214.02	25.89	60
	Total	206.25	28.88	180

Table 10: Descriptive Statistics (Preferred Price)

Green Requirements	Picture Stimulus	Mean	Std. Deviation	N
Green	*Nature*	876.67	108.57	30
	Face	896.33	116.78	30
	Control	855.33	68.42	30
	Total	876.11	100.47	90
Non-Green	*Nature*	838.67	58.35	30
	Face	897.33	122.75	30
	Control	836.00	120.39	30
	Total	857.33	107.48	90
Total	*Nature*	857.67	88.52	60
	Face	896.83	118.79	60

Green Requirements	Picture Stimulus	Mean	Std. Deviation	N
	Control	845.67	97.57	60
	Total	866.72	104.17	180

Table 11: Descriptive Statistics (Product Energy Level)

Green Requirements	Picture Stimulus	Mean	Std. Deviation	N
Green	*Nature*	173.47	36.98	30
	Face	163.43	31.00	30
	Control	178.10	39.56	30
	Total	171.67	36.15	90
Non-Green	*Nature*	184.20	37.16	30
	Face	166.20	36.53	30
	Control	185.80	46.24	30
	Total	178.73	40.76	90
Total	*Nature*	178.83	37.15	60
	Face	164.82	33.62	60
	Control	214.02	25.89	60
	Total	206.25	28.88	180

Table 12: Descriptive Statistics (Product Price)

Green Requirements	Picture Stimulus	Mean	Std. Deviation	N
Green	*Nature*	786.00	136.78	30
	Face	809.67	139.79	30
	Control	769.00	86.12	30
	Total	788.22	123.13	90
Non-Green	*Nature*	745.33	81.10	30
	Face	819.67	143.11	30
	Control	766.00	139.25	30

Green Requirements	Picture Stimulus	Mean	Std. Deviation	N
	Total	777.00	126.99	90
Total	*Nature*	765.67	113.35	60
	Face	814.67	140.34	60
	Control	767.50	114.80	60
	Total	782.61	124.85	180

Table 13: Descriptive Statistics (Rank of the Chosen Product in Recommendations)

Green Requirements	Picture Stimulus	Mean	Std. Deviation	N
Green	*Nature*	3.40	5.21	30
	Face	5.37	5.89	30
	Control	2.80	1.75	30
	Total	3.86	4.73	90
Non-Green	*Nature*	2.97	2.22	30
	Face	3.57	3.07	30
	Control	4.73	6.97	30
	Total	3.76	4.59	90
Total	*Nature*	3.18	3.98	60
	Face	4.47	4.74	60
	Control	3.77	5.13	60
	Total	3.81	4.65	180

Table 14: Descriptive Statistics (Attitude Change)

Green Requirements	Picture Stimulus	Mean	Std. Deviation	N
Green	*Nature*	0.43	0.92	30
	Face	0.39	0.77	30
	Control	-0.10	1.10	30
	Total	0.24	0.96	90

Green Requirements	Picture Stimulus	Mean	Std. Deviation	N
Non-Green	*Nature*	-0.10	1.09	30
	Face	0.24	0.88	30
	Control	-0.04	1.04	30
	Total	-0.07	1.00	90
Total	*Nature*	0.21	1.02	60
	Face	0.31	0.82	60
	Control	-0.07	1.06	60
	Total	0.15	0.98	180

Table 15: Descriptive Statistics (Reuse Intention)

Green Requirements	Picture Stimulus	Mean	Std. Deviation	N
Green	*Nature*	5.30	1.42	30
	Face	5.79	1.03	30
	Control	5.16	1.09	30
	Total	5.41	1.21	90
Non-Green	*Nature*	5.33	1.66	30
	Face	5.08	1.71	30
	Control	5.20	1.64	30
	Total	5.20	1.65	90
Total	*Nature*	5.32	1.53	60
	Face	5.43	1.44	60
	Control	5.18	1.38	60
	Total	5.31	1.45	180

Table 16: Descriptive Statistics (User Satisfaction)

Green Requirements	Picture Stimulus	Mean	Std. Deviation	N
Green	*Nature*	5.20	1.44	30

Green Requirements	Picture Stimulus	Mean	Std. Deviation	N
	Face	5.67	1.12	30
	Control	5.43	1.06	30
	Total	5.43	1.22	90
Non-Green	*Nature*	5.28	1.52	30
	Face	5.17	1.54	30
	Control	5.05	1.59	30
	Total	5.17	1.54	90
Total	*Nature*	5.24	1.47	60
	Face	5.42	1.36	60
	Control	5.24	1.35	60
	Total	5.30	1.39	180

Table 17: Descriptive Statistics (Usefulness)

Green Requirements	Picture Stimulus	Mean	Std. Deviation	N
Green	*Nature*	5.62	1.25	30
	Face	5.93	1.03	30
	Control	5.62	0.94	30
	Total	5.73	1.08	90
Non-Green	*Nature*	5.52	1.54	30
	Face	5.39	1.62	30
	Control	5.58	1.54	30
	Total	5.50	1.55	90
Total	*Nature*	5.57	1.39	60
	Face	5.66	1.37	60
	Control	5.60	1.27	60
	Total	5.61	1.34	180

Table 18: Descriptive Statistics (Ease of Use)

Green Requirements	Picture Stimulus	Mean	Std. Deviation	N
Green	*Nature*	4.93	1.36	30
	Face	5.36	1.38	30
	Control	5.33	1.01	30
	Total	5.21	1.26	90
Non-Green	*Nature*	5.06	1.50	30
	Face	5.13	1.52	30
	Control	5.15	1.41	30
	Total	5.11	1.46	90
Total	*Nature*	4.99	1.42	60
	Face	5.24	1.44	60
	Control	5.24	1.22	60
	Total	5.16	1.36	180

Table 19: Descriptive Statistics (Enjoyment)

Green Requirements	Picture Stimulus	Mean	Std. Deviation	N
Green	*Nature*	4.93	1.52	30
	Face	5.45	1.57	30
	Control	5.13	1.11	30
	Total	5.17	1.42	90
Non-Green	*Nature*	5.03	1.81	30
	Face	5.25	1.39	30
	Control	4.98	1.47	30
	Total	5.09	1.55	90
Total	*Nature*	4.98	1.66	60
	Face	5.35	1.47	60
	Control	5.06	1.29	60
	Total	5.13	1.48	180

Table 20: Descriptive Statistics (Decision Effort)

Green Requirements	Picture Stimulus	Mean	Std. Deviation	N
Green	*Nature*	3.18	1.73	30
	Face	2.65	1.46	30
	Control	3.12	1.52	30
	Total	2.98	1.58	90
Non-Green	*Nature*	2.97	1.93	30
	Face	2.86	1.38	30
	Control	2.53	1.69	30
	Total	2.78	1.67	90
Total	*Nature*	3.08	1.82	60
	Face	2.75	1.41	60
	Control	2.82	1.62	60
	Total	2.88	1.62	180

Table 21: Descriptive Statistics (Trust)

Green Requirements	Picture Stimulus	Mean	Std. Deviation	N
Green	*Nature*	5.20	1.39	30
	Face	5.18	1.36	30
	Control	4.78	1.20	30
	Total	5.06	1.32	90
Non-Green	*Nature*	4.93	1.54	30
	Face	4.90	1.48	30
	Control	4.67	1.40	30
	Total	4.83	1.46	90
Total	*Nature*	5.07	1.46	60
	Face	5.04	1.42	60
	Control	4.73	1.30	60
	Total	4.94	1.39	180

Table 22: Descriptive Statistics (Trust Integrity)

Green Requirements	Picture Stimulus	Mean	Std. Deviation	N
Green	*Nature*	5.18	1.26	30
	Face	5.37	1.21	30
	Control	5.18	0.99	30
	Total	5.24	1.15	90
Non-Green	*Nature*	5.12	1.20	30
	Face	5.32	1.28	30
	Control	4.87	1.27	30
	Total	5.10	1.25	90
Total	*Nature*	5.15	1.23	60
	Face	5.34	1.23	60
	Control	5.02	1.14	60
	Total	5.17	1.20	180

Table 23: Descriptive Statistics (Trust Competence)

Green Requirements	Picture Stimulus	Mean	Std. Deviation	N
Green	*Nature*	5.22	1.24	30
	Face	5.57	1.22	30
	Control	5.17	0.79	30
	Total	5.32	1.10	90
Non-Green	*Nature*	5.12	1.52	30
	Face	5.37	1.28	30
	Control	4.79	1.35	30
	Total	5.09	1.39	90
Total	*Nature*	5.17	1.37	60
	Face	5.47	1.24	60
	Control	4.98	1.11	60
	Total	5.21	1.26	180

Table 24: Descriptive Statistics (Trust Benevolence)

Green Requirements	Picture Stimulus	Mean	Std. Deviation	N
Green	*Nature*	5.31	1.27	30
	Face	5.48	1.14	30
	Control	5.29	0.91	30
	Total	5.36	1.11	90
Non-Green	*Nature*	5.42	1.37	30
	Face	5.43	1.31	30
	Control	4.96	1.63	30
	Total	5.27	1.44	90
Total	*Nature*	5.37	1.31	60
	Face	5.46	1.22	60
	Control	5.12	1.32	60
	Total	5.31	1.28	180

Table 25: Descriptive Statistics (Time Used in the Task)

Green Requirements	Picture Stimulus	Mean	Std. Deviation	N
Green	*Nature*	562.40	402.10	30
	Face	552.27	352.59	30
	Control	438.93	334.18	30
	Total	**517.87**	364.35	90
Non-Green	*Nature*	514.13	440.88	30
	Face	566.97	459.54	30
	Control	741.30	537.33	30
	Total	**607.47**	485.54	90
Total	*Nature*	538.27	419.05	60
	Face	559.62	406.15	60
	Control	590.12	469.10	60
	Total	562.67	430.39	180

Appendix E Detailed ANOVA Summary Tables

E.1 Tests of Between-Subjects Effects

Table 26: Dependent Variable (Preferred Energy)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	14155.250a	5	2831.050	3.645	.004
	7657031.250	1	7657031.250	9858.218	.000
Picture Stimulus	12269.200	2	6134.600	7.898	**.001**
Requirements	1170.450	1	1170.450	1.507	.221
Picture Stimulus * Requirements	715.600	2	357.800	.461	.632
Error	135148.500	174	776.716		
Total	7806335.000	180			
Corrected Total	149303.750	179			

a. R Squared = .095 (Adjusted R Squared = .069)

Table 27: Dependent Variable (Preferred Price)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	113202.778a	5	22640.556	2.154	.061
	1.352E8	1	1.352E8	12862.611	.000
Picture Stimulus	85921.111	2	42960.556	4.087	**.018**
Requirements	15867.222	1	15867.222	1.509	.221
Picture Stimulus * Requirements	11414.444	2	5707.222	.543	.582
Error	1829163.333	174	10512.433		
Total	1.372E8	180			
Corrected Total	1942366.111	179			

Table 28: Dependent Variable (Product Energy)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	12726.867a	5	2545.373	1.746	.127
	5525107.200	1	5525107.200	3790.020	.000
Picture Stimulus	9994.633	2	4997.317	3.428	**.035**
Requirements	2247.200	1	2247.200	1.541	.216
Picture Stimulus * Requirements	485.033	2	242.517	.166	.847
Error	253657.933	174	1457.804		
Total	5791492.000	180			
Corrected Total	266384.800	179			

a. R Squared = .048 (Adjusted R Squared = .020)

Table 29: Dependent Variable (Product Price)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	119022.778a	5	23804.556	1.551	.177
	1.102E8	1	1.102E8	7181.237	.000
Picture Stimulus	92581.111	2	46290.556	3.015	**.052**
Requirements	5667.222	1	5667.222	.369	.544
Picture Stimulus * Requirements	20774.444	2	10387.222	.677	.510
Error	2671250.000	174	15352.011		
Total	1.130E8	180			
Corrected Total	2790272.778	179			

a. R Squared = .043 (Adjusted R Squared = .015)

Table 30: Dependent Variable (Rank)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	157.028a	5	31.406	1.475	.200
	2606.806	1	2606.806	122.419	.000
Picture Stimulus	49.544	2	24.772	1.163	.315
Requirements	.450	1	.450	.021	.885
Picture Stimulus * Requirements	107.033	2	53.517	2.513	**.084**
Error	3705.167	174	21.294		
Total	6469.000	180			
Corrected Total	3862.194	179			

a. R Squared = .041 (Adjusted R Squared = .013)

Table 31: Dependent Variable (Change of Attitude)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	7.914a	5	1.583	1.676	.143
	4.110	1	4.110	4.353	.038
Picture Stimulus	4.720	2	2.360	2.500	**.085**
Requirements	1.352	1	1.352	1.432	.233
Picture Stimulus * Requirements	1.841	2	.921	.975	.379
Error	164.296	174	.944		
Total	176.320	180			
Corrected Total	172.210	179			

a. R Squared = .046 (Adjusted R Squared = .019)

Table 32：Moderator Analysis (Gender * Requirement)

	Value Label	N
Requirements	**Green**	90
	Non-green	90
Gender	**Female**	96
	Male	84

Table 33: Dependent Variable (Preferred Energy - Gender * Requirement)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	5439.305a	3	1813.102	2.218	.088
	7556627.215	1	7556627.215	9244.580	.000
Requirements	800.471	1	800.471	.979	.324
Gender	704.691	1	704.691	.862	.354
Requirements * Gender	3592.359	1	3592.359	4.395	**.037**
Error	143864.445	176	817.412		
Total	7806335.000	180			
Corrected Total	149303.750	179			

a. R Squared = .036 (Adjusted R Squared = .020)

Table 34: Moderator Analysis (Age * Requirement)

	Value Label	N
Age	**Young (19-49)**	87
	Old (50-77)	93
Requirements	**Green**	90
	Non-green	90

Table 35: Dependent Variable (Preferred Energy - Age * Requirement)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	8404.656a	3	2801.552	3.499	.017
	7617812.536	1	7617812.536	9515.569	.000
Age	3822.314	1	3822.314	4.775	**.030**
Requirements	1458.184	1	1458.184	1.821	.179
Age * Requirements	3427.980	1	3427.980	4.282	**.040**
Error	140899.094	176	800.563		
Total	7806335.000	180			
Corrected Total	149303.750	179			

a. R Squared = .056 (Adjusted R Squared = .040)

Table 36: Moderator Analysis (Age * Picture Stimulus)

	Value Label	N
Age	**Young (19-49)**	87
	Old (50-77)	93
Picture Stimulus	**nature**	60
	face	60
	control	60

Table 37: Dependent Variable (Preferred Energy - Age * Picture Stimulus)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	15633.249a	5	3126.650	4.070	.002
	7619815.796	1	7619815.796	9918.777	.000
Age	3140.837	1	3140.837	4.088	**.045**

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Picture Stimulus	11749.055	2	5874.527	7.647	**.001**
Age * Picture Stimulus	217.055	2	108.527	.141	.868
Error	133670.501	174	768.221		
Total	7806335.000	180			
Corrected Total	149303.750	179			

a. R Squared = .105 (Adjusted R Squared = .079)

Table 38: Moderator Analysis (Requirements * Attitude)

	Value Label	N
Requirements	green	90
	not green	90
Attitude	non-eco people	88
	eco people	92

Table 39: Dependent Variable (Preferred Energy - Requirements * Attitude)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	3171.699a	3	1057.233	1.273	.285
	7607075.117	1	7607075.117	9161.886	.000
Requirements	1198.226	1	1198.226	1.443	.231
Attitude	422.278	1	422.278	.509	.477
Requirements * Attitude	1574.098	1	1574.098	1.896	.170
Error	146132.051	176	830.296		
Total	7806335.000	180			
Corrected Total	149303.750	179			

a. R Squared = .021 (Adjusted R Squared = .005)

E.2 Detailed ANOVA Summary Tables

Table 40: Cell Division

Green Requirements	Picture Stimulus	Cell Number
Green	*Nature*	1
	Face	2
	Control	3
Non-Green	*Nature*	4
	Face	5
	Control	6

Table 41: ANOVA Summary Table on Preferred Energy Level

Green Requirements	Picture Stimulus	Cell Number	Sum of Squares	F	Sig.
Green	*Nature-Face*	*1 vs.2*	1622.4	1.805	.184
	Face-Control	*2 vs.3*	3697.4	4.699	**.034**
	Nature-Control	*1 vs.3*	421.4	.801	.375
Non-Green	*Nature-Face*	*4 vs.5*	5880.6	7.726	**.007**
	Face-Control	*5 vs.6*	7729.4	7.652	**.008**
	Nature-Control	*4 vs.6*	126.2	.186	.668
Nature	*Green-Non green*	*1 vs.4*	1224.0	2.296	.135
Face	*Green-Non green*	*2 vs.5*	2.0	.002	.966
Control	*Green-Non green*	*3 vs.6*	660.0	.985	.325

Table 42: ANOVA Summary Table on Preferred Price

Green Requirements	Picture Stimulus	Cell Number	Sum of Squares	F	Sig.
Green	*Nature-Face*	*1 vs.2*	5801.667	.456	.502
	Face-Control	*2 vs.3*	25215.000	2.753	.102
	Nature-Control	*1 vs.3*	6826.667	.829	.366
Non-Green	*Nature-Face*	*4 vs.5*	51626.667	5.589	**.021**
	Face-Control	*5 vs.6*	56426.667	3.817	**.056**
	Nature-Control	*4 vs.6*	106.667	.012	.913
Nature	*Green-Non green*	*1 vs.4*	21660.000	2.851	.097
Face	*Green-Non green*	*2 vs.5*	15.000	.001	.974
Control	*Green-Non green*	*3 vs.6*	5606.667	.585	.448

Table 43: ANOVA Summary Table on Product Energy Level

Green Requirements	Picture Stimulus	Cell Number	Sum of Squares	F	Sig.
Green	*Nature-Face*	*1 vs.2*	1510.017	1.297	.259
	Face-Control	*2 vs.3*	3226.667	2.555	.115
	Nature-Control	*1 vs.3*	322.017	.220	.641
Non-Green	*Nature-Face*	*4 vs.5*	4860.000	3.580	**.063**
	Face-Control	*5 vs.6*	5762.400	3.319	**.074**
	Nature-Control	*4 vs.6*	38.400	.022	.883
Nature	*Green-Non green*	*1 vs.4*	1728.067	1.257	.267
Face	*Green-Non green*	*2 vs.5*	114.817	.100	.753
Control	*Green-Non green*	*3 vs.6*	889.350	.480	.491

Table 44: ANOVA Summary Table on Product Price

Green Requirements	Picture Stimulus	Cell Number	Sum of Squares	F	Sig.
Green	*Nature-Face*	*1 vs.2*	8401.667	.439	.510
	Face-Control	*2 vs.3*	24806.667	1.840	.180
	Nature-Control	*1 vs.3*	4335.000	.332	.567
Non-Green	*Nature-Face*	*4 vs.5*	82881.667	6.127	**.016**
	Face-Control	*5 vs.6*	43201.667	2.167	.146
	Nature-Control	*4 vs.6*	6406.667	.493	.485
Nature	*Green-Non green*	*1 vs.4*	24806.667	1.962	.167
Face	*Green-Non green*	*2 vs.5*	1500.000	.075	.785
Control	*Green-Non green*	*3 vs.6*	135.000	.010	.920

Table 45: ANOVA Summary Table on Attitude Change

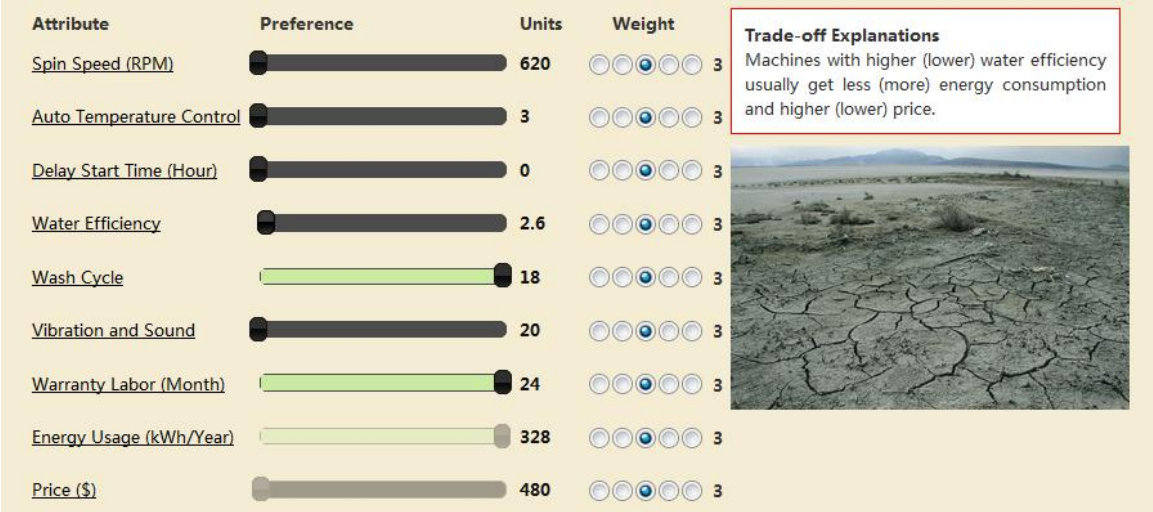
Green Requirements	Picture Stimulus	Cell Number	Sum of Squares	F	Sig.
Green	*Nature-Face*	*1 vs.2*	.024	.033	.856
	Face-Control	*2 vs.3*	3.553	3.977	**.051**
	Nature-Control	*1 vs.3*	4.161	4.057	**.049**
Non-Green	*Nature-Face*	*4 vs.5*	.913	.937	.337
	Face-Control	*5 vs.6*	1.176	1.273	.264
	Nature-Control	*4 vs.6*	.017	.015	.904
Nature	*Green-Non green*	*1 vs.4*	2.817	2.774	.101
Face	*Green-Non green*	*2 vs.5*	.323	.476	.493
Control	*Green-Non green*	*3 vs.6*	.054	.047	.828

Table 46: ANOVA Summary Table on Rank

Green Requirements	Picture Stimulus	Cell Number	Sum of Squares	F	Sig.
Green	*Nature-Face*	*1 vs.2*	58.017	1.878	.176
	Face-Control	*2 vs.3*	98.817	5.240	**.026**
	Nature-Control	*1 vs.3*	5.400	.358	.552
Non-Green	*Nature-Face*	*4 vs.5*	5.400	.752	.389
	Face-Control	*5 vs.6*	20.417	.704	.405
	Nature-Control	*4 vs.6*	46.817	1.751	.191
Nature	*Green-Non green*	*1 vs.4*	2.817	.176	.677
Face	*Green-Non green*	*2 vs.5*	48.600	2.205	.143
Control	*Green-Non green*	*3 vs.6*	56.067	2.173	.146

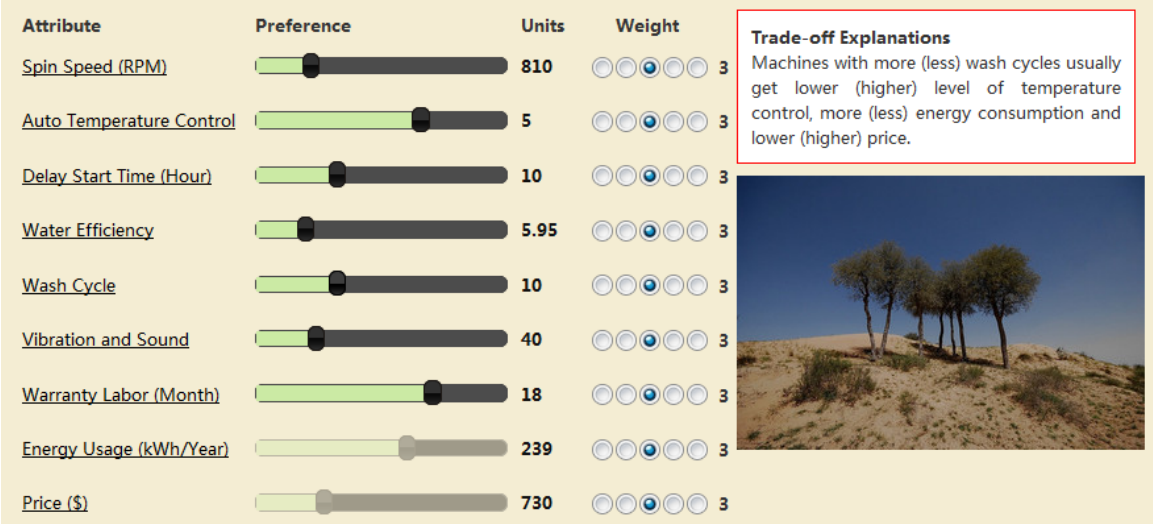
Appendix F Conditioning Design

F.1 Nature Stimulus



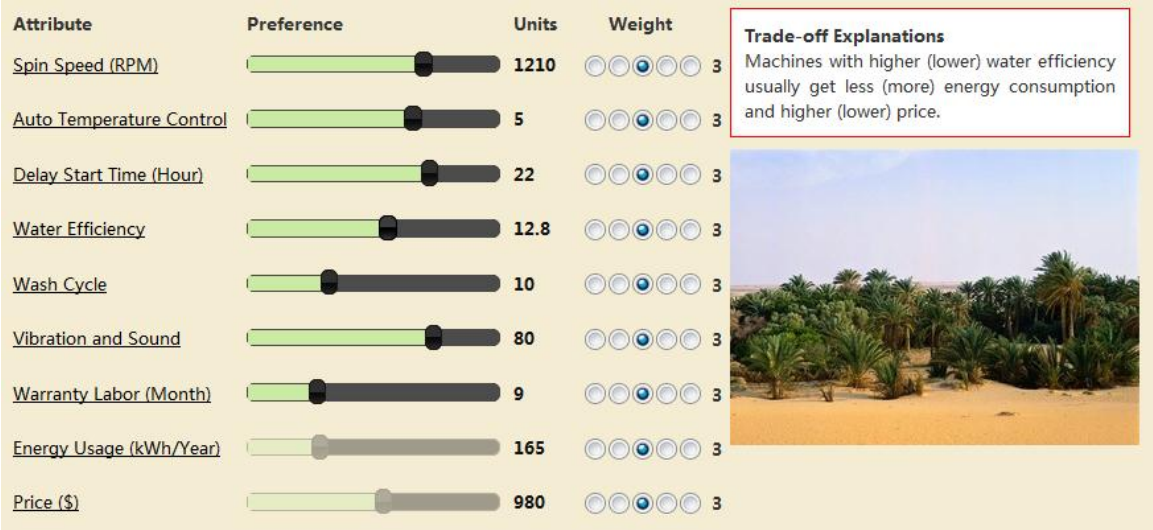
Ranking Score for Nature Pictures (1-10)：1.22

Ranking Score：2.77



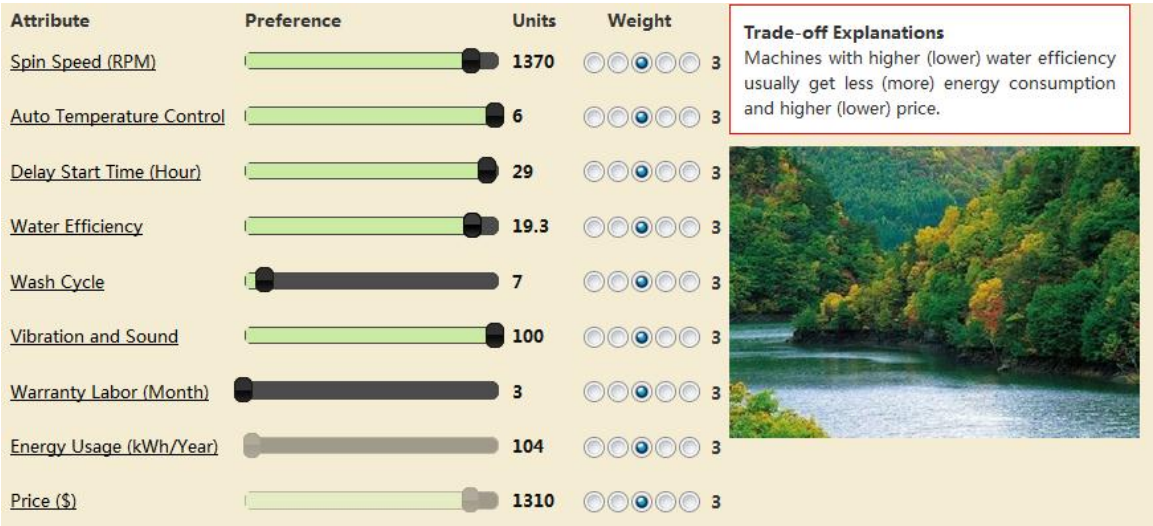
Ranking Score：4.22

Ranking Score：6.33



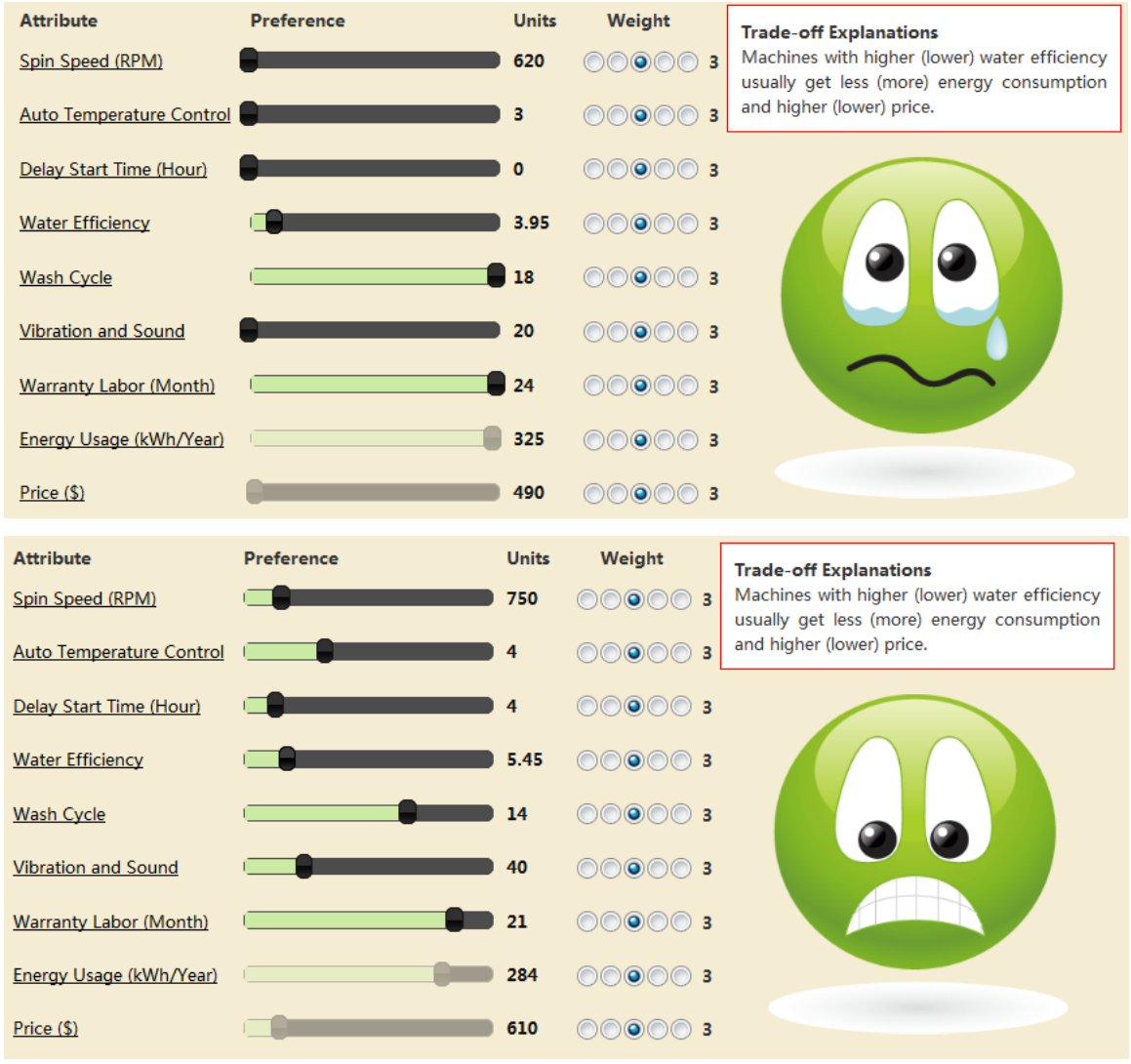
Ranking Score：7.33

Ranking Score：8.67



Ranking Score：9

F.2 Face Stimulus



Attribute	Preference	Units	Weight
Spin Speed (RPM)		1000	3
Auto Temperature Control		4	3
Delay Start Time (Hour)		10	3
Water Efficiency		11.25	3
Wash Cycle		14	3
Vibration and Sound		60	3
Warranty Labor (Month)		18	3
Energy Usage (kWh/Year)		239	3
Price ($)		770	3

Trade-off Explanations
Machines with higher (lower) water efficiency usually get less (more) energy consumption and higher (lower) price.

Attribute	Preference	Units	Weight
Spin Speed (RPM)		1100	3
Auto Temperature Control		5	3
Delay Start Time (Hour)		12	3
Water Efficiency		12.65	3
Wash Cycle		11	3
Vibration and Sound		80	3
Warranty Labor (Month)		15	3
Energy Usage (kWh/Year)		205	3
Price ($)		860	3

Trade-off Explanations
Machines with higher (lower) water efficiency usually get less (more) energy consumption and higher (lower) price.

Attribute	Preference	Units	Weight
Spin Speed (RPM)		1220	3
Auto Temperature Control		5	3
Delay Start Time (Hour)		18	3
Water Efficiency		14.2	3
Wash Cycle		9	3
Vibration and Sound		80	3
Warranty Labor (Month)		12	3
Energy Usage (kWh/Year)		169	3
Price ($)		970	3

Trade-off Explanations
Machines with more (less) wash cycles usually get lower (higher) level of temperature control, more (less) energy consumption and lower (higher) price.

Attribute	Preference	Units	Weight
Spin Speed (RPM)		1330	3
Auto Temperature Control		5	3
Delay Start Time (Hour)		23	3
Water Efficiency		17	3
Wash Cycle		9	3
Vibration and Sound		100	3
Warranty Labor (Month)		9	3
Energy Usage (kWh/Year)		141	3
Price ($)		1070	3

Trade-off Explanations
Machines with more (less) wash cycles usually get lower (higher) level of temperature control, more (less) energy consumption and lower (higher) price.

Attribute	Preference	Units	Weight
Spin Speed (RPM)		1370	3
Auto Temperature Control		6	3
Delay Start Time (Hour)		29	3
Water Efficiency		19.5	3
Wash Cycle		7	3
Vibration and Sound		100	3
Warranty Labor (Month)		3	3
Energy Usage (kWh/Year)		103	3
Price ($)		1320	3

Trade-off Explanations
Machines with higher (lower) water efficiency usually get less (more) energy consumption and higher (lower) price.

F.3 Cat Stimulus

Ranking Score (1-10): 2.14

Ranking Score: 2.86

Ranking Score: 3.14

Ranking Score: 3.71

Ranking Score: 4

Ranking Score: 6.86

Ranking Score: 7.43

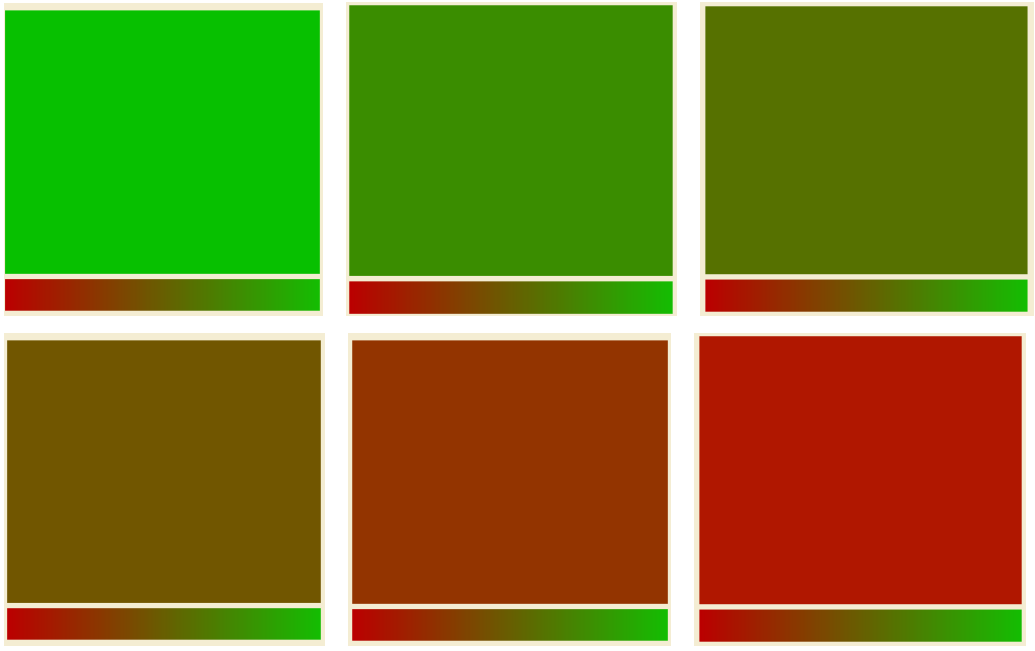
Ranking Score: 7.98

Ranking Score: 8.54

Ranking Score: 9.43

F.4 Color Stimulus

Notice: the pictures are just random screen shots of some stages.



Appendix G Recommendation Algorithm

The level of each attribute (A1, A2, A3…A9) is divided into four intervals (0–25%, 25–50%, 50–75%, and 75–100%), the most desirable level being 100% and the least desirable being 0%.

The first level of attribute 1 of product 1 (A1_P1) falls into the four intervals of A1 and is assigned a number N-A1-P1 (from 1-4). If it falls between 0 and 25%, the number is 1, and so forth, 4 being assigned to 75–100%. In the same way, each attribute can be given a number of desirability (D_A1_P1, D_A2_P1…D_A9_P1). Therefore, each product (P1-P60) can be presented through an array of desirability numbers.

When people specify their required levels for the first seven attributes (R_A1, R_A2…R_A7) by moving the attribute button, the levels of "Energy Consumption" (R_A8) and "Price" (R_A9) change accordingly due to the regression relationships we calculated with real products. Similarly, R-A1 also contains the four intervals of A1 and gets a desirability number (D_A1) from 1 to 4. D_A2 to D_A9 can be calculated in the same way. Thus, we can get a product that the user wants presented with D_A1 to D_A9.

The next step is to compare each product with the desirable product to calculate its fitness. For attribute 1 (A1), product 1 (P1) may have a desirability score of 3 (D_A1_P1). If a user's desirability for A1 (D_A1) is lower than 3(D_A1_P1), we do not give a misfit score. If D_A1_P1 equals D_A1, the misfit score is 4 (22); if D_A1_P1 misses D_A1 by one, the misfit score is 8 (23); if it misses by two, the misfit score is 16 (24); if it misses by three, the misfit score is 32 (25). Using this method, each attribute can get a misfit score.

We next need to calculate the overall "misfit" for each product and recommend the most suitable one. The overall "misfit" (M_Pi) is the sum of the misfit score for each attribute times the weight of the attribute. When users specify their preference for each attribute, they also need to rate its importance from 1 to 5 (s1, s2...s9). The weight for attribute 1 A1 is w1= s1/ sum (s1, s2...s9).

We also give users a fit percentage for each product. After calculating the misfit score for all 60 products (M-P1, M-P2...M-P60), we can get the highest (M_highest) and the lowest (M_lowest) misfit scores. A product's fit percentage is calculated by comparing its misfit score with the misfit score of the fittest one: (M_highest – M_Pi) / (M_highest – M_lowest) * 100%.