ACT 2.0: the next generation of assistive consumer technology research

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Abstract

Purpose – This paper seeks to review current research on assistive consumer technologies (ACT 1.0) and to discuss a series of research challenges that need to be addressed before the field can move towards tools that are more effective and more readily adopted by consumers (ACT 2.0).

Design/methodology/approach – This is a conceptual paper. The perspective, commensurate with the current research and areas of expertise, is that of consumer researchers.

Findings – The paper argues that, while substantial advances have been made in the technical design of ACTs – and the algorithms that power recommendation systems, there are substantial barriers to wide-scale consumer adoption of such tools that need to be addressed. In particular, future ACT designs will need to better integrate current research in human judgment and decision making to improve the ease with which such tools can be used.

Originality/value – From the perspective of consumer researchers, the paper highlights a set of key areas of enquiry that have the potential to substantially advance assistive consumer technology research.

Keywords Consumers, Decision making, United States of America

Paper type Conceptual paper

Information technology has fundamentally altered the day-to-day lives of the world's consumers. Today, it is hard for many people to remember how common consumption tasks – from booking a flight to buying a book – were accomplished before the worldwide web. Many of the multimedia technologies that consumers now take for granted –, e.g. downloading music or movies, sharing pictures or video with friends, watching a live stream of one's favorite sports team or engaging in multi-player online gaming – have only been widely available with the adoption of broadband Internet access, which the majority of US households did not have prior to 2007. This rapid evolution of information technology has led to the availability of vast – and ever-increasing – quantities of information.

Lyman and Varian (2000) estimated that in 1999 the world produced between 2 and 3 exabytes[1] of new information – approximately 500 megabytes for every human on the planet. However, that study did not include information available via the Internet. In a follow-up study, which included information on the World Wide Web, they estimated that approximately 18 exabytes of new data was produced in 2002 (Lyman and Varian, 2003). A report from the International Data Corporation estimated that in

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2007, 281 exabytes of digital data were created and they projected that the amount would grow to 1,800 exabytes by 2011 (Gantz *et al.*, 2009). More recently, a project conducted at the University of California, San Diego, entitled "How Much Information?" (Bohn and Short, 2009), estimated that the average person in the US now consumes about 34 gigabytes of information per day[2]. In addition, while much of the information that people have consumed prior to the advent of the worldwide web was passive – i.e. television, radio, newspaper, etc. – today half of the bytes delivered to people are consumed interactively, over the Internet.

Relative to the information available to contemporary consumers, most of our history has taken place in a state of extreme information poverty. In fact, it has been argued that humans evolved in a world that required us to make decisions with limited data and that the need to be able to make choices quickly with little information has defined the architecture of human cognition (e.g. Anderson, 1990). However, the success of a cognitive system that has excelled at making rapid decisions without much data is being challenged in an environment that generates a flow of information measured in zettabytes.

Fortunately, the rapid improvements in technology that have given rise to vast and ever-growing amounts of information also have the potential to facilitate solutions to many of the associated problems. In this article, we examine the potential for technology to assist people in their decision-making in an information rich environment. In particular, we focus on what we call assistive consumer technologies (ACTs) – i.e. tools that help consumers make better choices, with less effort, when faced with daunting data and limited time. In principle, ACTs can include a wide variety of decision aids. However, in this article we are specifically interested in those that help consumers search the marketplace for products that best match their preferences and then provide a set of recommendations. For the most part, we will be discussing the implementation of such tools within the context of Internet-based electronic commerce. We will also explore the movement toward a world of augmented reality where mobile applications allow consumers to interact with the real and virtual worlds simultaneously.

Our perspective, commensurate with our current research and areas of expertise, is that of consumer researchers. Although we will briefly review the advances that have been made in algorithms and ACT functionality, our primary focus is on providing decision assistance that is valued by consumers and on building tools that consumers are in fact likely to adopt for use in real-world choices. This paper is structured in four major sections. The first section describes the problems that consumers are facing in a world that offers ever-growing access to information and information of increasing complexity and interactivity. The subsequent two sections focus on previous research (ACT 1.0) and opportunities within emerging and future streams of research (ACT 2.0)[3]. Following that, we briefly discuss some emerging opportunities for research in the growing market for mobile commerce, as well as the rise of augmented reality and the progression toward multi-agent systems. In doing so, we intend to raise as many questions as we answer, in hopes of sketching out a general path for future research into assistive consumer technology.

Too much choice

Until very recently, consumers did most of their shopping at neighborhood stores that carried a small selection of items in a few different product categories. Choosing between a handful of breakfast cereals, or deciding to buy a book from a single shelf of best sellers, was a relatively easy decision that could be made with minimal effort. However, as the size of retail stores expanded, so did the number of product categories offered and the number of items in each category. Modern "big box" stores regularly stock more than 50,000 unique items, with some supercenters selling more than 150,000 items. Yet, even gigantic stores with hundreds of thousands of square feet have selections that are dwarfed by the millions of products being offered for sale on web sites such as Amazon or eBay.

At first glance, it would seem that the more choice consumers have the better off they would be. With more options consumers should be able to find products that better match their needs and wants. One of the fundamental tenets of marketing theory is that firms should segment markets and deliver products that are specifically designed to match the preference profiles of target customer segments (Dickson and Ginter, 1987; Smith, 1956). Ultimately, this approach implies that the number of available products should increase over time as improvements in technology and management efficiency allow firms to create products that are targeted at increasingly small segments – possibly even individual customers (Anderson, 2006). The better match between preferences and offered products should increase demand, allowing firms to sell more products that consumers are more satisfied with buying. And, in fact, research has clearly demonstrated that having options available – i.e. having the freedom to choose – does have positive effects; including enhancing intrinsic motivation, elevating consumers' sense of control, improving task performance and even increasing overall life satisfaction (Deci, 1975, 1981; Deci and Ryan, 1985; Glass and Singer, 1972a, b; Langer and Rodin, 1976; Rotter, 1966; Schulz and Hanusa, 1978; Taylor, 1989; Taylor and Brown, 1988).

The problem arises when the consumer goes shopping for the product that is the best match to his or her preferences (Schwartz, 2005). Faced with a shelf offering a few alternatives, the decision process is relatively easy. However, confronted by countless variations for even the most basic products, finding those that best match ones' preferences becomes a Herculean task. Given far more information and alternatives than a consumer can even begin to process, the benefits of having a choice give way to the negative consequences of having too much choice. Recent work has indicated that choosing from a large number of products can increase regret, decrease product satisfaction, lower self-esteem, reduce self-control and even decrease overall life satisfaction (e.g. Baumeister and Vohs, 2003; Carmon *et al.*, 2003; Iyengar and Lepper, 2000; Schwartz *et al.*, 2002). In turn, lower levels of consumer satisfaction, driven by too many options being available, can decrease firm profitability (Rust *et al.*, 2006; Thompson *et al.*, 2005).

The good news is that this is exactly the problem that ACTs have been shown to excel at solving. For example, Häubl and Trifts (2000) provided an early demonstration of the power of relatively simple tools to improve the quality of consumers' decisions, while simultaneously reducing the effort required to make these decisions. The research of Diehl *et al.* (2003) indicated that ACTs can also help consumers focus their decision making on the product attributes that are most important to them – for example, ACTs can help consumers to choose products with lower prices. In the next section, we briefly review some of the key research findings related to consumers' interactions with assistive consumer technology. We then detail a number of critical problems that have yet to be addressed and may be creating substantial barriers to the large- scale adoption of ACTs.

ACT 1.0 – agents and algorithms

For many years researchers in computing science and marketing have recognized the enormous potential of technology to improve consumers' lives by providing them assistance in everyday tasks and more complex decisions. For example, in his book *Being Digital*, Negroponte (1995) describes his vision of an agent with a deep knowledge of the user it serves:

> It has become obvious that people want to delegate more functions and prefer to directly manipulate computers less. The idea is to build computer surrogates that possess a body of knowledge both about something (a process, a field of interest, a way of doing) and about you in relation to that something (your taste, your inclinations, your acquaintances). Namely, the computer should have dual expertise, like a cook, gardener, and chauffeur using their skills to fit your tastes and needs in food, planting, and driving. When you delegate those tasks it does not mean you do not like to prepare food, grow plants, or drive cars. It means you have the option to do those things when you wish, because you want to, not because you have to (Negroponte, 1995, pp. 150-1).

Similarly, Alba and colleages (1997) expanded on Negroponte's work with a more detailed description of a home shopping assistant that has a deep knowledge of its user's preferences and leverages this information to facilitate shopping across a broad range of domains. Such an assistant is able to search the marketplace for specific products and recommend a small set of alternatives that would appeal to the tastes of its user. It could pay for purchases on behalf of the user, remind the user when s/he is running low on regularly purchased items and suggest other products that are complementary to the targeted item (e.g. a scarf to go with the chosen dress). Along similar lines, West *et al.* (1999) described a variety of roles that technology could play in the consumption process from clerking (assisting consumers in their product search) to advising (recommending products based on the individual consumer's preferences) to tutoring (assisting consumers in discovering and understanding what their preferences are).

Early empirical research into the potential of ACTs has demonstrated that software agents that provide product recommendations can substantially improve consumer decision-making (e.g. Adomavicius and Tuzhilin, 2005; Ariely *et al.*, 2004; Diehl *et al.*, 2003; Häubl and Trifts, 2000; Häubl and Murray, 2003; Senecal and Nantel, 2004). Yet, although these tools have tremendous potential, the advances that some had envisioned (e.g. Alba *et al.*, 1997; Negroponte, 1995) have not materialized. In the sections that follow we will discuss a number of problems that have slowed the pace of these advances. First, we address the fundamental problem of the quality of advice that ACTs are capable of providing. The issue here is that the initial algorithms employed by agents required extensive data collection – either through behavioral observation or through direct questioning of the consumer – before they were able to make recommendations that had a reasonable probability of being helpful to (and adopted by) consumers. This created a quandary: ACTs could "interrogate" consumers and provide a more accurate recommendation based on detailed preference profiles or the ACT could ask only a small number of questions (which is what consumers prefer) and provide less useful advice (e.g. Murray and Häubl, 2009). To some extent this problem has been addressed by recent work that has developed algorithms capable of both efficiently collecting consumer preference information and effectively providing advice to consumers.

Improving algorithms

Murray and Häubl (2009) point out that one of the problems with the first generation of recommendation systems was that they had to interrogate consumers before they were able to provide high quality recommendations. That is, to develop a preference profile of a particular consumer, many early ACTs required the consumer to answer a large number of questions. The process of providing this information is almost as difficult for consumers as would be searching a large marketplace and screening the available products without assistance. It is also a process that is very foreign to most consumers and in fact more akin to completing a market research survey than to asking for advice from a trusted (human) advisor.

The first part of this problem – i.e. the large number of questions that must be asked before a recommendation can be made – has been addressed in a variety of ways. One approach is to use what has been referred to as passive personalization, where individual consumer profiles are built by inferring preferences from behavior rather than directly eliciting such information. Murray *et al.* (2009) demonstrate that this type of personalization can be very effective at improving the efficiency with which consumers make decisions. However, passive personalization requires a substantial amount of behavioral data. This might work for a regular book buyer, frequent flyer or grocery shopper, but it will be much more difficult to implement in new product categories (where limited data on relevant prior behavior are available) or for the many products that consumers purchase infrequently (e.g. computers, TVs, automobiles and homes).

Another approach is to use a collaborative filtering algorithm and ask consumers just enough questions to allow them to be grouped with similar individuals (Balabanovic and Shoham, 1997). Recommendations can then be generated based on what other people have evaluated favorably or chosen. Yahoo!'s movie recommendation system follows this kind of approach. However, research has indicated that while collaborative filtering can provide good recommendations with very little initial information, this method may not be as effective at providing specific and detailed assistance when the consumer requires repeated advice over an extended period of time. In such cases, research by Ariely *et al.* (2004) has demonstrated that an algorithm that operates on explicit preference information – in terms of product attributes – that has been elicited from an individual consumer is better able to learn and adapt over time. Moreover, collaborative filtering algorithms have often been designed to work on data sets that have many more consumers than products. The MovieLens data set, for instance, has 65,000 users and 5,000 movies (see Herlocker *et al.*, 2004). It is not clear to what extent a collaborative filtering approach can work effectively in markets where there are fewer users, preferences are complex or when there are more products than users in the database.

The problem of how to elicit preference information in a minimally intrusive manner without significantly sacrificing recommendation quality has received considerable research attention (e.g. Ansari *et al.*, 2000; McNee *et al.*, 2006). Substantial advances have been made in building more efficient algorithms that require answers to fewer questions in order to provide personalized recommendations. For example, Adaptive Conjoint Analysis (Johnson, 1987) refines the questions that respondents are asked in real-time based on their previous answers. By doing so, this approach allows the researcher to ask fewer questions and more efficiently build a profile of the individual's preferences. Building on this approach, Toubia *et al.* (2003) have introduced more advanced techniques that further reduce the number of questions that need to be asked before an accurate profile can be compiled. Similarly, De Bruyn *et al.* (2005) developed a stepwise componential regression approach that can provide a high level of predictive accuracy by asking consumers to answer as few as two questions. In addition, there is some evidence that current recommendation algorithms are capable of predicting preferences better than human advisors. For example, in a recent study, Krishnan *et al.* (2008) found that, based on a survey, the MovieLens (Balabanovic and Shoham, 1997) recommender was more accurate than human advisors in predicting consumers' movie preferences. These advances in efficient preference profiling can go a long way towards improving ACTs' ease of use, thereby making consumers more likely to adopt these technologies.

Matching products to preferences

However, there is also evidence that building effective preference profiles for individual consumers that are stable over time may be much more difficult than originally envisioned (Murray and Häubl, 2009; Simonson, 2005). In theory, products that are better matched to consumers' preferences will be in greater demand and have the potential to substantially improve firms' profitability (Peppers and Rogers, 1993; Winer, 2001). Although there are some technical challenges to creating products that are closely matched to consumers' preferences, the bigger problem appears to be understanding what those preferences are in the first place. As Simonson (2005) points out, eliciting stable preferences from consumers is a challenging task. Consumers tend to construct their preferences on the fly (Slovic, 1995; Häubl and Murray, 2003, 2006) – that is, instead of simply retrieving their preferences from a sort of master list in memory, they tend to rely on a combination of what the situational context prompts them to think about, their current affective state (Bettman *et al.*, 1998), their current mode of information processing (Godek and Murray, 2008) and the cues that are present in the immediate environment (Mandel and Johnson, 2002).

In fact, very subtle differences in the way that consumers are asked about their preferences or very small differences in the choice environment can have substantial effects on the decisions that are ultimately made. For example, Häubl and Murray (2003) examined the impact of a recommendation algorithm that was selective in that it was based only on a subset of relevant product features. Specifically, the authors examined consumers' preferences for backpacking tents after they had been given a sorted list of products by a recommendation agent. Pre-tests had indicated that most consumers considered two product features, a tent's durability and its weight, to be of greatest importance in this product category. During the preference-elicitation phase of the recommendation process, study participants were asked to express their subjective importance of only one of these two primary product attributes along with that of several other attributes, and the subsequent recommendations were based on consumers' preference in terms of that set of attributes. To counterbalance this manipulation with the specific attributes used, the recommendation process included durability (but not weight) for half the subjects and weight (but not durability) for the other half.

The results of this study illustrate the powerful influence that personalized recommendations can have on consumers' choices. Specifically, if the selective inclusion of attributes in the recommendation process had no influence on purchase decisions, the extent to which an attribute drives product choice would be independent of whether or not it was used in generating the recommendations. However, 71 percent of the participants in this study selected a product that was superior on the attribute that had been included in the process of generating the recommendations, while only 29 percent selected an alternative that was superior on the other primary attribute – i.e. the one that had not been included in the recommendation process. Thus, simply including a particular product feature in the process of generating personalized product recommendations caused that feature to become more important in consumers' purchase decisions. In addition, Häubl and Murray (2003) found that the influence of the personalized recommendations, which were based on only a subset of tent attributes, on consumer preferences persisted into future purchase decisions (even though the subsequent shopping trips did not involve any form of personalization).

The research of Mandel and Johnson (2002) provides another example of the powerful effect that small differences in context can have on consumer decision-making. Although most of the participants in this study believed that they would be unaffected by subtle changes in the choice environment, the authors find that simply changing the background images on a web page had a significant effect on the choices that consumers made. For example, in one of the studies participants were exposed to either a blue background with clouds (to prime comfort) or a green background with pennies (to prime price). After that, they were asked to choose a sofa from a set of two alternatives – a more comfortable but more expensive one and a less expensive but less comfortable one. Of those consumers who had been exposed to the green/pennies background, 44 percent selected the more comfortable sofa. In contrast, among those consumers who had been exposed to the blue/clouds background, 61 percent chose the comfortable sofa. In addition, the authors found that the results were the same for both experts and novices in this study.

These are just two examples of consumer decision making during online shopping that are consistent with a larger stream of research, which demonstrates that preferences can be very labile and are often constructed by consumers on the fly (e.g. Slovic, 1995; Bettman *et al.*, 1998). Building on this line of thought, Simonson (2005) provides a detailed account of the problems associated with providing personalization in light of what is known about the construction of consumers' preferences. Specifically, he examines the assumption that stable preferences can be elicited and used to generate recommendations or customize products that will be received favorably by consumers. His process model of customers' responses to personalization suggests that preference construction may be a substantial barrier to the successful implementation of assistive consumer technologies.

What we do not know can hurt us

In addition to the problems that may be inherent when seeking to elicit stable preferences as a basis for making product recommendations, building profiles by asking participants about their preferences suffers from an "expertise paradox." That is, people who need advice are typically less knowledgeable about the domain in which they are seeking information – consumer expertise and the need for advice are negatively correlated (Murray and Häubl, 2009). For example, a camera enthusiast with a deep understanding of current technology and of the range of products that are for sale, and who has an informed opinion about what s/he prefers in a camera has less need for an ACT that can provide assistance during the purchase process. In contrast, a consumer who has very little knowledge about cameras, does not clearly understand the pros and cons of particular product attributes, and has trouble intelligently differentiating between the available alternatives, is an ideal candidate for recommendations and advice from an ACT. The problem is that the unknowledgeable consumer does not know enough about cameras to articulate his/her attribute preferences –, e.g. eight versus 12 mega pixels, an ISO rating of 400 versus 1,600, etc. (Liang and Murray, 2010). In other words, although less knowledgeable consumers are more likely to need the type of decision assistance an ACT can provide, their lack of knowledge may prevent them from providing the tool with the type of information that is necessary for it to provide useful assistance.

The double agent problem

The difficulty in eliciting stable preferences is likely to be a substantial barrier to the development of effective ACTs that are widely adopted by consumers. If the algorithms that the ACTs are built on do not provide satisfactory recommendations, consumers are unlikely to make use of these tools (McNee *et al.*, 2006; Murray and Häubl, 2008, 2009). However, in addition to such technical problems, there are also strategic problems associated with the development and implementation of ACTs. One example of a strategic issue facing ACTs is the "double agent" problem (Häubl and Murray, 2006). Many tools, that are designed, to provide decision assistance to consumers, have been developed by firms selling products. For example, Sears has developed tools that help online shoppers select a new appliance that best matches their needs. Consumers who are unsure about which refrigerator they should buy can consult Sears' personal kitchen advisor, which will ask them a series of questions before recommending a few models that have been screened from Sears' online inventory to best fit the preferences of the shopper. Similarly, Target has created an iPhone application that assists shoppers during the holiday season by suggesting Christmas gifts that can be purchased through the users' mobile phone. The problem is that these tools are double agents – they are working on behalf of the consumer to assist in the decision making process, but they are also working for Sears and Target to help sell products. Consumers recognize this conflict of interest and, as a result, may be less inclined to trust or use the ACT. At the same time, firms like Sears and Target have little incentive to provide recommendations for products that they do not sell. Yet, who else has both the motivation and the ability to build ACTs that can understand consumers' preferences *and* have access to details of the available products, which consumers might be interested in? A viable business model for an altruistic ACT, which is not created by a product vendor with a vested interest in the choices that consumers make, has yet to be developed.

The power of human habit

Beyond the technical problems of developing stable preference profiles and avoiding excessive bias in the nature of recommendations, ACT designers also have to deal with the highly habitual nature of consumer behavior. We know that people do not like to have to learn new skills, and that they prefer to use skills they already have when they begin to use a new technology (Carroll and Rosson, 1987; Murray and Häubl, 2007).

Unfortunately, when it comes to using something like an ACT, consumers have very limited skill and experience in taking advice from a machine. Traditionally, when people want advice, they ask a friend. Getting advice in that manner involves an etiquette and "interaction protocols" that have been developed and internalized over a lifetime of experience. Moreover, the process of getting advice from a human rarely requires a detailed interrogation or a comprehensive review of past behavior (Murray and Häubl, 2009). Thus, people are not used to providing detailed information about themselves and their preferences before receiving advice. The average consumer is not skilled at expressing his or her own preferences (West *et al.*, 1996) and tends to struggle to assess the value of advice from an external source (Godek and Murray, 2008). Moreover, given growing privacy concerns, consumers may be reluctant to provide personal preference information in exchange for advice, even if they are able to provide such information and are confident that the ACT is going to work in an unbiased way on their behalf.

To summarize ACT 1.0, it is clear that researchers have made significant advances in improving the algorithms that can be used to generate personalized product recommendations to consumers. Yet, there remain substantial barriers to the widespread adoption of ACTs in consumer markets. We envision an ACT 2.0 that puts more emphasis on usability (along with the functionality and accuracy of the underlying algorithms), can credibly establish consumer trust, integrates data from social media, is accessible to a broader range of consumers, and provides consumers with more natural and comfortable interactions.

ACT 2.0 – an agent of our own

Here we draw an analogy between ACT research and the evolution of the worldwide web. The first "version" of the web was about the ability to retrieve information. Web 2.0 was more focused on the user, as well as his/her ability to collaborate and share information. This allowed people to use standard platforms to create customized interfaces that integrated available information with their own personal preferences and the opinions of selected "friends". The first generation of ACT research focused primarily on the role of ACTs in the decision-making process (Alba *et al.*, 1997; Adomavicius and Tuzhilin, 2005; Häubl and Trifts, 2000; West *et al.*, 1999) and on improving the algorithms used to generate the recommendations (e.g. Balabanovic and Shoham, 1997; De Bruyn *et al.*, 2005; Toubia *et al.*, 2003). In the following sections, we examine some potential future directions for research that builds on what we have learned so far and aims to solve the problems that we have argued hinder the large-scale adoption of such tools (Murray and Häubl, 2009).

Personalized interfaces

One of the reasons that marketers have been interested in assistive consumer technology is its potential to provide personalized product advice – that is, matching recommendations to individual consumer preferences. Much less attention has been given to personalizing the interface through which the ACT interacts with the consumer. In other words, personalization has been used to address the usefulness of such tools, while personalizing the interface to make the tool easy to use has been under investigated. Nevertheless, there is some initial evidence suggesting that such an approach could substantially improve the willingness of consumers to use ACTs (e.g. Bright, 2008; Price *et al.*, 2006).

For example, a recent study conducted at MIT suggests that web sites that are able to adapt to the cognitive and cultural styles of individual consumers can substantially improve a consumer's preference for that site and increase the site's sales (Hauser *et al.*, 2009; Urban *et al.*, 2009). The basic idea is that, to effectively convey information, such as product specifications or recommendations, a web site must not only provide the right data (i.e. useful content, accurate recommendations, etc.), but it also has to provide it in the way that is the most appropriate for individual consumers. That is, much like good human advisors attempt to build some rapport with the consumer they are advising before getting down to the business of making recommendations, Hauser and colleagues developed web sites that were capable of "morphing" to connect with the individual user. Specifically, the web sites were designed to automatically match their basic "look and feel" to the users' cognitive style.

To personalize the web site in this way, the researchers "primed" the Bayesian inference engine with data on the different cognitive styles of a group of consumers sampled from the general population. This sample completed a detailed survey that assessed cognitive style (i.e. the extent to which people were visual versus verbal, analytic versus holistic, impulsive versus deliberate, leaders versus followers, technical versus nontechnical, etc.). The researchers then segmented the market into 16 different cognitive style groupings and examined the way that each of these groups preferred to interact with the web site (i.e. they analyzed the click-stream data for each of these segments) (Hauser *et al.*, 2009). That data was then used to categorize new users of the web site into one of the cognitive style segments. Based on how a new user navigates the site, the interface morphs to a design that best matches the cognitive style of the user (Urban *et al.*, 2009). In this way, the web site is quickly personalized to the "look and feel" that is best matched to the individual user. The results of this research show that the passive morphing web site (i.e. the one that did not ask the user about his or her preferences or cognitive style) was just as effective at personalizing the interface, as was a web site that was morphed based on an extensive user survey (which measured cognitive style explicitly). Specifically, when the web site was personalized to match the cognitive style of the user, purchase intentions increased by approximately 20 percent. The web site that the research was conducted on was an experimental interface for the BT Group (formerly British Telecom), and the authors estimated that, if implemented across BT's online system, the increase in purchase intentions would translate into tens of millions of dollars in additional revenue (Hauser *et al.*, 2009).

However, other research has indicated that although passive personalization can substantially improve the user experience and dramatically increase the loyalty that consumers exhibit towards a personalized web site, the value added by such personalization is not obvious or immediately apparent to consumers (Murray *et al.*, 2009). Specifically, the results of that study suggest that if the value of personalization – for example, more efficient interactions and purchases – is not explicitly explained to consumers, they will not exhibit a greater preference for the personalized web sites unless they have substantial direct experience with a non-personalized web site as a basis for comparison. This work suggests that, although passive interface personalization is one potential solution to the problem of ease of use that is worthy of additional investigation, designers should also continue to look for other ways to improve initial ease of use.

For example, research has indicated that when even very rudimentary social capabilities are built into computer interfaces, users tend to respond much more favorably (Bickmore and Picard, 2005; Picard, 1997). Prior work in this area suggests that people tend to treat interactions with electronic interfaces in much the same way they respond to interactions with other humans (Burgoon *et al.*, 2000; Reeves and Nass, 1996; Sundar, 2004). According to Nass and Moon (2000), this appears to be especially true when the interface outputs information as words (Turkle, 1984), is interactive in the sense that it bases its responses on multiple prior inputs (Rafaeli, 1990), and undertakes tasks that have traditionally been performed by humans (Cooley, 1966; Mead, 1934). Therefore, it seems that people are likely to respond to ACTs in a manner that is largely analogous to the way in which they would respond to another human being.

Even small steps towards designing more anthropomorphic interfaces have the potential to dramatically improve users' willingness to interact with technology (Murray and Häubl, 2009). For example, an emerging stream of research suggests that when a shopping web site employs humanoid avatars to interact with users, consumers tend to have more favorable attitudes towards both the retailer and their merchandise (Davis *et al.*, 2009; Hemp, 2006; Holzwarth *et al.*, 2006; Owens *et al.*, 2009). More specifically, it has been demonstrated that computers that apologize for errors increased the users' level of enjoyment when interacting with the machine, as well as their preference for that computer (Tzeng, 2004). Similarly, software agents that display empathy and respond to emotions displayed by users can improve the users' preference for the interface, perceptions of the web site's trustworthiness and the perceived supportiveness of the interface (Brave *et al.*, 2005; Prendinger *et al.*, 2004). In general, the initial evidence suggests that, when an electronic interface incorporates elements of typical human social interaction, the interface is able to exert a greater influence on human decision-making (Picard, 1997; Reeves and Nass, 1996).

Trusted advisers

One of the critical ways that interface design influences human decision-making is by improving the trust that a user has in the technology (Feng *et al.*, 2009). According to Urban *et al.* (2009), "Trust can be distilled down to three dimensions: integrity/confidence, ability/competence, and benevolence" (p. 180). Given that cooperative interactions with technology (Hoffman *et al.*, 1999) and opportunities for co-creation (Prahalad and Ramaswamy, 2004) tend to substantially enhance the trust that consumers are willing to place in technology, it would seem that the basic design characteristics of ACTs are conducive to building trust. Consistent with this notion, early evidence suggests that consumers are quite willing to trust ACTs. For example, Senecal and Nantel (2004) found that consumers who received product recommendations from an ACT were twice as likely to choose a product that the ACT recommended as compared to consumers who shopped without assistance. Moreover, the authors found that product recommendations made by an ACT were more influential than those provided by human experts. Similarly, Urban and Hauser (2003) found that customers trusted a virtual advisor that helped them make an automobile purchase eight times more than they trusted traditional automobile dealers.

At a minimum, for an ACT to be perceived as trustworthy, consumers will need to believe that it can protect their privacy and ensure their security (Shankar *et al.*, 2002).

However, recent research has clearly demonstrated that other factors can play an equally important role. For example, products with high levels of brand equity tend to gain trust quickly in electronic environments (Bart *et al.*, 2005). Positive reviews by other shoppers can also help accelerate the process of trust development (Smith *et al.*, 2005). Interestingly, interface design appears to play a predominant role in consumers' perceptions of trustworthiness and, ultimately, their purchase intentions (Schlosser *et al.*, 2005). In fact, according to Bart *et al.* (2005), ease of navigation/use is a more important factor in building trust than are the consumer's perceptions of a web site's privacy and security. Other studies have come to similar conclusions (e.g. Fang and Salvendy, 2003; Fogg *et al.*, 2003; Kim and Moon, 1998). Following ease of use, Bart *et al.* (2005) found that the next most important driver of trust was the ability of the seller to offer the consumer tools that provide decision assistance. Therefore, although most ACT research has focused on providing useful assistance, the extant research suggests that if the ACT wants to fulfill its role as a trusted advisor, it is equally (if not more) important to ensure that the design of the ACT maximizes the ease with which consumers can obtain recommendations.

There are two key reasons why building trust is at the heart of technology that aims to successfully provide assistance to consumers. First, without trust, ACTs will have a much more difficult time collecting the data that they need to build useful profiles of consumers' preferences (e.g. Chellappa and Sin, 2005; Milne and Boza, 1999; Schoenbachler and Gordon, 2002). Second, without trust, consumers are much less likely to accept assistance from an ACT (Murray and Häubl, 2008). Therefore, a better understanding of how trust forms and can be managed in electronic environments is a critical element in the advancement of assistive consumer technology. In addition, although work examining online trust has been undertaken by researchers in a variety of fields –, e.g. marketing, psychology, information technology, computing science, economics, etc. – further progress may well require a more interdisciplinary approach (Urban *et al.*, 2009).

It takes a village

Another area that seems to be ripe for additional research is the incorporation of social media data into recommendation systems. A great deal of preference information is now available on the web through social networks like Facebook and Twitter. Similarly, many online retailers report detailed product reviews by a wide range of people across a vast array of products. In addition, there are a myriad of blogs, discussion groups, and other electronic forums that are accumulating an increasingly large amount of information on the product and service preferences of a large sample of the population. It would seem that this is a data set with the potential to inform many recommendation systems, possibly reducing the number of questions that need to be directly asked of consumers and/or limiting the amount of behavioral data that must be collected before effective recommendations can be made.

A sub-class of recommendation systems is emerging that suggest to users of social online networks other members of the community that they might be interested in connecting with (e.g. Harper *et al.*, 2007; Liu *et al.*, 2008). What we are proposing here, however, is not making connection recommendations within social networks, but to instead use the information within these communities – especially those that provide public access to such information – to improve the effectiveness of ACTs.

A key distinction between this type of approach and the other algorithms that we have discussed is that social data mining systems do not need to ask the consumer questions (as feature-based recommendation systems do; Murray and Häubl, 2009), nor do they need to know the preferences of others (as collaborative filtering algorithms do; Herlocker *et al.*, 2004). Instead, social data-mining systems are a type of passive personalization that learn about consumers preferences by extracting information from online communities and conversations (including C2C, B2C, G2C, etc.). However, a key difference between extracting information from web navigation behavior (e.g. online shopping) and social networks is that the preference information on an individual's profile is non-arbitrary in the sense that it has been chosen by the individual for display. This type of information is likely to be more representative of the type of deep preferences and brand relationships (Fournier, 1994) that may be substantially more difficult to uncover through behavioral (e.g. click-stream) data alone. The basic idea being that social networks "do more than simply reveal the superficial structure of social connectedness – the rich meanings bottled with social network profiles imply deeper patterns of culture and taste" (Liu *et al.*, 2008, p. 1).

An early example of such a system was PHOAKS (People Helping One Another Know Stuff), which used a collaborative filtering approach to automatically recognize, filter and redistribute recommendations made by people writing Usenet news messages (Terveen *et al.*, 1997). Realizing that a great deal of knowledge was being disseminated through Usenet messages, Terveen and colleagues created a system that identified recommendations within those messages and organized them into a form that was easier to access and use. Recently, researchers have employed more sophisticated approaches to using the data that are available on the profiles of individuals within social networks (e.g. MySpace, Orkut, Facebook, etc.), to generate preference models.

For example, Golbeck and Hendler (2006) developed FilmTrust, a movie recommender that uses social network data to recommend movies. The basic idea is that people develop social connections with others who share similar preferences (e.g. Zeigler and Lausen, 2004). This approach infers and provides a value for the strength of each connection within a network using the TidalTrust algorithm (Golbeck, 2005). Movie recommendations are then made by a collaborative filtering algorithm that uses the strength of connection value to weight the movie ratings made by people within the network. Giving more weight to the ratings of people that an individual is more closely connected to and who, presumably, have preferences that are more similar to that individual. The system can also then display reviews of the recommended movies that are sorted according to the strength of connection between the person receiving the recommendation and the person who has written the review. Tyler and Zhang (2008) have also used a modified version of TidalTrust to generate recommendations for a much broader range of products using data from Epinions.com. They found that this approach was able to very accurately predict consumers' preferences, when it could be applied. However, because they were working with a very large number of products – which on average had only 2.4 ratings each – they were rarely able to use social network connection values to weight ratings.

Given that the widespread use of social networks is a fairly recent development, this approach to providing assistance to consumers is clearly still in its infancy. Nevertheless, as networks grow and become increasingly dense with data, the potential exists to substantially improve recommendations in an unobtrusive manner. At the same time, growing concern over information privacy within social networks may ultimately limit the availability of this type of data (Gross and Acquisti, 2005).

Greater accessibility

There is also a need for research that investigates the ability to use ACTs to assist consumers beyond the transaction and into the actual consumption of the product. A first step in this direction would be to collect data on where consumers most need assistance in their day-to-day lives. With a better understanding of what kind of assistance would be valuable, ACT design in this area can begin in earnest. For example, the Metro Group is experimenting with smart appliances that help consumers with routine shopping and meal preparation. This includes refrigerators that are able to use RFID tags embedded in grocery products to let the consumer know when they are running low on regular items or what additional products they might need to prepare a favorite recipe. The shopping list is then transmitted to a mobile phone, or even a smart shopping cart, that can use GPS technology to direct the consumer to the products on the list during the shopping trip.

Another promising area of post-purchase consumer assistance is the growing need to improve decision making for those that suffer from some form of cognitive impairment or disability. In particular, the aging population in many countries is expected to lead to substantially higher levels of cognitive impairment and dementia (Ferri *et al.*, 2005). Tools that provide such consumers with assistance could be extremely beneficial in helping with consumption tasks – from simple reminders to take particular pills to more advanced forms of assistance that allow for greater independent functioning. Newcastle University's e-business hub is in the initial stages of a large scale research project that aims to address these issues. Part of that project will involve building smart kitchens that go beyond helping with the next shopping trip to using technology to make regular routines easier for people who are less able to recall what they have already done and what they would like to accomplish next.

Ultimately, for technology to fulfill its promise of helping consumers, research will also have to address the accessibility of this type of technology. There is growing concern about the potential effects of the digital divide (e.g. Ferro, 2010). Obviously, ACTs can only be adopted by those who have access to the necessary technology. This means that research will have to broaden its scope from facilitating electronic commerce over the Internet to also include emerging technologies. For example, some types of ACTs are currently available as iPhone apps (e.g. GoodGuide, Alice, Yelp Monocle, etc.). As discussed previously, this could also include ACTs being built into the next generation of smart appliances. Your next coffee maker might not only produce a variety of coffees in a convenient way, but it could also help you select the right type of espresso to complement an almond biscotti. Similarly, a wine cooler might be capable of recommending a wine for a given meal – possibly even basing that recommendation on the ingredients you have available in your refrigerator for making dinner. Medicine cabinets could warn of drug interactions or provide advice on how to treat particular symptoms. Although a very interesting opportunity for future research, these types of ACTs require that we find solutions to the problems that appear to be hindering the adoption of current ACTs – that is, better algorithms and more usable interfaces – and it will require work that better integrates consumer research with computing science and engineering. In particular, research will need to address the ability of people to integrate the vast availability of electronic information, while they make decisions in the real world – that is, we need to better understand how the emergence of augmented reality will affect consumer behavior. Along the same lines, we know very little about how consumers will behave in a world that offers information and assistance at any time and place. In the next section we discuss these issues, which we believe provide very interesting prospects for future research.

Augmented reality and multi-agent systems

The full potential of assistive consumer technologies (Negroponte, 1995; Alba *et al.*, 1997) is unlikely to be realized by the development of single agents that operate across multiple domains. It is becoming clear that no single recommendation methodology, technique or algorithm will work best for all users in all situations. Instead, the field appears to be moving towards multi-agent systems that work on top of a "semantic web" of information (Zeigler, 2005). These agents will be able to talk to each other and share information. Some may work for retailers (or other sellers), while others will work for consumers and, possibly, others will work for information intermediaries (organizations that collect and distribute information to both buyers and sellers) (e.g. Maes *et al.*, 1999). One possibility for such a system is similar to what Negroponte (1995) and Alba *et al.* (1997) envisioned – each person has their own agent that works on their behalf and collects (and shares) information with other agents to assist the consumer with a wide variety of tasks. Alternatively, consumers may use different ACTs to accomplish different consumption goals and rely on a meta-system to help them choose the appropriate ACT for a given situation (e.g. Fullam, 2007; Wei *et al.*, 2005; Yu, 2002).

In addition, the design and development of ACTs is quickly moving into mobile devices, which paves the way for consumption to take place in a world of augmented reality. In a simple form, this is already taking place as consumers use smart phones to check the prices and availability of products online while shopping in a bricks and mortar store (Fredrix, 2009). For example, the Android and iPhone app ShopSavvy allows consumers to scan the bar code of a product to find the best price for product online and in nearby stores. With this type of technology, a shopper can easily compare the price of an item that they are looking at in one store with the price for the same item in a variety of other stores. Another application, CouponSherpa, will deliver coupons to a consumer's smartphone for stores that s/he is physically near. In-car navigation systems can respond to voice commands to find and supply directions to specific types of restaurants. Projects like PocketLens (Millar *et al.*, 2004) have demonstrated the potential to run sophisticated recommendation systems on mobile devices. Other examples include the Collaborative Travel Agent System (CTAS) based on an intelligent Multi-Agent Information System (MAIS) architecture, which has been proposed to proactively assist travelers on the web and through mobile devices (Chiu *et al.*, 2009). The MyCampus project at Carnegie Mellon combines a multi-agent recommendation system with GPS technology, which allows for personalized recommendations that take into account location, time of day, local events, and individual preferences (Sadeh *et al.*, 2002, 2005). Ultimately, ACTs that are able to incorporate context-specific information with more accurate and stable consumer preference profiles can provide assistance that is tailored to particular consumers in specific situations.

Managerial implications – consumer-centric design

In this paper we have discussed the importance of ACTs, briefly reviewed current research and conjectured about the opportunities that are likely to arise as technology continues to progress. However, it is important to keep in mind that at the heart of ACTs is not the technology nor the corporation, but the consumer. It is the consumer who will ultimately pay the bills. ACT designs that focus on functionality – such as recommendation quality – run the risk of being relegated to the lab as consumers shy away from tools that are too difficult to use. For managers and organizations thinking about providing decision assistance to their customers, building tools that deliver high quality recommendations is only ACT 1.0. Throughout this article we have discussed a variety of issues that need to be addressed before firms will be ready to deploy the types of decision aids that we believe will be required for ACT 2.0. At the top of this list is the ability to develop stable preference profiles without unduly burdening or violating the privacy of the consumers that we aim to help (Murray and Häubl, 2009; Simonson, 2005). Similarly, although there is a role for ACTs that work as double agents, building excessive bias into these tools runs the risk of damaging consumer trust and reducing satisfaction, which in the long run will hurt the success of the firms that implements these tools. Ultimately, ACTs that put the consumer first and make ease of use a core element of their design, have the potential to substantially improve the decisions that consumers make.

Notes

1. An Exabyte is 10 to eighteenth power bytes – i.e. 1,000,000,000,000,000,000,000.
2. Bohn and Short (2009) defined information consumed as the amount of data delivered to people, measured as the bytes, words, and hours consumers received in 2008. They estimated that consumption totaled 2.6 zettabytes and 10,845 trillion words in 2008. A zettabyte is 10 to the twenty-first power bytes or a million million gigabytes – i.e. 1,000,000,000,000,000,000,000,000.
3. With ACT 1.0 and ACT 2.0 we are referring to periods of research rather than specific assistive consumer technologies.

References

Adomavicius, G.A.T. and Tuzhilin, A. (2005), "Toward the next generation of recommender systems: a survey of the state-of-the-art and possible extensions", *IEEE Transactions on Knowledge and Data Engineering*, Vol. 17 No. 6, pp. 734-49.

Alba, J., Lynch, J.G., Weitz, B., Janiszewski, C., Lutz, R., Sawyer, A. and Wood, S. (1997), "Interactive home shopping: consumer, retailer, and manufacturer incentives to participate in electronic marketplaces", *Journal of Marketing*, Vol. 61 No. 3, pp. 38-53.

Anderson, C. (2006), *The Long Tail: Why the Future of Business Is Selling Less of More*, Hyperion, New York, NY.

Anderson, J.R. (1990), *The Adaptive Character of Thought*, Lawrence Erlbaum Associates, Hillsdale, NJ.

Ansari, A., Essegaier, S. and Kohli, R. (2000), "Internet recommendation systems", *Journal of Marketing Research*, Vol. 37 No. 3, pp. 363-75.

Ariely, D., Lynch, J.G. and Aparicio, M. (2004), "Learning by collaborative and individual-based recommendation agents", *Journal of Consumer Psychology*, Vol. 14 Nos 1-2, pp. 81-95.

Balabanovic, M. and Shoham, Y. (1997), "Content-based collaborative recommendation", *Communications of the ACM*, Vol. 40 No. 3.

Bart, Y., Shankar, V., Sultan, F. and Urban, G.L. (2005), "Are the drivers and role of online trust the same for all websites and consumers? A large-scale empirical study", *Journal of Marketing*, Vol. 69 No. 4, pp. 133-52.

Baumeister, R. and Vohs, K. (2003), "Willpower, choice and self-control", in Loewenstein, G., Read, D. and Baumeister, R. (Eds), *Time and Decision*, Russell Sage Foundation, New York, NY.

Bettman, J.R., Luce, M.F. and Payne, J.W. (1998), "Constructive consumer choice processes", *Journal of Consumer Research*, Vol. 25, pp. 187-217.

Bickmore, T.W. and Picard, R. (2005), "Establishing and maintaining long-term human-computer relationships", *ACM Transactions on Computer-Human Interaction*, Vol. 12 No. 2, pp. 293-327.

Bohn, R.E. and Short, J.E. (2009), "How much information? 2009 report on American consumers", Global Information Industry Center, University of California, San Diego, CA, working paper, December 9.

Brave, S., Nass, C. and Hutchinson, K. (2005), "Computers that care: investigating the effects of orientation of emotion exhibited by an embodied computer agent", *Internal Journal of Human Computer Studies*, Vol. 63, pp. 161-78.

Bright, L.F. (2008), "Consumer control and customization in online environments: an investigation into the psychology of consumer choice and its impact on media enjoyment, attitude and behavioral intention", PhD dissertation, The University of Texas at Austin, Austin, TX.

Burgoon, J.K., Bonito, J.A., Bengtsson, B., Cederberg, C., Lundeberg, M. and Allspach, L. (2000), "Interactivity in human-computer interaction: a study of credibility, understanding, and influence", *Computers and Human Behavior*, Vol. 16, pp. 553-74.

Carmon, Z., Wertenbroch, K. and Zeelenberg, M. (2003), "Option attachment: when deliberating makes choosing feel like losing", *Journal of Consumer Research*, Vol. 30 No. 1, pp. 15-29.

Carroll, J.M. and Rosson, M.B. (1987), "Paradox of the active user", in Carroll, J.M. (Ed.), *Interfacing Thought: Cognitive Aspects of Human Computer Interaction*, MIT Press, Cambridge, MA, pp. 80-111.

Chellappa, R.K. and Sin, R.G. (2005), "Personalization versus privacy: an empirical examination of the online consumer's dilemma", *Journal of Information & Management*, Vol. 6 Nos 2-3, pp. 181-202.

Chiu, D.K.W., Yueh, Y.T.F., Leung, H. and Hung, P.C.K. (2009), "Towards ubiquitous tourist service coordination and process integration: a collaborative travel agent system architecture with semantic web services", *Information Systems Frontiers*, Vol. 11 No. 3, July, Boston, pp. 241-56.

Cooley, C.H. (1966), *Social Process*, Southern Illinois University Press, Carbondale, IL.

Davis, A., Murphy, J., Owens, D., Khazanchi, D. and Zigurs, I. (2009), "Avatars, people, and virtual worlds: foundations for research in metaverses", *Journal of the Association for Information Systems*, Vol. 10 No. 2, February, p. 90.

De Bruyn, A., Liechty, J.C., Huizingh, E.K.R.E. and Lilien, G.L. (2005), "Offering online recommendations to impatient first-time customers with conjoint-based segmentation trees", MSI working paper series 2005, Vol. 1, report no. 05-001, pp. 71-84.

Deci, E.L. (1975), *Intrinsic Motivation*, Plenum Press, New York, NY.

Deci, E.L. (1981), *The Psychology of Self-Determination*, Heath, Lexington, MA.

Deci, E.L. and Ryan, R.M. (1985), *Intrinsic Motivation and Self-Determination in Human Behavior*, Plenum Press, New York, NY.

Dickson, P.R. and Ginter, J.L. (1987), "Market segmentation, product differentiation, and marketing strategy", *Journal of Marketing*, Vol. 51 No. 2, pp. 1-10.

Diehl, K., Kornish, L.J. and Lynch, J.G. (2003), "Smart agents: when lower search costs for quality information increase price sensitivity", *Journal of Consumer Research*, Vol. 30 No. 1, pp. 56-71.

Fang, X. and Salvendy, G. (2003), "Customer-centered rules for design of e-commerce web sites", *Communications of the ACM*, Vol. 46 No. 12, pp. 332-6.

Feng, L., Pienkowski, D., Smith, C. and van Moorsel, A. (2009), "Towards an institutional framework of trust for online transactions", paper presented at British Academy of Management Annual Conference, Brighton, September 13-15.

Ferri, C.P., Prince, M., Brayne, C., Brodaty, H., Fratiglioni, L., Ganguli, M., Hall, K., Hasegawa, K., Hendrie, H., Huang, Y., Jorm, A., Mathers, C., Menezes, P.R., Rimmer, E. and Scazufca, M. (2005), "Global prevalence of dementia: a Delphi consensus study", *Lancet*, Vol. 366, pp. 2112-17.

Ferro, E. (2010), *Handbook of Research on Overcoming Digital Divides: Constructing an Equitable and Competitive Information Society*, IGI Global, Hershey, PA.

Fogg, B.J., Soohoo, C., Danielson, D.R., Marable, L., Stanford, J. and Tauber, E. (2003), "How do users evaluate the credibility of web sites? A study with over 2,500 participants", *Proceedings of the 2003 Conference on Designing for User Experiences, San Francisco, CA*, pp. 1-15.

Fournier, S. (1994), "Consumers and their brands: developing relationship theory in consumer research", *Journal of Consumer Research*, Vol. 24, March, pp. 343-73.

Fredrix, E. (2009), *Shoppers with Smart Phones IQ Squeezing Retailers*, Associated Press, New York, NY, available at: www.forbes.com/feeds/ap/2009/12/17/personal-finance-specialized-consumer-services-us-holiday-shoppers-smart-phones_7220117.html

Fullam, K.K. (2007), "Adaptive trust modeling in multi-agent systems: utilizing experience and reputation", PhD dissertation, The University of Texas at Austin, Austin, TX, AAT 3290878.

Gantz, J.F., Chute, C., Manfrediz, A., Minton, S., Einsel, D., Schlichtling, W. and Toncheva, A. (2009), "The diverse and exploding digital universe: an updated forecast of worldwide information growth through 2011", IDC, March.

Glass, D.C. and Singer, J.E. (1972a), *Stress and Adaptation: Experimental Studies of Behavioral Effects of Exposure to Aversive Events*, Academic Press, New York, NY.

Glass, D.C. and Singer, J.E. (1972b), *Urban Stress*, Academic Press, New York, NY.

Godek, J. and Murray, K.B. (2008), "Willingness to pay for advice: the role of rational and experiential processing", *Organizational Behavior and Human Decision Processes*, Vol. 106 No. 1, pp. 77-87.

Golbeck, J. (2005), "Computing and applying trust in web-based social networks", PhD dissertation, University of Maryland, College Park, MD.

Golbeck, J. and Hendler, J. (2006), "Filmtrust: movie recommendations using trust in web-based social networks", *Proceedings of the IEEE Consumer Communications and Networking Conference*.

Gross, R. and Acquisti, A. (2005), "Information revelation and privacy in online social networks", paper presented at Workshop on Privacy in the Electronic Society, Alexandria, VA, November 7.

Harper, F.M., Sen, S. and Frankowski, D. (2007), "Supporting social recommendations with activity-based clustering", paper presented at Recommendation Systems Conference, Minneapolis, MN, October 19-20.

Häubl, G. and Murray, K.B. (2003), "Preference construction and persistence in digital marketplaces: the role of electronic recommendation agents", *Journal of Consumer Psychology*, Vol. 13 No. 1, pp. 75-91.

Häubl, G. and Murray, K.B. (2006), "Double agents: assessing the role of electronic product-recommendation systems", *Sloan Management Review*, Vol. 47 No. 3, pp. 8-12.

Häubl, G. and Trifts, V. (2000), "Consumer decision making in online shopping environments: the effects of interactive decision aids", *Marketing Science*, Vol. 19 No. 1, pp. 4-21.

Hauser, J.R., Urban, G.L., Liberali, G. and Braun, M. (2009), "Web site morphing", *Marketing Science*, Vol. 28 No. 2, pp. 202-23.

Hemp, P. (2006), "Avatar-based marketing", *Harvard Business Review*, June, pp. 48-57.

Herlocker, J.L., Joseph, A.K., Terveen, L.G. and Riedl, J.T. (2004), "Evaluating collaborative filtering recommendation systems", *ACM Transactions on Information Systems*, Vol. 22 No. 1, pp. 5-53.

Hoffman, D.L., Novak, T.P. and Peralta, M. (1999), "Building consumer trust online: how merchants can win back lost consumer trust in the interests of e-commerce sales", *Communications of the ACM*, Vol. 42 No. 4, pp. 80-5.

Holzwarth, M., Janiszewski, C. and Neumann, M.M. (2006), "The influence of avatars on online consumer shopping behavior", *Journal of Marketing*, Vol. 70 No. 4, pp. 19-36.

Iyengar, S.S. and Lepper, M.R. (2000), "When choice is demotivating: can one desire too much of a good thing?", *Journal of Personality and Social Psychology*, Vol. 79 No. 6, pp. 995-1006.

Johnson, R. (1987), "Accuracy of utility estimation in ACA", working paper, Sawtooth Software, Sequim, WA.

Kim, J. and Moon, J.Y. (1998), "Designing towards emotional usability in customer interfaces – trustworthiness of cyber-banking system interfaces", *Interacting with Computers*, Vol. 10 No. 1, pp. 1-29.

Krishnan, V., Narayanashetty, P.K., Nathan, M., Davies, R.T. and Konstan, J.A. (2008), "Who predicts better? Results from an online study comparing humans and an online recommendation system", paper presented at Recommendation Systems Conference, Lausanne, October 23-25.

Langer, E.J. and Rodin, J. (1976), "The effects of choice and enhanced personal responsibility for the aged: a field experiment in an institutional setting", *Journal of Personality and Social Psychology*, Vol. 34 No. 2, pp. 191-8.

Liang, J. and Murray, K.B. (2010), "The interplay between form, function, and expertise in consumer choice", working paper, School of Business, Sun Yat-sen University, Guangzhou.

Liu, H., Maes, P. and Davenport, G. (2008), "Unraveling the taste fabric of social networks", in Szewczak, E.J. (Ed.), *Selected Readings on the Human Side of Information Technology*, Information Science Reference, Hershey, PA, pp. 256-82.

Lyman, P. and Varian, V.R. (2000), "How much information?", available at: www2.sims.berkeley.edu/research/projects/how-much-info/

Lyman, P. and Varian, V.R. (2003), "How much information?", available at: www2.sims.berkeley.edu/research/projects/how-much-info-2003/

McNee, S.M., Ridel, J. and Konstan, J.A. (2006), "Making recommendations better: an analytic model for human-recommender interaction", paper presented at Computer-Human Interaction Conference, Montreal, April 22-27.

Maes, P., Guttman, R.H. and Moukas, A.G. (1999), "Agents that buy and sell", *Communications of the ACM*, Vol. 42 No. 3, pp. 81-91.

Mandel, N. and Johnson, E.J. (2002), "When web pages influence choice: effects of visual primes on experts and novices", *Journal of Consumer Research*, Vol. 29 No. 2, pp. 235-45.

Mead, G.H. (1934), in Morris, C.W. (Ed.), *Mind, Self and Society, From the Standpoint of a Social Behaviorist*, University of California Press, Berkeley, CA.

Millar, B.N., Konstan, J.A. and Riedl, J. (2004), "PocketLens: toward a personal recommender system", *ACM Transactions on Information Systems*, Vol. 22 No. 3, pp. 437-76.

Milne, G.R. and Boza, M. (1999), "Trust and concern in consumers' perceptions of marketing information management practices", *Journal of Interactive Marketing*, Vol. 13 No. 1, pp. 5-24.

Murray, K.B. and Häubl, G. (2007), "Explaining cognitive lock-in: the role of skill-based habits of use in consumer choice", *Journal of Consumer Research*, Vol. 34 No. 1, pp. 77-88.

Murray, K.B. and Häubl, G. (2008), "Interactive consumer decision aids", in Wierenga, B. (Ed.), *Handbook of Marketing Decision Models*, Springer Science + Business Media, New York, NY, pp. 55-77.

Murray, K.B. and Häubl, G. (2009), "Personalization without interrogation: towards more effective interactions between consumers and feature-based recommendation agents", *Journal of Interactive Marketing*, Vol. 23 No. 2, pp. 138-46.

Murray, K.B., Häubl, G. and Johnson, E.J. (2009), "Increasing loyalty through passive personalization", working paper, University of Alberta, Edmonton.

Nass, C. and Moon, Y. (2000), "Machines and mindlessness: social responses to computers", *Journal of Social Issues*, Vol. 56 No. 1, pp. 81-103.

Negroponte, N. (1995), *Being Digital*, Random House, New York, NY.

Owens, D., Davis, A., Murphy, J.D., Khazanchi, D. and Zigurs, I. (2009), "Real-world opportunities for virtual-world project management", *IT Professional Magazine*, Vol. 11 No. 2, March/April, p. 34.

Peppers, D. and Rogers, M. (1993), *The One to One Future*, Currency Doubleday, New York, NY.

Picard, R. (1997), *Affective Computing*, MIT Press, Cambridge, MA.

Prahalad, C.K. and Ramaswamy, V. (2004), "Co-creating unique value with customers", *Strategy & Leadership*, Vol. 32 No. 3, pp. 4-9.

Prendinger, H., Dohi, H., Wang, H., Mayer, S. and Ishizuka, M. (2004), "Empathetic embodied interfaces: addressing users' affective state", in Andre, E. (Ed.), *ADS 2004, LNAI 2068*, Springer-Verlag, Berlin, pp. 53-64.

Price, B., Greiner, R., Häubl, G. and Flatt, A. (2006), "Automatic construction of personalized customer interfaces", paper presented at International Conference on Intelligent User Interfaces, Sydney, January 29-February 1.

Rafaeli, S. (1990), "Interacting with media: para-social interaction and real interaction", in Ruben, B.D. and Lievrouw, L.A. (Eds), *Mediation, Information, and Communication: Information and Behavior, Vol. 3*, Transaction, New Brunswick, NJ, pp. 125-91.

Reeves, B. and Nass, C. (1996), *The Media Equation: How People Treat Computers, Television, and New Media Like Real People and Places*, Cambridge University Press/CSLI, New York, NY.

Rotter, J.B. (1966), "Generalized expectancies for internal versus external *locus* of control of reinforcement", *Psychological Monographs*, pp. 80-128.

Rust, R.T., Thompson, D.V. and Hamilton, R.W. (2006), "Defeating feature fatigue", *Harvard Business Review*, Vol. 84 No. 2, pp. 98-107.

Sadeh, N.M., Chan, E. and Van, L. (2002), "MyCampus: an agent-based environment for context-aware mobile services", paper presented at AAMAS – 1st International Joint Conference on Autonomous Agents and Multi-Agent Systems, July.

Sadeh, N.M., Gandon, F.L. and Kwon, O.B. (2005), *Ambient Intelligence: The MyCampus Experience*, Technical Report (CMU-ISRI-05-123), Carnegie Mellon University, Pittsburgh, PA, June.

Schlosser, A.E., White, T.B. and Lloyd, S.M. (2005), "Converting web site visitors into buyers: how web site investment increases consumer trusting beliefs and online purchase intentions", *Journal of Marketing*, Vol. 70 No. 2, pp. 133-48.

Schoenbachler, D.D. and Gordon, G.L. (2002), "Trust and customer willingness to provide information in database-driven relationship marketing", *Journal of Interactive Marketing*, Vol. 16 No. 3, pp. 2-16.

Schulz, R. and Hanusa, B.H. (1978), "Long-term effects of control and predictability-enhancing interventions: findings and ethical issues", *Journal of Personality and Social Psychology*, Vol. 36 No. 11, pp. 1194-201.

Schwartz, B. (2005), *The Paradox of Choice: Why More Is Less*, HarperCollins, New York, NY.

Schwartz, B., Ward, A., Monterosso, J., Lyubomirsky, S., White, K. and Lehman, D. (2002), "Maximizing versus satisficing: happiness is a matter of choice", *Journal of Personality and Social Psychology*, Vol. 83 No. 5, pp. 1178-97.

Senecal, S. and Nantel, J. (2004), "The influence of online product recommendations on consumers' online choices", *Journal of Retailing*, Vol. 80 No. 2, pp. 159-69.

Shankar, V., Urban, G.L. and Sultan, F. (2002), "Online trust: a stakeholder perspective, concepts, implications and future directions", *Journal of Strategic Information Systems*, Vol. 11 Nos 3-4, pp. 325-44.

Simonson, I. (2005), "Determinants of customers' responses to customized offers: conceptual framework and research propositions", *Journal of Marketing*, Vol. 69 No. 1, pp. 32-45.

Slovic, P. (1995), "The construction of preference", *American Psychologist*, Vol. 50, pp. 364-71.

Smith, D., Menon, S. and Sivakumar, K. (2005), "Online peer and editorial recommendations, trust, and choice in virtual markets", *Journal of Interactive Marketing*, Vol. 19 No. 3, pp. 15-37.

Smith, W.R. (1956), "Product differentiation and market segmentation as alternative marketing strategies", *Journal of Marketing*, Vol. 21 No. 1, pp. 3-8.

Sundar, S.S. (2004), "Loyalty to computer terminals: is it anthropomorphism or consistency?", *Behavior and Information Technology*, Vol. 23 No. 2, pp. 107-18.

Taylor, S.E. (1989), *Positive Illusions: Creative Self-Deception and the Healthy Mind*, Basic Books, New York, NY.

Taylor, S.E. and Brown, J.D. (1988), "Illusion and wellbeing: a social psychological perspective on mental health", *Psychological Bulletin*, Vol. 103 No. 2, pp. 193-210.

Terveen, L., Hill, W., Amento, B., McDonald, D. and Creter, J. (1997), "PHOAKS: a system for sharing recommendations", *Communications of the ACM*, Vol. 40 No. 3, pp. 59-62.

Thompson, D.V., Hamilton, R.W. and Rust, R.T. (2005), "Feature fatigue: when product capabilities become too much of a good thing", *Journal of Marketing Research*, Vol. 42 No. 4, pp. 431-42.

Toubia, O., Simester, D.I., Hauser, J.R. and Dahan, E. (2003), "Fast polyhedral adaptive conjoint estimation", *Marketing Science*, Vol. 22 No. 3, pp. 273-303.

Turkle, S. (1984), *The Second Self: Computers and the Human Spirit*, Simon & Schuster, New York, NY.

Tyler, S.K. and Zhang, Y. (2008), "Open domain recommendations: social networks and collaborative filtering", in Tang, C. (Ed.), *ADMA, LNAI 5139*, Springer-Verlag, Berlin, pp. 330-41.

Tzeng, J. (2004), "Toward a more civilized design: studying the effects of computers that apologize", *International Journal of Human-Computer Studies*, Vol. 61, pp. 319-45.

Urban, G.L. and Hauser, J.R. (2003), "'Listening in' to find unmet customer needs and solutions", Working Paper No. 427603, MIT Sloan School, Cambridge, MA, available at: http://ssrn.com/abstract=373061 or DOI: 10.2139/ssrn.373061

Urban, G.L., Hauser, J.R., Liberali, G. and Braun, M. (2009), "Morph the web to build empathy, trust and sales", *MIT Sloan Management Review*, Vol. 50 No. 4, pp. 53-61.

Wei, Y.Z., Moreau, L. and Jennings, N.R. (2005), "A market-based approach to recommender systems", *ACM Transactions on Information Systems*, Vol. 23 No. 3, pp. 227-66.

West, P.M., Brown, C.L. and Hoch, S.J. (1996), "Consumption vocabulary and preference formation", *Journal of Consumer Research*, Vol. 23, pp. 120-35.

West, P.M., Ariely, D., Bellman, S., Bradlow, E., Huber, J., Johnson, E.J., Kahn, B., Little, J. and Schkade, D. (1999), "Agents to the rescue?", *Marketing Letters*, Vol. 10 No. 3, pp. 285-300.

Winer, R.S. (2001), "A framework for customer relationship management", *California Management Review*, Vol. 43, Summer, pp. 89-105.

Yu, B. (2002), "Emergence and evolution of agent-based referral networks", PhD dissertation, AAT 3048940, North Carolina State University, Raleigh, NC.

Zeigler, C.N. (2005), "Semantic web recommender systems", *Lecture Notes in Computer Science*, Vol. 3268, pp. 78-9.

Zeigler, C.N. and Lausen, G. (2004), "Spreading activation models for trust propagation", *Proceedings of the IEEE International Conference on e-Technology, e-Commerce, and e-Service*, IEEE Computer Society Press, Los Alamitos, CA.

Further reading

Golbeck, J. (2009), "Trust and nuanced profile similarity in online social networks", *ACM Transactions on the Web*, Vol. 3 No. 4, pp. 2-33.

Landro, L. (2006), "The informed patient: social networking comes to health care: online tools give patients better access to information and help build communities", *Wall Street Journal*, December 27, (Eastern edition), New York, NY, p. D1.

Zimmer, L. (2007), "How viable is virtual commerce? Businesses that understand the potential of Second Life are finding real-world commercial opportunities in the virtual space", *Optimize, Manhasset*, Vol. 6 No. 1, January, p. 44.

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