



REVIEW ARTICLE

INTELLIGENT SYSTEMS IN TOURISM

A Social Science Perspective

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Abstract: Intelligent systems sense their environment and learn from the actions they implement to reach specific goals. They are increasingly used to support tourist information search and decision making as well as work processes. In order to model the tourism domain, these systems require a profound understanding of its nature. Looking at existing literature in tourism, this paper discusses critical gaps in the knowledge of the field to be filled so that intelligent system design can be informed and impacts understood. Specifically, it discusses the need to better conceptualize technology in tourism research and argues for a focus on uses and interactions. It challenges simplistic views of tourist information search and decision-making processes and calls for more research on potential impacts. **Keywords:** intelligent system design, group decision making, preferences, persuasion, technology-user interaction, privacy. © 2011 Elsevier Ltd. All rights reserved.

INTRODUCTION

Much has been said already in the literature about the information intensity of tourism and the resulting need for, and symbiosis with, information and communication technology (ICT) (Poon, 1993; Sheldon, 1997; Werthner & Klein, 1999). Changes in ICTs have led to fundamental changes in tourism behaviors and demand as well as tourism industry functions and structures (Buhalis & Law, 2008). Werthner and Ricci (2004) emphasize the increasing “informatization” of the entire tourism value chain, meaning that ICTs have become fundamental elements of value generating strategies in the tourism industry. Technological innovations such as Web 2.0 applications and location-based services are currently driving value generation and change and will pave the way for even more sophisticated systems influencing the manner in which tourism information is created, exchanged, and evaluated, and relationships are formed and maintained (Law, Fuchs, & Ricci, 2011).

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As an interdisciplinary field of inquiry, technology and tourism is well established through conferences and journals. Recent review papers identified a growing number of publications in this field (Buhalis & Law, 2008; Frew, 2000; Leung & Law, 2007; Wang, Fesenmaier, Werthner, & Wöber, 2010). They also revealed a heavy emphasis on consumer behavior and marketing related topics. Further, most of the papers deal with single empirical studies while conceptual papers driving theory development and critique are rare (Wang et al., 2010). Publications related to the topic are also found in the main tourism journals. However, of the 195 papers Leung and Law (2007) analyzed, only five appeared in the *Annals of Tourism Research*, suggesting a critical lack of a social science perspective in the discourse that informs tourism and technology studies. For instance, a topic as fundamental as the increasing mediation of tourism experiences through ICTs has only been sporadically discussed and not necessarily in the leading tourism journals (Boksberger, Akinsola, Nan, & Unnikrishnan, 2011; Gretzel, 2010; Gretzel, Fesenmaier, Lee, & Tussyadiah, 2011; Gretzel & Jamal, 2009; Jansson, 2002; Jansson, 2007; Tussyadiah & Fesenmaier, 2009; White & White, 2007). Further, while science and technology studies (STS) has permeated other fields, it is absent from mainstream tourism literature.

One of the topics that has been discussed almost entirely from a technological perspective is the issue of intelligent systems in tourism. Intelligent systems are next-generation information systems that promise to supply tourism consumers and service providers with more relevant information, greater decision-support, greater mobility, and, ultimately, more enjoyable tourism experiences. They currently encompass a wide range of technologies relevant for tourism contexts such as recommender systems, context-aware systems, autonomous agents searching and mining Web resources, and ambient intelligence. Creating these systems requires a profound understanding of the psychology of tourists, of the social structures within which tourism is experienced, of tourists' relationship with and use of technology, of the structure of the tourism industry, the language of tourism, etc. While some of these issues have been addressed sufficiently in the tourism literature, others have not been discussed in a way that can critically inform the development of intelligent systems in tourism. It is the goal of this paper to view intelligent systems through a social science lens in order to identify gaps and direct future research in tourism that is not only relevant but also challenging and has the potential to influence tourism and technology discourse beyond this rather specific topic.

INTELLIGENT SYSTEMS

What Makes Intelligent Systems Intelligent?

Intelligence means the ability to comprehend, to profit from experience, to acquire and retain knowledge and to respond quickly and

successfully to a new situation (Rudas & Fodor, 2008). There are two components of intelligence that are usually emphasized when distinguishing intelligent systems from those which are not: (1) the ability to sense the environment; and, (2) the ability to learn from actions to maximize success in achieving particular objectives. Thus, intelligent systems are in communication with their environment and continuously evaluate the responses they receive from this environment with respect to their actions to determine the favorability of these actions (Fritz, 2006). They perceive, reason, learn and act (IEEE Computer Society, 2011). They are user friendly, capable, effective and adaptive in responding to the needs of complex environments (Institute for Integrated Intelligent Systems, 2011). NASA (2011) describes intelligent systems as autonomous, robust and collaborative. Krishnakumar (2003) defines intelligent systems as systems that can be characterized by flexibility, adaptability, memory, learning, temporal dynamics, reasoning, and the ability to manage uncertain and imprecise information.

A fundamental requirement for intelligent systems is to have a model of the domain in which they operate so that they can understand inputs sensed from the environment and generate appropriate behavioral responses (Meystel & Messina, 2000). In addition, they must also be able to set goals and envision a future state of the world they operate in so that they can determine what impact their actions will have (Russell & Norvig, 2003). The main issues related to the design of intelligent systems from a technical perspective involve knowledge representation, reasoning, machine learning, and perception such as natural language processing and facial recognition.

The intelligence of these systems is usually judged against human intelligence. According to the Turing Test (Oppy & Dowe, 2011), achieving system intelligence would mean that the interaction with a system was indistinguishable from an interaction with human beings. However, varying levels of intelligence are typically not accounted for in the discussions surrounding intelligence tests. Systems can show some instead of all aspects of intelligence as described above. For instance, some of the existing recommender systems successfully reason about user preferences and make intelligent guesses based on incomplete data. Overall, there has been a strong bias towards building intelligent systems over evaluating them. This is mainly due to a lack of a practical and universal measure of intelligence (Hernández-Orallo & Dowe, 2010). Instead, if intelligent systems are evaluated at all, the focus is usually on general information system success, involving measures such as intention to use or actual use and user satisfaction as determined by system quality, information quality and service quality (DeLone & McLean, 2003).

The Role of Intelligent Systems in Tourism

Tourism is a main application domain for intelligent systems because of the general complexity of decisions to be made in tourism contexts.

This complexity stems, among other factors, from the mobility of tourists (Hall, 2005) and the increased risk and uncertainty experienced in unfamiliar environments, information contained in distributed sources, the idiosyncratic quality of tourism decision-making, the multi-faceted nature of tourism experiences, and the interdependency of sub-decisions (Jeng & Fesenmaier, 2002). Thus, intelligent systems can provide great value if they help in collecting and pre-processing information according to personal and situational needs of the user.

Early approaches to intelligent systems in tourism mostly focused on expert systems providing support for tourism industry professionals (Hruschka & Mazanec, 1990; Loban, 1997). Nowadays, intelligent systems in tourism are typically envisioned as fully autonomous travel counselors or concierges that have the ability to determine user preferences and anticipate user needs while having a large and at the same time specialized knowledge repository at their fingertips and continuously evaluate their suggestions based on feedback received from their users (Venturini & Ricci, 2006). Intelligent systems in tourism are also developed to provide functions traditionally offered by tour operators and travel guides, such as travel planning/scheduling tasks, navigation and interpretation (Kramer, Modsching, & ten Hagen, 2007). Examples therefore include recommender systems that suggest travel destinations (Fesenmaier, Werthner, & Wöber, 2006) and context-aware mobile systems (e.g. Martin, Alzua, & Lamsfus, 2011). The Villach Spa Resort's virtual advisor (www.warmbad.com) is a concrete example for how such systems can mimic human–human interactions to support the travel planning process. YourTour (www.yourtour.com) is an application that uses sophisticated algorithms to dynamically assemble tour packages. The mobile application for Urban Spoon (www.urban-spoon.com) is a context-aware system that also integrates consumer reviews into its restaurant recommendations and makes the interaction process fun by allowing the user to shake the phone instead of pressing a button to initiate the recommendation process.

Werthner (2003) stresses the potential contributions of intelligent systems from a tourism industry perspective in the areas of process automation, efficiency gains and value creation. In addition, Min (2008) discusses the application of intelligent systems in tourism product development contexts. The European Commission (2003) identified intelligent systems as important for supporting the complex tourism value chain but also for “addressing the expectations of a population of socially and culturally diverse consumers (mass market) with unpredictable behaviour in a wide range of contexts” (p. 6). Another application aspect of tourism seen as an area that could benefit greatly from the use of intelligent systems is tourism demand forecasting (Intelligent Business Systems, 2006).

Staab and Werthner (2002) describe intelligent systems in tourism as needing to be heterogeneous, distributed, scalable, open and cooperative, enabling full autonomy of the respective participants, supporting the entire tourist life cycle and all business phases. In order to do so, these systems need to have an understanding of what the processes are they are trying to support. Basic foundations for conceptualizing

tourist information search and decision making are summarized in Fesenmaier et al. (2006). The following critically reflects on the current state of tourism research in providing the models needed by intelligent systems to mimic human intelligence.

CRITICAL ISSUES IN DESIGNING AND EVALUATING INTELLIGENT SYSTEMS

There are abundant technical issues that have yet to be resolved in the area of intelligent systems design but even the most technically sophisticated system will not be useful unless it can truly understand the human processes it is supposed to support. Intelligent systems do not (yet) have intuition; consequently, they can only understand what is made explicit to them. Further, by modeling some aspects of the domain and not others, normative judgments of what is important are made. Such judgments need to be informed by theory-driven discussions of what matters to what end and to whom. Thus, the focus should not be on what is technically possible but what is relevant to achieve selected aims. This is also important in understanding the impacts such systems can have on individual tourism experiences, aggregate tourist behaviors, interactions with service providers, industry structures, etc.

Technology-User Interactions

Intelligent systems are interactive systems. In order to successfully anticipate what such interactions could look like, intelligent system designers need information on how tourists relate to various technologies and negotiate their use in the context of tourism. Tourism as a use context is special and knowledge from other areas derived from everyday uses of technologies might not be applicable. However, at the same time, uses of technologies while traveling influence everyday uses as well as everyday relationships and vice versa (White & White, 2007). Thus, tourism has to be understood as a special stage for technology use, but one that is not independent from other settings.

Driven by the overuse of the Technology Acceptance Model (TAM) (Venkatesh & Davis, 2000) in tourism and technology-related studies, there is also a great bias toward investigating intentions to use and not enough research on actual use, use patterns, and, most importantly, non-use. Further, the context of use is often neglected. A website like Couchsurfing makes only sense in a social system where offering hospitality to strangers is not understood as common practice but rather has developed as a commercial enterprise. Context is also important when studying potential and actual impacts. In addition, intelligent systems have to take specific use contexts and use patterns into account so that they can successfully adapt their interaction strategy with the user.

Current literature in the area of intelligent systems but also in tourism in general very much conceptualizes these systems as tools independent of the social systems in which they are being developed and used. This reflects a very particular philosophical view of technology as neutral and deterministic (Chandler, 1995). Many scholars have vehemently argued against such a view and suggest that no matter how technology is used, it has of itself consequences. Technology is neither good, bad, nor neutral but rather changes the conditions in the system within which it exists (Ellul, 1964). It also reflects particular cultural values and, thus, cannot be understood outside of the cultural system in which it is present (Pursell, 1994). Further, technology is not politically neutral as it opens certain social options and closes others (Winner, 1978). Importantly, technology does not always lead to specific changes independent of the social system within which it exists as McLuhan (1962) would suggest.

Given the above, user-technology interactions have to be understood within the context of the co-evolution triangle of users, knowledge and technology (Bruce, 2002). This socio-technical system then becomes the unit of analysis. The behaviors and knowledge of a system user cannot be seen as belonging to the user as an isolated and static entity but rather should be understood as processes of the full situation of user-technology interaction (Dewey & Bentley, 1960). For example, mobile technologies simultaneously emerge from and foster an increasingly mobile population that travels to ever distant places. However, most adaptive/interactive systems are built on the assumption that the system learns about the user and often forget that the user also learns about and from the system (Jameson, 2003). An interaction is not just a means by which users communicate input to the system and systems provide feedback; interactivity changes the state of mind of the user (Choi, 1997). A number of studies have confirmed that users form social relationships with technologies and apply rules of human-human social interaction to their relations with the technology (Bechwati & Xia, 2003; Gershoff, Mukherjee, & Mukhopadhyay, 2003; Nass & Moon, 2000; Reeves & Nass, 1996). In addition, users can appropriate technologies to fit certain use contexts and needs and in doing so change the technology itself.

Intelligent systems are part of digital ecosystems. A digital ecosystem is an “open, loosely coupled, domain clustered, demand-driven, self-organizing agent environment, where each agent of each species is proactive and responsive regarding its own benefit/profit . . . but is also responsible to its system” (Boley & Chang, 2007:2). Thus, like natural ecosystems, these ecosystems follow the fundamental principles of interaction/engagement, balance, shared goals within loosely connected groups, and self-organization. Users are just one species within the system and intelligent systems are another. There is complexity in their interactions and this complexity has so far been widely neglected in tourism and technology research.

The Myth of the Autonomous Utility Maximizer

In order to support tourism decision-making processes, intelligent systems need to be able to model basic elements of these processes and understand their underlying assumptions. Sirakaya and Woodside (2005) present a very comprehensive overview of decision making theories developed and/or tested in the context of tourism. They observe that despite the growing literature on bounded rationality and decision biases, most discussions of decision-making in tourism conceptualize decision-makers as rational and utilitarian. This is especially true for studies looking at technology adoption decisions in tourism, where utility maximization (through effort minimization as well as gain maximization) assumptions are prominently operationalized as the constructs “Perceived Usefulness” and “Perceived Ease of Use” of TAM (Venkatesh & Davis, 2000). Sirakaya and Woodside (2005) actually outline a research agenda and call for more research to clarify under which circumstances rationality can be assumed and under which conditions other decision approaches are selected. Unfortunately, over five years later, these questions remain still unanswered.

In addition to the focus on rational decision-making, most models of travel information search and decision-making represent these processes from an individualistic point of view (Hwang, Gretzel, Xiang, & Fesenmaier, 2006). Issues related to the joint collection and consumption of tourism information, increasingly supported through social media, are not addressed in the tourism literature. The multitude of studies using the Theory of Reasoned Action/Theory of Planned Behavior (e.g. Brown, 1999; Lam & Hsu, 2006; Quintal, Lee, & Soutar, 2010; Tsai, 2010) incorporate the influence of others on decisions but only in the form of perceived subjective norms, not actual group processes. The tourism literature acknowledges at least to some extent the importance of group dynamics in decision-making, mostly looking at family dynamics and especially the influence of children (e.g. Jenkins, 1978; Mansfeld, 1992; Myers & Moncrief, 1978). Thornton, Shaw, and Williams (1997) provide a review of the group decision making in tourism literature and note the high complexity of processes, identify sub-decisions as the level to be looked at, stress the prominence of joint decision-making, and suggest separate dynamics for information search behaviors. Loban's (1997) framework for computer-assisted travel counseling proposes to sum up individual levels of satisfaction that would be derived from a specific trip while making sure that the satisfaction level for an individual does not drop below a certain threshold. Brown and Chalmers (2003) suggest that negotiating technology use is an important aspect of group decision-making in tourism. However, while there is evidence of the relevance of group decision-making in tourism, the literature fails to provide clear insights as to how joint decision-making related to tourism happens.

The general consumer behavior literature suggests that the outcome of a group decision is a weighted function of the individual preferences, with weights being determined by the relative influence of each

group member (Corfman & Lehmann, 1987). However, how such influence is achieved and executed is a different story. Group members will engage in various strategies to exercise their influence, e.g. bargaining, impression management, claiming authority and displaying emotions (Perner, 2010). The social psychology literature provides a rich account of group decision making as social interaction (Davis, 1973). It is therefore quite surprising that tourism research has not yet developed a comprehensive understanding of the social dynamics of tourism decision-making in families and other forms of groups. The assumption that these processes are the same across all decisions is not supported by the tourism literature, which provides important arguments as to how information search and decision-making in this context differs significantly from, for example, the purchase of fast-moving consumer goods.

Interestingly, while consumer-related research mostly assumes individual decision-making, the organizational literature has a long tradition of studying group decision-making processes in work contexts (Miller, Hickson, & Wilson, 1999). Most of this research has yet to be transferred to the consumer decision-making context and also needs to be applied and tested specifically for tourism, as far as organizational as well as consumer decisions are concerned. Organizational research in this area has mostly been conducted in traditional, big manufacturing companies and thus might not be directly applicable to organizations in the tourism contexts. Intelligent systems aimed at supporting work processes need to be aware of the specific organizational environment in tourism that determines work flows and decision-making processes. For the evaluation of intelligent systems it is also important to critically examine the influence the use of an intelligent system has on these group dynamics.

Organizational science literature provides critical insights regarding computer-mediated group decision-making (Baltes, Dickson, Sherman, Bauer, & LaGanke, 2002; Kiesler & Sproull, 1992). It has also put a greater emphasis on understanding the influence of the structure of social relationships on information search and decision-making by conceptualizing and extensively researching transactive memory, social capital, trust, etc. as emerging from social networks rather than as individual characteristics (Borgatti & Cross, 2003; Reagans & Zuckerman, 2001). These issues are equally important in consumer decision-making settings. Intelligent systems design increasingly acknowledges the importance of social network perspectives in modeling trust and building systems that take social relationships into account when presenting information to users (e.g. Alshabib, Rana, & Ali, 2006).

A group level or social perspective of information search and decision-making is becoming increasingly important in light of the collective intelligence tourists can now tap into through the existence of social media. Swarm theory is not only helpful in developing algorithms that help intelligent systems mine data (Panigrahi, Shi, & Lim, 2011), it should also be applied to examining collective attitudes and social phenomena in tourism for the benefit of developing intelligent systems that can support such processes. Swarm theory basically

explains how seemingly random, unconnected and unimportant decisions at an individual level can lead to coherent collective action and better decision-making at the aggregate level (Fisher, 2009; Miller, 2010). The prime examples used to illustrate swarm theory are bee hives and ant colonies, which make social decisions without voting processes or executive committees. Hotel reviews and the resulting accommodation decisions could be seen as great example for swarm behavior in tourism where the individuals swarm out to various hotels and report back to the community what they found so that in the end the community can avoid unfavorable options.

Persuasion Opportunities

Since intelligent systems interact with users in quasi-social ways, they have the ability to influence human attitudes and behaviors (Gretzel & Fesenmaier, 2006). Understanding under what circumstances these systems can intentionally or unintentionally influence choices is important from a consumer marketing point of view but also a social marketing point perspective if certain choices are less socially desirable (e.g. visiting destinations in fragile natural environments). There is a plethora of evidence that human choice is inherently adaptive and constructive (Carenini & Poole, 2000); however, traditional models of consumer choice assume that consumers' tastes are well defined and easily accessible for introspection. In contrast, the evolving view of constructed preferences argues that for some kinds of preferences people construct guesses about what they like based on information available at the moment they are asked to express an evaluative judgment or make a decision (Payne, Bettman, & Johnson, 1993; Slovic, 1995). Importantly, this preference construction process is "shaped by the interaction between the properties of the human information processing system and the properties of the decision task" (Payne, Bettman, & Schkade, 1999, p. 245). Supporting empirical evidence suggests that preference construction is largely driven by heuristics and is greatly influenced by context (Lloyd, 2003). Preferences may, for instance, be biased by initially presented values (anchoring effects) or by the specific wording of the alternatives (framing effects) (Payne et al., 1993).

Important insights regarding the "constructedness" of preferences can also be derived from research on attitudes. Evidence that evaluative reactions tend to be immediate and fast and can often occur outside of awareness, has been accumulating rapidly (Ajzen, 2001), which would suggest that attitudes are stored in memory rather than constructed on the spot. However, studies have also confirmed that attitudes are often quite labile and change according to the context as well as to current thoughts (Wilson & Hodges, 1992), which would confirm the constructive-nature-of-attitudes view. Wilson, Lindsey, and Schooler (2000) have recently proposed a model of dual attitudes which posits that individuals can simultaneously have implicit and explicit attitudes toward the same attitude object. Explicit attitudes can be defined as measures of attitudes that operate in a conscious mode and are exemplified by traditional self-report measures (Dovidio, Kawakami, Johnson,

Johnson, & Howard, 1997). In contrast, implicit attitudes operate in an unconscious fashion and represent “introspectively unidentified (or inaccurately identified) traces of past experience that mediate favorable or unfavorable feeling, thought, or action toward social objects” (Greenwald & Banaji, 1995, p. 8). Explicit attitudes change relatively easily, whereas implicit attitudes are more habitual and change slowly (Wilson et al., 2000). Wilson and his colleagues further suggest that, when dual attitudes exist, individuals will report or act upon the attitude that is most accessible.

Two aspects are important to consider within the context of tourists interacting with intelligent systems: (1) stability, or the extent to which preferences are typically constructed on the spot; and (2) insight, or the extent to which consumers know that their preferences are constructed or stable and what the content of these preferences is. Not all preferences are completely constructed every time a purchase decision is made (Payne et al., 1999). Consumers typically have stable preferences for familiar, simple, or directly experienced preference objects (Kramer, 2003). Thus, whether preferences are constructed or stable seems to largely depend on the characteristics of the product and the knowledge of the consumer.

Product Type. King and Balasubramanian (1994) found evidence that preference formation strategies differ by product type, with recommendations being more likely sought for experience goods than search goods. In general, stable preferences are more likely to exist for products that are:

1. not characterized by variety-seeking
2. not characterized by satiation
3. characterized by little change in preferences over time
4. part of a product category for which available options change little over time
5. purchased rather mindlessly and for which consumers do not feel the need to re-evaluate options before each decision (Simonson, 2003).

Except for lack of satiation, none of these characteristics are applicable to most tourism-related decisions, which generally involve a great amount of variety-seeking, preference changes based on popularity of places and changes in the life stages of the consumer, substantial variations in the accessibility/attractiveness of travel destinations, as well as high risk and generally rather extensive planning, even when a destination is revisited. Further, tourism services are a product class in which there is an extraordinarily high number of options available. The larger the number of alternatives to be considered, the more the expression of preferences is likely to reflect a constructive process (Payne et al., 1999). Consequently, preferences for destinations and tourism products can be assumed to be rather ill-defined unless they are regularly experienced.

Product Knowledge. Preference construction has been found to be especially apparent for alternatives for which prior exposure to information or direct experience is limited. King and Balasubramanian (1994) state that consumers whose declarative and procedural knowledge about a product is high are more aware of the existence of specific product attributes and the importance of specific pieces of product information and, thus, are more likely to rely on internal information for their preference formation. In contrast, novice consumers consider product-specific information much less interesting because they lack the necessary mental framework to correctly process it, find that attribute-oriented thoughts are more difficult, and are more likely to seek out recommendations from others. Hoeffler and Ariely (2004) argue that consumers are more likely to construct preferences when encountering a domain that does not allow for direct comparison with familiar product categories; however, with increasing experience, stable preferences can develop.

It is also important to consider that, even if consumers have stable preferences for certain products, having stable preferences does not necessarily mean that one is immune to influences arising from the decision context. Recent research in the area of decision-making has shown that the influence of context can be so high that it can even override preferences based on very stable values (Payne et al., 1999).

Insight into Preferences. Insight into one's preferences has two underlying dimensions: (1) the belief that one has well-defined preferences; and (2) knowledge or awareness of the content of one's preferences (Simonson, 2003). Limits to our self-knowledge become apparent when considering the many processes that are inaccessible to conscious awareness. Although many aspects of the unconscious are still only poorly understood, there is increasing empirical evidence that mental processing outside our consciousness plays a vital role and is indeed a rather widespread phenomenon. For instance, Nisbett and Wilson (1977) and Wilson and Nisbett (1978) report that subjects are sometimes not only unaware of the existence of a stimulus, but also unaware of the response and the way in which the stimulus affected the response. Similarly, individuals can be primed to behave in accordance with a certain stereotype without being consciously aware of it (Wheeler & Petty, 2001). Also, people have been found to be unaware of their incompetence (Dunning, Johnson, Ehrlinger, & Kruger, 2003). Finally, research increasingly shows that consumer choice is not always a conscious, deliberative process but rather often occurs outside of conscious awareness and/or is influenced by factors unrecognized by the decision maker (Bargh, 2002; Fitzsimons et al., 2002).

Insight into one's preferences for destinations can be considered to be rather limited. Vacations are not only complex but also have important sensory and emotional components that cannot easily be described or elaborated on. In addition, destination choice usually involves many compromises due to demands of other individuals in the travel party as well as a number of constraints such as time and

budget. Thus, a selected destination might not necessarily provide a good basis for inferring one's "true" preferences. However, consumers have learned to conceptualize their destination decisions using easily definable functional attributes, such as climate, distance, activities available, and, therefore, might not be aware that they do not have good insight into their preferences for destinations, even if they are stable.

Preference Measurement. Intelligent systems need to learn about a user's preference in order to provide relevant information or decision-support. It is often assumed that "preference elicitation methods reveal systematic components that underlie people's evaluations of objects" (Huber, Wittink, Fiedler, & Miller, 1993, p. 105). Accordingly, preference elicitation methods are usually employed with the goal of producing accurate reflections of a consumer's underlying preferences. As discussed above, consumers may not be able to fully or accurately self-explicate their preferences (Ansari & Mela, 2003). Many techniques exist to measure consumer preferences; however, since preferences are often unstable and not always accessible to the consumer, these measurement approaches have to be seen as means that not only measure but often also lead to an ad hoc construction of preferences (Kramer, 2003). Consequently, preference elicitation should be viewed as "architecture" (building a set of values) rather than "archeology" (uncovering existing values) (Payne et al., 1999). The influence of the preference elicitation task is very likely subtle enough that it does not arouse consumers' defenses and hence may lead to persuasion (Payne et al., 1999). Thus, the constructive preferences literature raises serious concerns for measuring consumer preferences (Hoeffler & Ariely, 2004). It follows from the research on preference construction that the data derived through preference elicitation tasks most often partly reflects an individual's preferences and partly the manner in which the preferences were elicited (Lloyd, 2003).

In addition to the prior knowledge that a decision maker may bring to a preference elicitation task, information that is presented as part of the task itself will be used as local knowledge (Coupey, Irwin, & Payne, 1998). Thus, when constructing a preference, decision makers will usually draw upon a mixture of prior knowledge and stimulus-based information. Preference construction through preference elicitation has been shown to be sensitive to many contextual factors such as the framing of the decision problem, the particular alternatives available, and the nature of the response required (Kramer, 2003). In addition, Huffman and Kahn (1998) show that preference construction can be influenced by the way information about the product class is presented during a preference measurement task.

Preference elicitation can motivate consumers to gain insight into their preferences before answering the questions. Perhaps the most common way in which people attempt to gain insight into their preferences and judgments is through introspection (Wilson & Dunn, 2004). Accounts in the psychology literature suggest that: (1) Consumer

preferences might not (or at least not under all circumstances) be open for introspection (Wilson & Dunn, 2004); (2) Those preferences that consumers are consciously aware of might not necessarily correspond to their implicit preference structures (Wilson et al., 2000); (3) Implicit and explicit preferences and dispositions typically predict different kinds of behaviors; thus, inferring preferences from introspection or observation of user behaviors might be problematic (West-erink, Bakker, De Ridder, & Siepe, 2002); and, (4) Although information presented to the consumer as the result of an interaction with an intelligent system provides opportunities for consumers to increase their self-knowledge, such information might not be recognized as being truly customized if it is based on implicit preferences or might be ignored if it would cause cognitive dissonance/challenge the consumer's positively biased view of himself/herself (Simonson, 2003). Thus, introspection might not always lead to increased knowledge about one's true preferences.

Introspection in the form of analyzing the reasons for one's feelings and attitudes has been found to have many negative consequences. For instance, it can change our attitudes in the direction of the reasons mentioned, which can be problematic as individuals are more likely to list reasons that are plausible, readily accessible in memory, and/or easy to verbalize instead of reasons that correspond to their actual feelings (Wilson & Kraft, 1993). Wilson and Dunn (1986) found that it decreased the correlation between people's expressed feelings and their later behavior. Similarly, Wilson and LaFleur (1995) found that this specific kind of introspection lowered people's ability to predict their own future behavior. Wilson and Schooler (1991) report that reasoning about feelings can lead to new, less stable preferences and decisions that correspond less with those of experts. Introspection in the form of reasoning about one's feelings has also been shown to reduce post-choice satisfaction (Wilson & Kraft, 1993). Further, consumers often engage in reasoning to justify decisions, especially when spending money on luxuries, and these reasons that guided a consumer's choice may become irrelevant or even regretful at the time of the actual consumption (Kivetz, 1999). Given the long information search process and the time gap between purchase decisions and consumption in tourism, this is especially noteworthy. However, knowledge of the attitude object has been found to moderate the effects, i.e. "experts" did not change their attitudes as a result of introspection (Wilson, Kraft, & Dunn, 1989).

Tourism Information Searches as Conversations

Tourism information searches are processes that can span over a long time, involve multiple stages of decision-making, and draw on multiple sources (Bieger & Laesser, 2004; Zins, 2007). As a field, we have also investigated the role of technologies in this process, including websites (Kim & Fesenmaier, 2008), search engines (Xiang, Wöber, & Fesenmaier, 2008), and social media (Yoo & Gretzel, 2008). The

benefits of tourism information searches reach beyond the functional goal of finding specific information and include stimulation and entertainment, and satisfy social needs as well (Vogt & Fesenmaier, 1998). Therefore, tourism information searches are not always goal-directed and can be part of ongoing, intensive engagements with tourism-related media (Gretzel & Kang, 2011).

What is somewhat missing from the literature is the examination of performative aspects of tourism information searches. In essence, they are conversations in which knowledge deficiencies have to be acknowledged, status has to be built, trust has to be established, goals have to be pursued and potentially adjusted, arguments have to be constructed and relationship roles have to be considered. Further, the end-points of these conversations are not easily identifiable. Zins (2007) emphasizes the need for research that makes it possible to follow these conversations over longer periods of time to understand their essence and their role in informing specific tourism behaviors.

Early reflections on intelligent systems already acknowledge the conversational nature of the interaction with such systems (Hruschka & Mazanec, 1990). Mahmood and Ricci (2009) argue that recommender systems need to be able not only to have conversations with users but also to adapt their conversational strategies in the course of interacting with users. Although the importance of understanding the “language” of tourism (Dann, 1996) has been established, there is still very little research on how tourists express their information needs and respond to information offers. Social media actually make such conversations more visible and provide immense opportunities to better understand conversations. Publications looking at online conversations are emerging (Crotts, Mason, & Davis, 2009; De Ascaniis & Morasso, 2011), but more systematic approaches to understanding all aspects of these conversations are needed if intelligent systems have to mimic human conversation strategies employed in tourism information search processes.

The “Dark Side” of Intelligent Systems

Research on technology in tourism focuses almost exclusively on the benefits of technology adoption and use and rarely on the drawbacks of technology dependence, even in such controversial areas as biometrics (Kang, Brewer, & Bai, 2007). Intelligent systems capture information about their environment and their users, and this information can be highly personal, including the physical location of a tourist. Intelligent systems are thus a potential threat to privacy and an important element in a growing *überveillance* machinery (Michael, Fusco, & Michael, 2008) that raises significant ethical concerns. Turkle (2011) points to the instabilities in how we understand privacy and the risks often taken unknowingly. Tourism as a context in which information is collected is special and might lead to less awareness of threats and also greater vulnerability to violations (Anuar & Gretzel, 2011). Evaluations of intelligent systems in tourism then need to increasingly focus on their potential to harm users and not only their ability to help. This

requires critical perspectives on technology and research on how tourists and tourism employees conceptualize and negotiate privacy.

Tourism often incorporates elements of spontaneity and exploration. The tourism and the intelligent systems literatures generally assume that uncertainty reduction is a desirable goal while tourists might actually seek out risk and the opportunity to get lost and explore (Gretzel, 2010). Indeed, some intelligent system-related research in tourism has actually stressed the importance of inspiration rather than precise matching of destinations to user preferences (Mahmood, Ricci, Venturini, & Höpken, 2008). Unless the field gains a better understanding of the role of uncertainty and inspiration in tourism decision-making and tourism experiences, intelligent systems might lead to rather dull tourism experiences.

Another danger lies in intelligent systems actually being able to effectively steer tourists off the beaten paths (Modsching, Kramer, ten Hagen, & Gretzel, 2008). While that might be a desirable effect from the tourist point of view and lead to advantages for destination marketing, it raises important questions as to the ability of reaching sustainability goals in a tourism penetrated with intelligent system applications. The sustainable tourism literature has acknowledged potential impacts of technology (e.g. Eagles, McCool, & Haynes, 2002) but lacks empirical research to inform design practice in terms of how to integrate sustainability goals in intelligent systems algorithms. This raises the general questions of if and how intelligent systems can and will balance individual benefits with larger societal goals.

DISCUSSION

If intelligent systems are designed based on the current literature in tourism, they will be more or less sophisticated tools that provide individual tourists with a mechanism to retrieve information when a need occurs/is identified rather than a true conversational partner in a continuous, social process. Such tools will never have the ability to imitate the capacity of human advice givers to engage counterparts in meaningful interactions because they will lack fundamental insights as to what types of interactions can occur and how they can be directed to reach a goal. Rather than optimizing decisions they could introduce even greater biases than already incurred in human-only decision-making and lead to decisions that do not result in satisfactory tourism experiences or management outcomes. They could also encourage decisions that maximize individual utility while placing burdens on individual others or entire social groups.

Even simple intelligent systems can potentially occupy very powerful positions within the socio-technical system in which they operate. Their overall goals need to be determined a priori and might not be visible to tourists or tourism organization employees who interact with them. A critical theory approach (Tribe, 2007) to technology studies in tourism is needed to ask essential questions about power relationships created

or reinforced through such systems. Greater knowledge as to how tourists interact with such technologies is also required.

If interactions among users and intelligent systems within larger social contexts can be understood as digital ecosystems, maybe sociological theories will not be sufficient and ecosystem theories will need to be applied to understand interactions and their implications for the ecosystem rather than individuals or groups. Swarm theory is a prominent example for how looking at interactions in nature can foster the understanding of social behavior and at the same time can also encourage the development of algorithms to guide intelligent systems.

Building strong theories that can form the basis for designing intelligent system interactions requires methodological rethinking in what is currently common practice in tourism research: one-off, one-context research. Replication or systematic expansion and testing of existing theories is important if they are to be formalized for mathematical representation in the “minds” of intelligent systems. Longitudinal studies are critical in understanding processes, influence and impact. In addition, critical theory approaches are essential in challenging the assumptions underlying much of the technology-related research in tourism.

Overall, intelligent systems raise important philosophical questions about how autonomous these technologies can or should become and how they can be controlled from within a socio-technical system (The Economist, 2009). Winner (1978) was the first to emphasize the importance of thinking about the complexities of systems and their implications for communities. If tourism research informs their design, it also needs to inform the larger debate around issues related to their use even if tourism decisions are seen as “harmless” in comparison to other areas such as medical support.

CONCLUSION

Tourism research has important contributions to make to the development of intelligent systems, which will likely increasingly permeate consumption and work processes related to tourism. Intelligent systems require reasonable models of the domain within which they have to realize goals through their actions. The tourism domain is complex and the current literature has focused on simplification instead of exploring its richness. Simple models are helpful to some extent but with increasing computational power and more sophisticated algorithms that can handle complexity and uncertainty it becomes possible to represent the world in more sophisticated ways. There is also a need to critically reflect on the impacts these intelligent systems have on the socio-technical systems within which they exist.

Importantly, while there are certain issues that are especially pertinent for intelligent systems, most of the identified research gaps have implications for many areas related to tourism. The above discussion revealed that technology and tourism literature has favored certain

topics and clearly left out others, information search and decision-making models have yet to incorporate changes in the information ecology and the ways tourists as well as tourism organizations interact with this information, and most tourism research is still based on antiquated representations of the human mind as a protected storage container instead of a malleable entity that functions within a social context. Consequently, efforts to increase our understanding in these areas will not only be beneficial to the development of intelligent systems that can truly support tourism systems but will also provide insights of relevance to general theory building in tourism. **A**

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