DISSERTATION

THE DEVELOPMENT AND EVALUATION OF AN AUTOMATED MULTIMEDIA KIOSK-BASED VISITOR SURVEY SYSTEM IN IGUAÇU NATIONAL PARK, BRAZIL

Submitted by

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ABSTRACT

THE DEVELOPMENT AND EVALUATION OF AN AUTOMATED MULTIMEDIA KIOSK-BASED VISITOR SURVEY SYSTEM IN IGUAÇU NATIONAL PARK, BRAZIL

The Brazilian system of parks and related areas has shown a continued increase in geographic area and in recreational use demands. The federal government recently established policies aimed at improving visitor management and setting standards for public visitation to the nation's protected area (PA) system - a major shift from the era where visitors were seen as burdensome to conservationists. New policies require the collection of visitor information to inform improvements to the visitor experience and other management actions. Brazilian PA managers, however, have a limited data base, limited experience and few resources for undertaking visitor studies.

Accordingly, this research developed and evaluated an automated visitor interviewing system to help close this information gap. The system developed and integrated custom-made software and hardware capable of collecting multidimensional survey data, including cognitive data, environmental variables, and the affective state of respondents. The kiosk system utilizes an animated virtual host as part of a machine-human communication strategy aimed at intertwining the survey system with the park experience. The multimedia design reduces the respondent burden and enables the

evaluation of current or future physical, social and managerial settings using virtual reality depictions. A variety of features reduces the administrative burden for managers. The development and use of the kiosk are described in detail.

The prototype survey station was tested in Iguaçu National Park, Brazil, between January and December of 2008 yielding a sample size of 4,047 respondents. The study evaluated the ability of an unhosted station to collect good visitor information and the time and effort visitors spent answering the questionnaire and interacting with the survey station. It also assessed how environmental variables like weather or river flow, (also measured by the station), affected visitor satisfaction. The study found among other results that the survey station operating in either a hosted or unhosted mode, produced the same results; that 54.8% of respondents were committed to answering to all questions, 26% were partially committed and 19.1% were uncommitted; and verified that environmental variables did affect overall visitor satisfaction.

"Everything is simpler than you think and
at the same time more complex than you imagine"

Johann Wolfgang von Goethe

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DEDICATION

to my wonderful family, especially to Nair – my greatest friend and mother

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CHAPTER 1: INTRODUCTION

1.1 PROBLEM STATEMENT

In the last 30 years the US National Park System has received over 8 billion recreational visits, averaging roughly 267 million visits per year (National Park Service, 2010b). The National Park Service manages 394 Protected Areas (PAs) covering roughly 34 million hectares in almost all US states and territories with a budget of US$ 3.16 billion for the 2010 fiscal year and a staff of 20,500 diverse professionals and 145,000 volunteers (National Park Service, 2010a).

Although Brazil created its first National Park back in 1937, the current state of public use in the Brazilian National Parks is quite different. There are 62 national parks (Ministério do Meio Ambiente, 2007b), but only 22 (37%) are open to visitation by the public. Federally managed National Parks and Reserves in Brazil cover an area of 69.7 million hectares or 8.2% of the Brazilian continental territory and 0.35% of the Brazilian marine territory (Ministério do Meio Ambiente, 2007a). The 2010 fiscal year budget for the entire park system was only US$100 million. Between 2004 and 2007, 54 new federal protected areas were established, and other 9 areas were expanded, adding 19.6 million hectares to the protected area system. This represents an increase in Brazil's protected area system of about 40% (Ministério do Meio Ambiente, 2007a).

In addition to protecting ecosystems, scenic landscapes and providing places for research, both federal and state protected areas in Brazil have a legal mandate to provide

visitation. The Brazilian National System of Protected Area Law requires managers to favor conditions that promote education and environmental interpretation, nature-based recreation, and ecotourism (Brazil, 2000). Specific policies have been developed to deal with this aspect of park visitation. These policies aim to increase and enhance visitation in Brazilian national parks (Ministério do Meio Ambiente, 2008).

The growth of Brazil's PAs follows a worldwide trend. Ideally, ecotourism in and around protected areas, strengthens the bond between the community and PAs, boosts the economy, promotes job creation and income for local communities and the protected area, and increases environmental awareness and public knowledge about the importance and management of protected areas (Wallace & Pierce, 1996).

The Brazilian Environment Ministry presents a set of principles, recommendations and practical guidelines geared towards organizing PA visitation, and developing and adopting rules and regulations which guarantee the sustainability of the tourism (Ministério do Meio Ambiente, 2008). Within the larger scope of these regulations, some of them relate specifically to the need for social science that generates a variety of information from visitors such as:

- "Visitation is an essential instrument in order to close the gap between society and nature and to awaken society's conscience to the importance of environmental conservation and of natural processes, regardless of the activity which is being carried out in the PA."
- "Visitation should satisfy visitor expectations regarding the quality and variety of experiences, safety and knowledge needs."

The Brazilian Environment Ministry conducted a comprehensive assessment of park visitation in Brazil up to 2004 (Ministério do Meio Ambiente, 2003). The study describes several activities including ecotourism that have demonstrated significant growth in PAs. They note that increasing visitation represents an activity with great potential to increase the funding for PAs in addition to playing a key role in bridging the gap between society and nature, in order to foment conservation and sustainable use of resources.

Visitation at Iguaçu National Park has significantly increased during the past ten years, giving rise to the need for the type of information that can improve visitor management in the park. In general, information from visitors participating in outdoor recreation in protected areas is underutilized in the management decision-making processes (Manning, 1999). Underutilization is more pronounced in the Brazilian protected area system, which lacks an established tradition of using social science to better understand visitor characteristics, motivation and perceptions.

Nonetheless, survey research is now recognized in Brazil as an essential tool for sound decision making in managing visitors and natural and cultural resources found in protected areas. The visitor surveys that have been done have frequently counted on trained researchers or professors and graduate students and are generally expensive to conduct. Funding for protected area management in Brazil does not often allow managers to commission or develop and conduct traditional on-site surveys.

Survey research has evolved along with the development of information technology. On-line survey technology is revolutionizing the availability of survey data in most studies where large-scale sampling is required. On-site surveys in protected areas,

however, are still conducted primarily utilizing paper and pencil with personal interviews, or self-administered surveys that are mailed back, and, to a lesser extent, computer-aided personal interviews. Much of the advancement of on-line survey research is not being translated to on-site surveys. The evolution of on-line surveys has been dependent upon a centralized computer network, such as the Internet, which, without adaptation, may not be suitable for use in PAs. Protected areas are often located in remote areas, usually out-of-range of stable Internet connections, and visitors do not have much patience for long, complicated questionnaires that compete with their leisure time and interests. Visitor tolerance for on-site questionnaires radically differs from off-site survey modes where the respondent can choose a convenient time to complete the survey. Besides being unable to choose a time that "costs" less, on-site respondents are asked to answer the questionnaire in its entirety at once.

Existing information technologies could be used to diminish the burden of requirements for on-site visitor surveys that utilize an on-line venue. It is also possible to capture data regarding environmental physical variables simultaneously with the feelings and perceptions of the visitors, which may be influenced by physical variables, such as extreme weather conditions, river flow, water quality, and others. Such environmental variables may change quickly depending on the location and time of year. Recreationists themselves might not be aware of the extent to which environmental variables may influence experience outcomes. For example, physical phenomena may interfere with visitor satisfaction scores. A survey instrument that is sensitive to environmental variations could explain variations in satisfaction that would otherwise be regarded either as unexplained or measurement error. Managers who understand the effect of

environmental conditions may take actions to mitigate any negative effects. An on-site approach that incorporates place-specific information into a survey could be realized with a kiosk-based interviewing process. Currently, kiosks are typically of a passive nature and dispense information and services using one-way communication. This study proposes to advance the development of an automated multimedia system that is essentially a computer assisted kiosk that can conduct surveys or interviews using a two-way communication. With the addition of multiple sensory devices, this type of visitor information collection station can also measure environmental variables, emotions, gestures and other non-cognitive information from visitors. All of these things may add new dimensions to our understanding of the visitor experience. The proposed system allows for increased complexity of data collection and manipulation, and potentially, an increased burden for both researchers and respondent, unless this aspect is handled creatively. If done well, the proposed kiosk methodology could decrease the "burdens" associated with social science survey research for both visitors and managers.

The very nature of electronic interviewing allows many enhancements to data collection methods and to the variety of data that may be collected. More complex branching, randomization, and pooling of the data are possible, as well as the elimination of costly and error-prone data transfer from paper to binary form (de Leeuw & Nicholls II, 1996). When comparing the different modes of electronic surveys such as web-based, e-mail and point of contact (on-site), Jansen, Corley, & Jansen (2007) consider benefits of the later: the absence of software compatibility issues; fewer computer access issues; access to populations without computers; identical instrument across all respondents; technology available for multiple question formats and potential to capture data directly

in database. Electronic surveys can, furthermore, facilitate multiple and effective survey campaigns in close collaboration with centers of excellence in social sciences worldwide via remote access and control tools which this study includes. The development of the proposed, automated, multimedia on-site survey system in context with the visitor experience as part of protected area planning and management is shown in Chapter 4. The study that follows will test the feasibility and effectiveness of using this type of approach for collecting and analyzing visitor information in one of Brazil's best known protected areas.

1.2 RESEARCH QUESTIONS AND STUDY OBJECTIVES

This research looked to answer four main questions:

1.) How might an on-site, automated multi-media system (survey kiosk) be designed, developed and utilized to collect needed information in protected areas while reducing the burden on both the visitors and managers involved?

2.) Are automated survey stations feasible and will they yield results that are comparable with traditional, on-site survey methods requiring the presence of interviewers or facilitators? Key for the feasibility assessment is an evaluation of public acceptance of and willingness to engage an electronic survey device during a leisure time visit to a protected. This leads us to a third question:

3.) What will be the tolerance level of visitors to engage/attend an automated survey device that competes for their leisure time?

Since environmental and other non-cognitive data can be assessed simultaneously using sensors that are added to the automated multimedia survey system,

4.) Can environmental data help explain or enhance understanding of the social data collected?

Study Objectives

The study includes four specific objectives: 1) Development of the automated, on-site multimedia survey system, including the creation or integration of software and hardware, and a social communication strategy; 2) To test the feasibility and effectiveness of a fully automated electronic survey terminal and the quality of the survey data; 3) As part of feasibility, to assess the level of engagement and the burden on survey respondents who are being surveyed in a leisure setting; and finally 4) To assess the potential to integrate environmental data, such as real-time weather conditions and river flow, on variables such as visitor satisfaction in order to enhance visitor information and inform management actions.

CHAPTER 2: LITERATURE REVIEW

This chapter reviews the literature upon which this study builds and will help identify knowledge gaps that are addressed by the objectives of the study. Initially, the literature review assesses the connections between and the importance of visitor studies for protected area managers and decision-makers. Next the review will look at the literature specifically related to the influence of environmental variables (such as weather and river flow) on the visitor experience since such measurements were included in the current study conducted at Iguaçu National Park. There will then be a brief review of current methods and technologies commonly utilized for on-site visitor research before moving to the literature regarding the development and use of automated multi-media systems which represent the major focus and potential contribution of this study

2.1 VISITOR STUDIES AND PROTECTED AREA MANAGEMENT

2.1.1 The Case of Brazil

Brazil's legislation regarding visitation in protected areas (Ministério do Meio Ambiente, 2008) include the following guidelines: a) "Forecast the updating of planning instruments and other PA normative instruments, aiming to enhance visitor activities"; b)"establish a system of visitor records and carry out periodic research to identify the visitor's profile, opinion and satisfaction related to visitor opportunities offered in the PAs"; c) "establish the monitoring of indicators linked to visitor satisfaction, such as: crowding/group

encounters, environmental conservation, noise and safety, usage conflicts between different users, number of violations, among others"; d) "understand the diversity of visitor expectations, aiming to meet them with a wide spectrum of management strategies, which maximize the variety of offered opportunities."

In research aimed at assessing the management strategies of Brazilian parks regarding nearby rural areas, (Hauff & Milano, 2005) found that most of the sampled PAs had insufficient personnel. Another study found that the managers of Brazilian protected areas consider lack of personnel, insufficient qualification, and inadequate training of the PA staff to be among the main problems faced by the federal PAs (Theulen, 2004). IBAMA and WWF-Brasil's comprehensive study "Brazilian Protected Areas Management Efficiency" analyzed the majority of Brazil's national PAs using the RAPPAM (Rapid Assessment and Prioritization of Protected Area Management) method. Regarding National Parks, the study's findings underscore the need to improve management of human resources, funding, research, and monitoring and evaluation of management results. Deficiency in human resources was also pinpointed as a problem in PAs such as Ecological Stations, Biological Reserves, Environmental Protection Areas, among others (IBAMA & WWF-Brasil, 2007). In Pinheiro's (2009) talk on Management of PAs, he concludes that one of the main guiding axioms of management is that what one cannot measure, one cannot manage.

The above studies attest that obstacles to visitation and visitor management in the Brazilian PA system include a lack of human resources, specialized personnel to work with the public, training, and a pressing need for technical and creative management approaches reliant on precise data collection and measurement.

The few existing Brazilian visitor studies are largely limited to characterization of visitor profiles (Castro, Faria, Pires, & Silva, 2007; Ladeira et al., 2007; Moura, Rosa, Santana, & Moura, 2008; Niefer, 2002; Nobre, 1997); measures of experience quality (Dutra, Senna, Ferreira, & Adorno, 2008); and landscape preferences (W. K. de Freitas & Magalhaes, 2003). Magro (2004) studied Itatiaia National Park's visitors and visitation correlating measurements of impact such trail width, soil compaction, soil exposure, erosion, root exposure and littering with information from visitor interviews.

In Vila Velha State Park, Brazil, a major revitalization program was carried out, preceded by a planning phase, which was guided by an on-site visitor survey. The social information obtained was merged with an environmental evaluation and park objectives. The resulting data led to the creation of management guidelines for improving of the park's facilities, visitor management scheme, and the reducing visitor impacts to the park's natural resources. (Nobre, 1999).

A major difference found when comparing the literature on American and Brazilian Protected Area (PA) is the fact that visitor studies carried out in Brazil are seldom initiated by managers, are predominantly initiated by academicians and are done in a piecemeal manner that does not provide baseline information for managers comprehensively, as is the case of the US National Park Service's VSP project. This study hopes to make it easier for more Brazilian PA managers to undertake visitor surveys in more systematic and economically feasible way and to have more immediate access to the results.

2.1.2 Visitor Studies Elsewhere

The United States and other developed countries with established protected area systems such as Canada, Australia and New Zealand have produced a large body of research on park visitor information and its implications for management. In 1996, the NPS reinforced the use of visitor studies in its "Usable Knowledge" plan, which included a new emphasis on social science in the National Parks (Machlis, 1996). The plan states that understanding the relationship between parks and people is crucial for protecting resources, while providing for public enjoyment. According to this plan, usable knowledge shall be provided to managers that will help them make decisions that directly impact visitors, local communities, concessionaires and employees. The plan came at a time of growing demand for social science information among managers of protected areas. "Usable Knowledge" foresees state-of-the art research, which is timely, understandable, defensible, and relevant to decision-making processes.

Visitor information, generally sought by managers, has been actively generated by managers themselves, as well as government agencies, universities, the private sector and cooperative studies units—collaborations between universities and park management, established to provide research, technical assistance, and education to resource and environmental managers. A multitude of journal articles, books and official technical reports form a well-documented body of studies on PA visitors and management, encompassing general visitor data, visitor experience, visitor perception, visitor impacts, visitor conflicts, crowding, and ecotourism, among others.

Among studies aimed at generating a vast gamut of general visitor data, the VSP (Visitor Service Projects) is a prominent research project. The VSP is an ongoing effort

of the National Park Service (NPS) Social Science Program, which provides superintendents with usable knowledge about visitors. This systematic and recurrent analysis of visitation is a cooperation between the NPS and the University of Idaho Cooperative Park Studies Unit. The project began in 1982 when the University of Idaho Cooperative Park Studies Unit (UI CPSU, now called UI Park Studies Unit) developed a new approach to visitor studies in response to the need to learn more about visitors and their opinions. The technique provided an easy-to-understand, consistent, and efficient means of studying visitors. Through the more than 165 survey studies conducted by the National Park System (NPS), park staffs obtained accurate customized information about visitors: who they are, what they do, their needs, and opinions.

The literature related to visitor experience, specifically that pertaining to visitor interaction with the environment, is addressed in several studies in countries with a history of social science research in protected areas. In the US, Brooks, Wallace and Williams (2006), studied how Park visitors build relationships with a protected natural area over time. Manning (1999) further explores the topic of visitor's relationship with the environment and with management strategies in his study by measuring environmental values and ethics and exploring their relationships to attitudes toward national forest management. Visitor's attachment to a place is also studied by Vaske and Kobrin (2001) and Williams and Vaske (2003). The latter analyzes the psychometric properties of a place attachment measure designed to capture the extent of emotions and feelings people have for places. Hammitt (1981) analyzes the degree to which previous familiarity with a given environment influences response to the visual environment, as well as the degree of familiarity resulting from the on-site encounter. The potential

impacts of such studies for managers are considerable, allowing them to foster settings that would nurture the active construction of relationships between visitors and the PAs.

Still within the realm of visitor experience, the literature related to quality and satisfaction in the tourism and recreation field dates back to at least the Outdoor Recreation Resources Review Commission reports of 1962 (Manning, 1986). The high level and sustained interest in this topic derives from a widely held belief that the primary managerial criterion for success should be defined in terms of level of satisfaction. Among the authors who researched the topic of visitor satisfaction, Noe and Uysal (1997) describe overall satisfaction as a function of instrumental and expressive factors, expectations, and past-use. Barker (2000) analyzes factors that can influence behavioral intentions and satisfaction.

Despite the benefits for destination managers of monitoring visitor satisfaction and the subsequent academic interest in this area, the actual implementation of satisfaction measurement is still potentially onerous and confusing. In a review paper, Fallon (2008) considers the various quantitative frameworks—incorporating the expectations, importance and performance constructs—that are available to managers to monitor their destinations' effectiveness in terms of meeting the needs and wants of visitors. He systematically evaluates each construct and framework, acknowledging their potential in terms of informing management strategies, conceptual and practical concerns related to their operationalization and subsequent modifications and extensions.

Most of the theory and research on visitor satisfaction have focused on elements of human personality and psychological needs. A detailed examination of the characteristics of recreation activities and their influence on user satisfaction is carried

out by Vaske, Donnelly, Heberlein and Shelby (1982). Previously, Haas (1979) measured wilderness users' motivations and preferences for recreation experience opportunities and physical resource attributes and Newman (2002) integrated social, ecological and managerial indicators of quality into carrying capacity decision making.

These various studies have given rise to the concept of experience based setting management. Among the studies that propelled this concept is Manfredo, Driver, & Brown's "A Test of Concepts Inherent in Experience Based Setting Management or Outdoor Recreation Areas" (1983). It examines assumptions of the concepts that form the basis for experience based setting management of outdoor recreation areas. The research on visitor experience has also contributed to the elaboration of management tools like the Recreation Opportunity Spectrum (ROS), which is based on several visitor studies and aims to provide quality experiences and facilities in natural areas. Both the concept of experience based setting management and management tools such as ROS have provided managers with a zoning strategy widely used in US Protected Areas: one that provides a range of visitor experiences and different levels of resource protection.

Besides the direct impact on knowledge and management practices represented by these many studies, conducted over decades, it becomes possible to assess their effectiveness, as Manning (1996) did in a review work about motivations and benefits in recreation. He has pointed out methodological issues regarding the measurement of motivation for recreation in which the relationship between use level and crowding has been partially confounded by the measurement techniques used. Attitude surveys and behavioral observations have sometimes yielded conflicting results. Despite the three basic approaches to measuring human behavior in general, and motivations for recreation

in particular, i. e., verbal behavior, overt nonverbal behavior, and physiological response (Driver, 1976), nearly all studies on motivations for recreation have relied on verbal behavior manifested in written responses to attitude surveys, with a few exceptions, which include a study that relied at least partially on participant observation (Bryan, 1977) and studies of pupillary response to natural landscape scenes (Peterson & Neumann, 1969; Wenger & Videbeck, 1969). Manning (1986) contends that additional attention to alternative measures of motivations will enhance the confidence with which findings might be applied in the field. These methodological considerations underline this study's goal of providing alternative tools for measuring cognitive opinions on-site, especially given that questionnaires can be coupled with behavioral electronic observations and psychophysiological measurements.

Many studies have also been developed to look at how visitors perceive the PAs and which aspects directly impact their perception. Loomis (2004) evaluates how changes in bison and elk populations impact park visitation and concluded that managers can rely on survey estimates as good indicators of what the likely change in visitation would be if a particular policy change in bison and elk population were implemented. Arriaza (2004) furthers presents a survey methodology to assess public preferences regarding the visual quality of diverse agricultural landscapes. This type of information would be useful in the management of many PAs with agricultural holdings found in Brazil and is suitable for integration in an automated multimedia survey system. Mitchell, Wallace and Wells (1996) analyzed visitor characteristics and the perceptions visitors had about cattle grazing on national forest land. The study had direct implications for management. Study information guided improvements in the allotment planning process and the design of

effective interpretive programs—both of which reduced conflicts between forest visitors and livestock.

Visitor information and education about minimum impact skills and practices are attractive and potentially effective management alternatives to minimize the ecological and social impacts of outdoor recreation. Research suggests that recreational visitors can significantly impact resources through compaction and erosion of soils, trampling of vegetation, disturbance of wilderness, and pollution of streams and lakes (Knapp, 1978). In the study done by Newman, Manning, Bacon, Graefe and Kyle (2003), the minimum impact knowledge of Appalachian Trail (AT) Hikers is analyzed. The author concludes by stating that information and education programs represent an attractive management alternative that can potentially reduce the ecological and social impacts of recreation while maintaining visitor freedom of choice.

Visitor conflicts and crowding form a branch of research that has been greatly developed in order to better understand the interaction among people when in a natural setting. Vaske and Shelby (2008) comprehensively examined perceived crowding using 615 evaluation contexts obtained from 181 studies that used a 9-point scale. They found that four methods for summarizing the crowding scale were highly correlated across all evaluation contexts and four independent variables (year study was conducted, region of United States, country, specific activity) affected perceived crowding for both the collapsed scale and the mean of the scale. One factor, specific location of the encounter, only affected perceived crowding for the percentages, not the mean. Consumptive versus nonconsumptive activities had no effect on perceived crowding. Using capacity judgment standards, 40% of the 615 evaluation contexts were in the suppressed crowding category,

16% were over capacity and 9% were greatly over capacity. Public preference and the management of recreational congestion was analyzed by Price (1979) and examples of context-specific studies involving crowding include: an analysis on how the increasing number of visitors in ski resorts may affect the ability of ski areas to sustain acceptable social conditions (Needham, Rollins, & Wood, 2004); a study about the social carrying capacity of the Columbia Icefield (Vaske & Donnelly, 1997); and an assessment on crowding at the Brule River (Heberlein & Vaske, 1977).

There is also a considerable body of social science that analyzes ecotourism in a context that is closely related to Nature's conservation and visitation in protected areas. Boo (1993) examined the status and impacts of nature tourism in 5 representative countries in the Latin America or the Caribbean region with recommendations for tourism planning and management. Wallace and Lindberg (1993) studied a prime ecotourism destination, the Galapagos National Park in Ecuador, analyzing the inadequacies of the park's zoning and visitor management strategies in the face of current visit levels, among other issues. The discussed solutions relate to the presence of park personnel, balancing commercial and non-commercial opportunities for visitors, and zoning that improves the visitor experience. In a study in the Brazilian and Ecuadorian portions of the Amazon Basin, Wallace (1996) provided systematic approaches to evaluate ecotourism operations in an effort to promote ecologically sound tourism. Martha Honey (2008) provides a review on the perception of ecotourists as to the environmental protection at their destinations. In an analysis of dozens of recent surveys by the Center on Ecotourism and Sustainable Development (CESD) it was found that more than two-thirds of U.S. and Australian travelers, and 90% of British tourists

consider active protection of the environment, including the support of local communities, to be part of a hotel's responsibility; and more than 75% of U.S. travelers and 87% of British travelers felt that it is important for their visits to not damage the environment; Additionally, over one-third of both British and U.S. travelers said they were willing to pay more to travel companies committed to environmental protection.

In summary, the literature substantiates that, differently from Brazil, there are regions with a strong tradition in generating social science knowledge linking visitation to PA management, and that a considerable amount of research is done in the fields of visitor experiences, motivations, place attachment, conflict, carrying capacity, and ecotourism, both within parks and their surrounding natural areas and local communities. The studies are either applied, furnishing usable data for managers, or methodological, contributing to enhance the quality of the measurements done. Nevertheless, though they are abundant and well established, these studies make consistent use of cognitive survey instruments (in a deductive or inductive form) and could potentially benefit from the new developments in survey methodology proposed in this study.

2.2 THE EVOLUTION OF ON-SITE SURVEY RESEARCH

2.2.1 Commonly Used On-Site Methods

The need for survey research in order to better describe characteristics of a larger population is an established paradigm in sociological research (Vaske, 2008). The work conducted by Vaske (2008), on the application of survey research in parks, recreations and human dimensions, underscores the need for survey research through the use of consistent or standardized questions, so that comparisons among groups can be

facilitated. The author further points out that survey research allows for large sample sizes, in a relatively short period of time, as well as numerous questions in a single survey. Potential disadvantages to survey research are also discussed, among which is the requisite that all questions in a questionnaire be understandable to all potential respondents. The inflexibility and oftentimes artificial nature of questionnaires is presented as a great limitation for alterations after implementation and public willingness to complete the survey, respectively. When assembling the survey questions, Vaske (2008) strongly suggests that every question be designed with a purpose and specific research objective in order to avoid excessive respondent burden, question non-responses and increased overall response rates. The author also cautions against excessive costs associated with on-site surveys related to out-of-state or international travel and accommodation. This is especially true when the study site is large and potential respondents are widely scattered across the site. Reducing these costs is crucial in order to ensure long-term practicality of the survey. Another weakness of on-site surveys discussed in Vaske's study (2008) is that interviewers must be trained in interpersonal communication, in explaining why the project is being conducted, the format of the questionnaire, and know how to respond professionally to anticipated and unanticipated questions. Supervisors should be present to monitor interviewers and ensure that questionnaires are being filled out completely during survey administration. Extensive training and supervisor presence can increase costs of on-site surveys. Despite these shortcomings, on-site surveys are popular because of their high response rates and ability to reach populations for which no contact list (e.g., addresses, telephone numbers) currently exists. Electronic surveys are portrayed as a method that is more efficient than

mail, telephone, and on-site surveys with no need for paper, postage, travel, etc. Moreover, this kind of survey can automatically transfer answers to an electronic spreadsheet, thus eliminating the need for data-entry, and its associated costs. Time required for survey implementation and administration can be reduced from several weeks to just a few days or hours (Dilman, 2007). The weaknesses associated with electronic surveys are mostly related to people's differing experience with electronic surveys which may need explanation and instruction for proper completion. Anonymity, security, and confidentiality of electronic responses are also important issues to be dealt with (Sills & Song, 2002).

The recognition that the fundamental nature of self-administered questionnaires is undergoing substantial change is addressed by Dilman (2007). Emerging technology has significantly improved the delivery and retrieval of questionnaires electronically. People's growing familiarity with computers is also greatly influencing how questionnaires can be completed and returned. Dilman (2007) also discusses how responding to a self-administered questionnaire involves not only cognition, but also motivation. People must clearly understand what is wanted of them and be motivated to go through the process associated with understanding and answering each question and returning the questionnaire to the survey sponsor. In an earlier study, Dilman, Tortora, Conradt and Bower (1998) analyze the influence of plain versus fancy design on response rates for web surveys. Despite concluding that plain surveys were more successful, the authors concede that technological barriers may have been largely responsible for the frustration of respondents with fancy questionnaires that demanded more transmission and loading time. A more recent study (Vaske, 2008) corroborates the importance of

layout in stating that questionnaire layout is one of the most important factors influencing response rates and data quality, especially for mail, on-site, and electronic surveys. The study further states that questionnaires should minimize respondent burden, which means: (a) keeping time required to complete the questionnaire to a minimum, (b) decreasing time that respondents need to think about questions, and (c) respecting respondents by ensuring that they will not be embarrassed by not understanding what is expected. Too many questions can increase respondent burden and item nonresponse, and decrease response rates (Heberlein & Baumgartner, 1978).

Haraldsen (2002), referring to the work of Fisher and Kydoniefs (2001), considers three types of survey burden: Respondent Burden, Design Burden and Interaction Burden. Respondent burden relates to the personality of the respondent as well as their behavioral and attitudinal attributes that impact the completion of the survey. The survey sponsor is unlikely to moderate Respondent Burden. The Design Burdens encompass the burdens that can be linked to the mode of data collection and to the content and presentation of the questionnaire used. These are the main components that the survey developer can moderate. The Interaction Burdens are the result of the interactive relationship that exists between some aspects of the respondent burden and the design burden. Therefore, according to this model, the perceived burden is influenced both by the respondents ability to answer, by the design of the survey, and by the combination of these elements. Haraldsen (2002) points out that the term "response burden" should define the intersection between the survey instrument and the respondent's qualifications to respond it, a concept that points to the respondent's experience with the survey. In his view, burden is perceptual and subjective; the issue is not the amount of burden, rather,

the balance between burden and gratifications, since the survey may have also advantages and other positive aspects. Building on Fisher and Kydoniefs' (2001) model, Haraldsen (2002) developed a model that specified two main kinds of personal prerequisites and eight survey design properties that can potentially affect the burdens and gratifications of the respondent. His model also considers the influence of the technology behind web surveys, which can also affect the response burden. This technology is referred to as web survey tools and relates to question controls, response controls and presentation tools. Figure 2.1 shows the model with the main factors related to web surveys that lead to response burden and affect data quality.

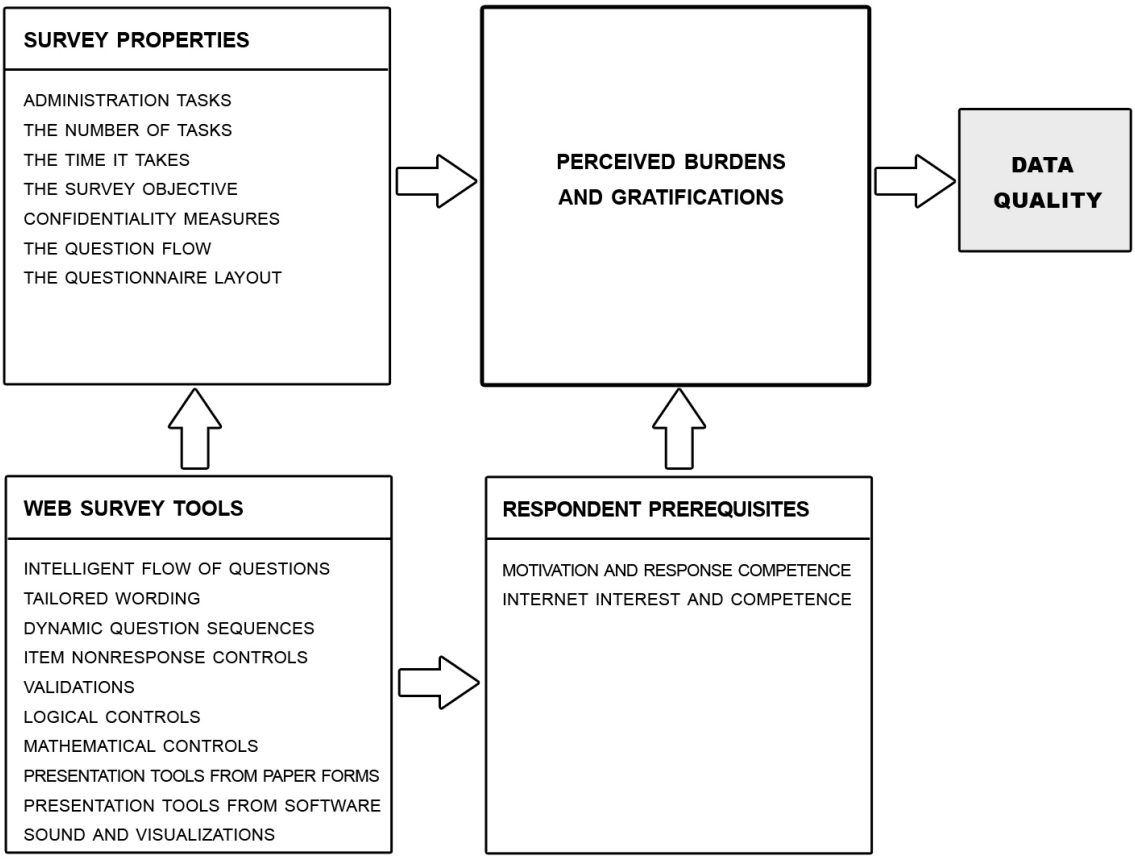


Figure 2.1: Personal prerequisites, survey design properties, and survey technology (tools) that can affect the burdens and gratifications of the respondent (Haraldsen, 2002)

2.2.2 Automated Machine-Human Interaction in Kiosk Systems

The premise of using Kiosks as an active form of obtaining data from the public inherently raises a set of questions. Several studies have been conducted in an effort to address these issues, broaching each question from several standpoints and allowing for a comprehensive understanding of the topic as it stands today. Among the predominant questions raised, is the degree of veracity that can be attributed to the data collected at these kiosks, and the extent to which they are scientifically sound.

Blignaut (2004) analyzes precisely the degree to which the output from computerized self-administered questionnaires represents scientifically valid data. This question arose as a result of the voluntary nature thereof and uncontrolled circumstances in which respondents can complete such a survey. In order to determine whether the feedback could be regarded as representing the true feelings of kiosk users, respondents were categorized according to the number of items completed and the internal consistency of responses within each category. The resulting comparison between the CSAQ (Computerized Self-Administered Questionnaire) and a paper-based survey led the authors to conclude that the CSAQ results can be trusted if they are analyzed correctly.

Borchers, Deussen and Knorzer (1995) deal with a second issue commonly associated with the use of kiosks: layout and presentation. The success of such systems depends largely on the attractiveness of their user interface, how easily they allow access to information and how clearly they present it. The authors claim a clear and appealing screen layout is crucial to the success of on-line kiosk systems and public terminals that are connected to a network. The paper addresses the problem of developing such a layout,

and provides several guidelines, drawn on traditional typography and Gestalt psychology as well as from hypertext authoring, and human -computer interaction. The concluding remarks point out that despite the availability of alternative systems such as HTML, the ideal system for the authoring of documents for on-line kiosk systems has yet to be designed.

There are several studies to date, which address the potential of creating kiosks that, in real time, sense and respond to their environment (Cassell et al., 2002; Christian & Avery, 1998). Today's public kiosk has good multimedia display abilities but limited sensing capabilities. In an effort to further improve the kiosk's ability to interact and respond to their environment, the Smart Kiosk project (Christian & Avery, 1998) was initiated as an "aware" information kiosk that detects and tracks prospective clients and conveys this awareness. The study concludes that people react positively to the presence of the face, underscoring the original premise of the importance of improved human-machine interaction. The continuous evolution of technology over the last decade has led to the development of increasingly sophisticated autonomous or semi-autonomous virtual humans. Cassell et al. (2002), for example, built upon the research developed on embodied conversational agents (ECAs) and on information displays in mixed reality and kiosk format in order to display spatial intelligence. ECAs leverage people's abilities to coordinate information displayed in multiple modalities, particularly information conveyed in speech and gesture. Mixed reality depends on users' interactions with everyday objects that are enhanced with computational overlays. The authors describe an implementation, MACK (Media lab Autonomous Conversational Kiosk), which uses a combination of speech, gesture, and indications on a normal paper map that users place

on a table between themselves and MACK. Research issues involve users' differential attention to hand gestures, speech and the map, and flexible architectures for Embodied Conversational Agents that allow these modalities to be fused in input and generation.

Another important factor to consider when discussing kiosks, is the concept of usability by the public. Kules, Kang et al. (2001) broach the theme in their paper where they describe a novel set of design principles and guidelines to ensure the immediate usability of public access systems, namely: Immediate Attraction, which uses the most attractive content ("treasures") to demonstrate the system and invite use; Immediate Learning, which supports zero-trial learning where users should be able to use the interface after observing others or using it themselves for a brief period of time; and Immediate Engagement, which encourages users to immediately interact with content, providing immediate reward and avoiding interrupting users.

These principles and guidelines were formulated while developing the PhotoFinder Kiosk, a community photo library. The observations and log data compiled from user input were essential in providing specific guidance for practitioners, as well as a useful framework for additional research in public access interfaces.

All three guidelines proposed by Kules, Kang et al. (2001) were fully incorporated in the developed kiosk interface. Given the differences intrinsic to an automated survey, additional usability features were introduced specifically targeted toward surveying, where the rewards are relative—nothing is given to the user but the survey experience. Following the engagement phase, a further principle was established to provide endurance from the user, i.e., arguments to maintain his or her commitment and interest in completing the questionnaire. These solutions encompassed non-verbal

approaches to express opinion, extra-large buttons, and slider controls, and system interactivity elements guide the survey progress. These guidelines and their implementation are detailed in Chapter 4.

It is furthermore important to consider the application of automated kiosks in the realm of self-service technologies. Given that the emphasis in the academic literature has focused almost exclusively on the interpersonal dynamics of service encounters, there is much to be learned about customer interactions with technology-based self-service delivery options. Self-service technologies (SSTs) are increasingly changing the way customers interact with firms to create service outcomes (Meuteur, Ostrom, Roundtree, & Bitner, 2000). Meuteur et al. (2000) describe the results of a critical incident study based on more than 800 incidents involving SSTs solicited from customers through a Web-based survey. The authors categorize these incidents to discern the sources of satisfaction and dissatisfaction with SSTs. The authors present a discussion of the resulting critical incident categories and their relationship to customer attributions.

Overall, the advantages of developing and perfecting the automated Kiosk services are clearly evident in the myriad of studies carried out over the past decade. Despite the uncertainties associated with any emerging technology, the underlying potential in the amount and quality of data that can be obtained through these systems is of immense value. The analysis of the results of an automated survey can be even more representative of user's true feelings regarding the system than the paper-based survey (Blignaut, 2004). The layout has also shown to be crucial to attractive, information-conveying kiosk systems (Borchers, et al., 1995). The layout used in the Iguaçu study attempted to minimize the respondent burden and create a friendlier type of machine-user

interaction. The kiosk automation developed in this study also focused on diminishing what is referred to as "operational survey burden," i.e. the costs, the needed for survey specialists, and the lack of tradition in carrying out visitor social studies—all of which represent significant hurdles in obtaining survey data in Brazil's protected areas.

2.2.3 Machine-Human Communication through Virtual Humans

A closer look at the social relationship between humans and virtual humans was carried out by Park (2007). The author conducts a theoretical analysis on virtual humans or embodied conversational agents (ECAs). He analyzes a range of human-human relationship models and research that might provide insights to understanding the social relationship between humans and virtual humans. This involves investigating several social constructs (expectations, communication, trust, etc.) that are identified as key variables that influence the relationship between people and how these variables should be implemented in the design for an effective and useful virtual human. This theoretical research contributes to the foundational theory of human computer interaction involving virtual humans.

Virtual Human is an intelligent computer simulation of a human personality. They are generally a modular construction with voice or text input, a brain that figures out what is said, and with an output system that delivers useful, expressive responses. They may have an animated robotic character face that talks to the audience though synthetic speech, with-lip synch and emotional expression (Plantec, 2003).

Cowell (2003) examines the effectiveness of enhancing human-agent interaction through the use of nonverbal behaviors. His work focuses on the variables facial expression, eye contact, gestures, paralanguage, and posture. Figure 2.2 shows the taxo-

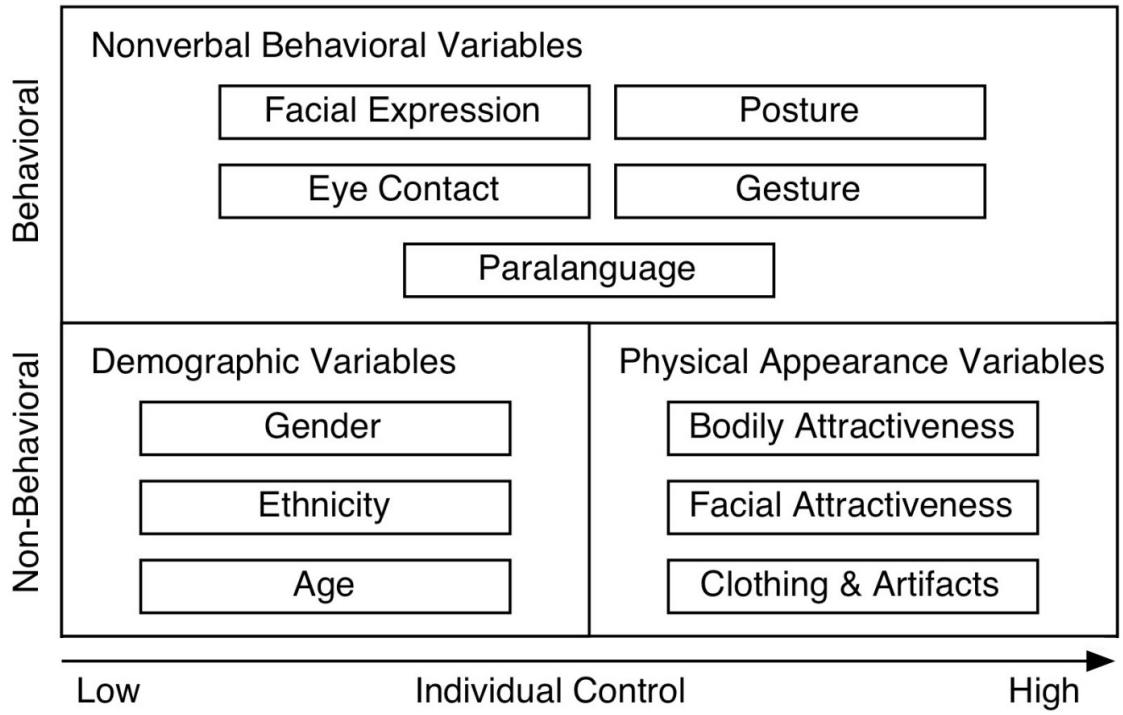


Figure 2.2: Taxonomy of nonverbal behavior (A.J. Cowell & K.M. Stanney, 2003; de Meuse, 1987)

nomy of nonverbal behavioral variables and non-behavioral variables such as demographic variables, physical appearance variables.

The taxonomy below focuses on human characters. It does not include a taxon regarding the type or species of the virtual character, which would reflect the usage of non-humans agents, as is the case of the present study. Nevertheless, the non-verbal behavioral variables were applied to the chosen life-like animal virtual character, which was computer-manipulated to show human-like expressions.

The results indicate that by including trusting nonverbal behaviors, the perceived credibility of a computer character was enhanced, although addition of trusting bodily nonverbal behavior provided little in addition to trusting facial nonverbal behavior. Perhaps more importantly, a character expressing non-trusting nonverbal behaviors was

perceived to be the least credible of all characters examined (including a character that expressed no nonverbal behavior).

The results corroborate with the concept that the face is the primary site for communication of emotional states and hence the primary signaling system to communicate such states (Knapp, 1978). Ekman & Friesen (1981) categorized the different facial expressions into seven major messages, or emotions, namely happiness, surprise, sadness, fear, anger, disgust and interest. Cowell (2003) considers smile as perhaps the most important facial characteristic when expressing credibility. The character should also show movements such as eye blinking, eyebrow movement and slight movements of the head, during a conversation (Massaro, Cohen, Beskow, & Cole, 2000). The results from these studies suggest that there may indeed be benefit to endowing computer characters with nonverbal trusting behaviors, as long as these behaviors are accurately and appropriately portrayed. Such behaviors may lead to a more trusting environment and positive experience for users. The cues presented in these papers were fundamental in developing the traits of the virtual interviewer character of this study, which was based on an anthropomorphic animal.

Cutler (2009) examined the feasibility of a computer-based program that alleviates the human resource challenge associated with blind photoarrays (photoarrays in which the investigator is blind to the suspect's identity). Students watched videotaped crimes and attempted to identify the perpetrators from photoarrays conducted by a "virtual officer" who responds to simple voice commands or by research assistants playing the role of investigators. The student investigators and virtual officer produced comparable identification performance and student reactions to the photoarray

procedures. Results of this evaluation study are encouraging, and the authors recommend further laboratory and field-testing of the virtual officer technology for conducting blind lineups.

Gong (2007) researched the essential theoretical question of how people identify humanlike but clearly artificial, hence humanoid, entities in comparison to natural human ones. This identity categorization inquiry was approached under the framework of consistency and tested through examining inconsistency effects from mismatching categories. Study 1 (N = 80), incorporating a self-disclosure task, tested participants' responses to a talking-face agent, which varied in four combinations of human versus humanoid faces and voices. In line with the literature on inconsistency, the pairing of a human face with a humanoid voice or a humanoid face with a human voice led to longer processing time in making judgment of the agent and less trust than the pairing of a face and a voice from either the human or the humanoid category. Female users particularly showed negative attitudes toward inconsistently paired talking faces. Study 2 (N = 80), using a task that stressed comprehension demand, replicated the inconsistency effects on judging time and females' negative attitudes but not for comprehension-related outcomes. Voice clarity overshadowed the consistency concern for comprehension-related responses. The overall inconsistency effects suggest that people treat humanoid entities in a different category from natural human ones.

2.2.4 Affective Computing

The term "affective computing" is commonly referred to as computing that relates to, arises from, or influences emotion (Picard, 1997). Given the essential role of emotion in both human cognition and perception, as demonstrated by recent neurological studies,

affective computers have great potential in assisting humans and machines alike in better improving performance. The growing interest in the topic of affective computing is driven by a wide spectrum of promising applications in many areas such as virtual reality, smart surveillance, perceptual interface, etc. Affective computing concerns multidisciplinary knowledge background such as psychology, cognitive, physiology and computer sciences. Tao and Tan (2005) discuss the several issues involved implicitly in the whole interactive feedback loop. Various methods for each issue are discussed in order to examine the state of the art. The authors conclude the study with an in-depth discussion of some research challenges and potential future directions.

One of the most prominent published studies dealing with affecting computing is done by Picard (1997), who presents and discusses key issues in this realm, dealing specifically with models that are proposed for computer recognition of human emotion. The author delves into new applications, which are geared towards computer assisted learning, perceptual information retrieval, arts and entertainment and human health and interaction. She concludes that advances in affective computing, coupled with new wearable computers, will provide the ability to gather new data necessary for advances in emotion and cognition theory.

Aside from the aspect of computer recognition of human emotion, another relevant aspect in affective computing is the use of physiological measures as evaluators of user experience. Several authors over the past decade have attempted to better quantify user enjoyment through the use of these kinds of measurements (Mandryk, 2005). This topic is particularly challenging, as current methods of evaluating success in the realm of affective computing environments are sparse and insufficiently robust.

Moreover, success isn't defined in terms of productivity and performance but in terms of enjoyment and interaction. Mandryk (2005) deals mainly with the efficacy of physiological measures as evaluators of collaborative user experience with play technologies. The author's study revealed distinct physiological responses in the body when the subject played against a computer versus against a friend. These results were corroborated in the subjective reports submitted by the participants and represent an initial step in gauging physiological responses to objectively evaluate a user's experience with collaborative play technology.

Given the historic lack of appropriate sensing devices, physiological measurements are not commonly used in emotion-related human–computer interaction (HCI) research or affective applications. Moreover, existing systems often don't live up to the high requirements of the real life in which such applications are to be used. Peter, Ebert and Beikirch (2009) broach the physiological processes affective applications rely on today, and commonly used techniques to access them. This study provides a much-needed analysis in the field of physiological sensing, delving into the requirements of affective applications for physiological sensors. The study concludes with a design concept, which meets the requirements as well as exemplary implementations including evaluation results.

User modeling has recently emerged as a promising tool in the creation of interactive entertainment (Tanenbaum & Tomizu, 2007). However, only preliminary investigations have been done into the potential applications of user modeling in interactive narrative, primarily in the realm of character-driven story architectures (El-Nasr, 2004) and multiplayer mixed reality games (Natkin & Yan, 2006). Tanenbaum and

Tomizu (2007) describe a prototype for an interactive multimedia story project called Scarlet Skellern and the Absent Urchins (SSAU) where they explore how user interaction can modify non-plot-centric presentational elements of a story. They carry this out by implementing a simple user model that gauges the effects of the interaction, which in turn drives the elements of the narrative environment. Overall, SSAU represents a promising venue for exploring a variety of new applications for adaptive narrative techniques and for non- plot-driven interactive narratives.

It is argued that physiological computing has enormous potential to innovate human–computer interaction (HCI) by extending the communication bandwidth to enable the development of 'smart' technology. The review paper by Fairclough (2009) provides an overview of the development of physiological computing systems that employ real-time measures of psychophysiology to communicate the psychological state of the user to an adaptive system. The paper focuses on six fundamental issues for physiological computing systems through a review and synthesis of Fairclough (2009) existing literature, these are: (1) the complexity of the psycho-physiological inference, (2) validating the psycho-physiological inference, (3) representing the psychological state of the user, (4) designing explicit and implicit system interventions, (5) defining the biocybernetic loop that controls system adaptation, and (6) ethical implications. The paper concludes that physiological computing provides opportunities to innovate HCI but complex methodological/conceptual issues must be fully tackled during the research and development phase if this nascent technology is to achieve its potential.

The research developed thus far in the realm of HCI clearly illustrates the potential of this emerging technology. Fairclough (2009), Peter et al. (2009), among

others, clearly point a few of the conceptual issues which must be overcome in order to fully take advantage of HCI in the coming years. The work developed in this dissertation serves to significantly enhance the development of HCI technology, providing not only a solid theoretical base, but also numerous case studies and statistically relevant data that can be used to substantiate the premises developed.

2.3 THE USE OF MULTI-SENSING DATA COLLECTION

2.3.1 Effect of Environmental Variables on Natural Area Visitors and Tourists

Several papers broach the topic of environmental variables and their effect on tourists. Richardson and Loomis (2004) apply a contingent visitation analysis to estimate the effects of changes in the global climate and resource variables on nature-based recreation demand. In this study, a relatively small proportion of respondents indicated that their visitation behavior would change under the hypothetical climate scenarios, and the net effect of the scenarios on visitation is slightly positive. The results of the contingent visitation analysis were compared with the results of a regression analysis of historic visitation and climate variation for methodological assessment, and were found to be in close agreement. Snuffling and Scott (2002) estimated the magnitude of climate change anticipated for Canada's 38 National Parks (NPs) and Park Reserves, constructing seasonal temperature and precipitation scenarios for 2050 and 2090 using the Canadian Centre for Climate Modeling and Analysis (CCCma) coupled model (CGCM1).For each park, they assessed impacts on physical systems, species, ecosystems and people, as the foresaw widespread changes to marine and fresh water hydrology, glacial balance, waning permafrost, and predicted increased natural disturbance, shorter ice season biome

shifts, and changed visitation patterns. They recommend, among other things, incorporating climate uncertainty into park plans and management. Potential Visitor Response to Climate-Induced Environmental is explored by Scott, Jones and Konopek (2008). In this study, the scientific community and park professionals recognize that climate change could have important implications for conservation policy and park planning. To explore this question in the context of Canada's Rocky Mountain national parks, a visitor survey was administered (n = 809) in two national parks: Banff and Waterton Lakes. The environmental change scenarios constructed for the early and mid-decades of the 21st century were found to have minimal influence on intention to visit. The environmental change scenario for the latter decades, under a high emission climate change scenario, was found to have a negative effect on intention to visit, as 36% of respondents indicated they would visit the parks less often and 25% not at all. Visitors most likely to be negatively affected by climate-induced environmental change were nature-based tourists from overseas, motivated by the opportunity to view mountain landscapes and wildlife.

Another environmental variable that greatly affects the quality of the visitor experience is human-caused noise. Manning et al. (2007) conducted a research in which five recordings of a mix of natural and human-caused sounds recorded in Muir Woods National Monument, California were prepared and incorporated into a visitor survey. Respondents rated the acceptability of each recording, reported the types of sounds they found pleasing and annoying, and identified the recording that best represented the soundscape conditions of the park during their visit. The resulting data helped formulate standards of quality for the soundscape of the park. This type of research could greatly

benefit from an automated multimedia survey system that is capable of playing audio cues or even systematically measuring actual sounds or noise at the time the electronic questionnaire is applied. This type of physical-cognitive integration was a core design guideline for the present study. The concept of multi-sensing was pilot-tested for weather and river flow, but the system was developed with built-in functionality for gauging a wide range of local physical and social environmental phenomena.

CHAPTER 3: METHODS

The following study objectives address the goal of making useful social visitor information widely available for the protected area (PA) planning and management.

- To develop an automated, on-site multimedia visitor survey system, including the creation or integration of software and hardware, and a social communication strategy;
- To test the feasibility and effectiveness of a fully automated electronic survey terminal.
- As part of feasibility, to assess the level of engagement and the burden on survey respondents who are being surveyed in a leisure setting. and finally
- To assess the potential to integrate environmental data, such as real-time weather conditions and river flow, on variables such as visitor satisfaction in order to enhance visitor information and inform management actions.

The interdisciplinary methods used in this study, are taken from fields as diverse as survey research, computer program development, social communication, character animation, biophysics, and marketing research. After describing the study location, Iguaçu National Park, the six subsequent phases involved in the development and evaluation of a prototype automated, multi-media visitor survey system. The proposed prototype initially integrates traditional survey methods with Computer-Assisted Survey

Information Collection (CASIC) as described by Couper & Nicholls II (1998). Runtime data gathered includes biophysical, environmental, social science measurements of an improved quality and lower cost (Groves et al., 2004). In the chapter, a methodological framework is established, and then the development of the prototype survey system is described including the kiosk, hardware, software and multi-dimensional sensing devices. Finally the survey development, sampling strategy, survey data analysis, and analysis of overall system effectiveness methods are described.

3.1 THE CASE STUDY SITE IGUAÇU NATIONAL PARK, BRAZIL

3.1.1 Location

The Iguaçu National Park is located in southern Brazil, in the State of Paraná, between coordinates 25º05' to 25º41' Latitude South and 53º40' to 54º38' Longitude West (Figure 3.1).

The Iguaçu Falls were discovered in 1549 by a Spanish explorer, Cabeza de Vaca, who stumbled onto the falls while trailing down a river. The nearby city of Foz do Iguaçu was mostly a small village until the late 1960's when it experienced a big economic boom with the construction of the Friendship Bridge and the Itaipu Dam. The world economy's recession resulted in a temporary lull in tourists, lasting until 2004 when the city's economy started to grow up again.

As one of Brazil's top tourist destinations, Foz do Iguacu's economy is largely reliant on tourism to sustain itself. The bulk of industries in Foz do Iguaçu are textile and electrical energy related. Because of the importance of tourism, domestic and international crises can affect the city's economy by reducing tourist numbers and by bringing fewer consumers to Ciudad del Este.

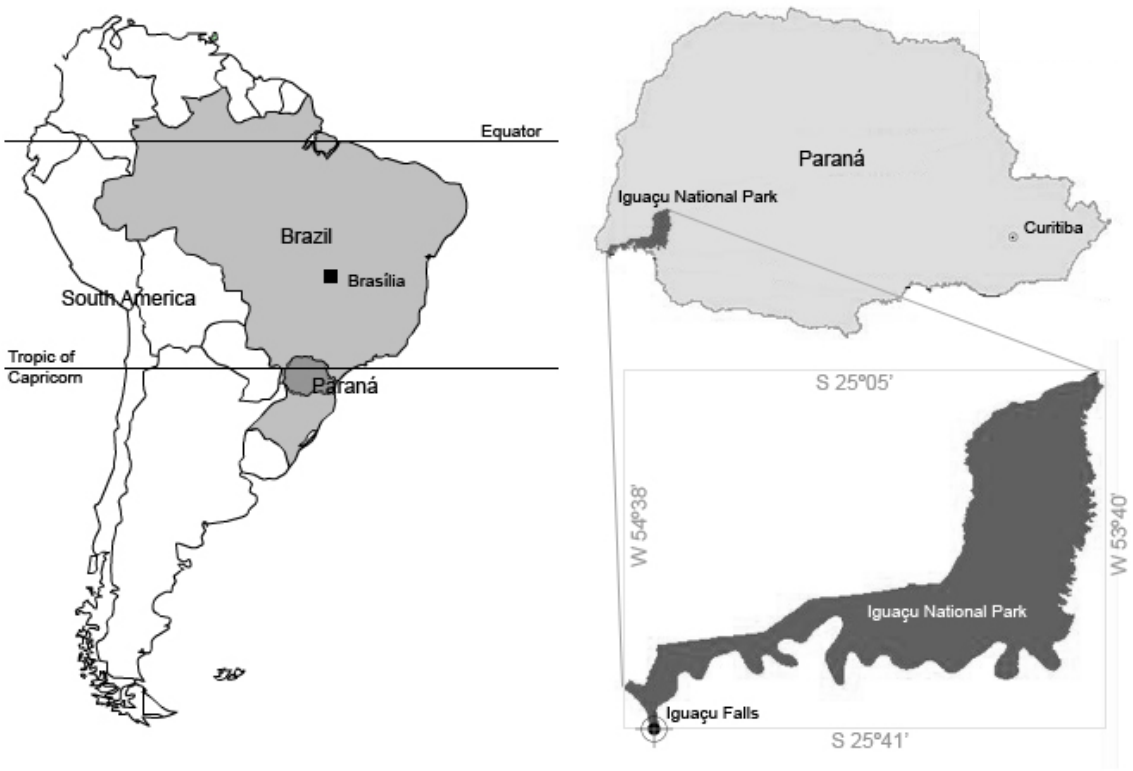


Figure 3.1: Location of Iguaçu National Park.

The city boasts over 100 hotels and inns to accommodate the constant inflow of tourists from all over the world. One of the main attractions is the Iguaçu Falls, which has a flow capacity equal to three times that of Niagara Falls. Part of the falls is on the Brazilian side and part are on the Argentine side, including the "Garganta do Diabo" ("Devil's Throat" in Portuguese), the tallest of the falls, which is 97 m (318 ft.) high. Other attractions include the Iguaçu National Park, the Itaipu Dam, the Triple Frontier, the Omar-Ibn Al-Khattab mosque, and the Bird Park.

Many residents of Foz do Iguaçu work in the neighboring city of Ciudade del Este, in Paraguay, which is a duty-free market. The Friendship Bridge is where all the trade between the two countries takes place. A second bridge (Fraternity Bridge) connect

Foz do Iguaçu to Puerto Iguaçu, in Argentina. The city is in a strategic location due to its positions in Mercosul.

Foz do Iguaçu currently boasts a population of 325,137 inhabitants, whilst the Triple Frontier region, Puerto Iguazu and the rural areas have a total of 820,000. The city's heterogeneous population is composed of a wide range of immigrant communities, such as Arabs, Chinese, Germans, Italians, Portuguese, etc. The city has the second largest Chinese community in Brazil and the third largest Islamic community. The city is predominantly Roman Catholic but a relatively large minority of Muslims and Buddhists are represented in the city as well. The city itself has a large mosque and a Buddhist temple.

The climate of Foz do Iguaçu is sub-tropical, with two distinctive seasons; one humid and hot in the summer and another, dry and cold, in the winter. The city's annual average temperature is 23.8°C (74.8°F), but can be as high as 40°C (104°F) in the summer (highest) or as low as -5°C (23°F) in the winter (lowest). The average in the summer is 26.5°C (79.7°F) and in the winter 15.4°C (59.6°F). The climate of the city is generally hot or warm throughout the year, due to the relatively low altitude (standing only 173 m (567 ft), above sea level). Generally, the city is sunny during the year, but rain is fairly common during the spring and in the summer. The weather of the city, however, changes very constantly, because the region where the city stands is the zone where frequently three fronts meet. As consequence, it is not uncommon to see temperatures as high as 35°C (95°F) and in the summer as low as 8°C (46°F) in the city and, frequently, thunderstorms.

3.1.2 The Place's Highlights

Iguaçu is one of the best structured and most visited national parks in the country, attracting over 1 million visitors per year, including international, national and local visitors. This is a remarkable number of visitors given the statistical trends in other Brazilian parks. The Iguaçu Falls is the park's main attraction (Figure 3.2). The Iguaçu

Figure 3.2: Photos showing an aerial view of the Iguaçu Falls, between Brazil (left rim) and Argentina (right rim).

National Park was listed as Human Natural Heritage in 1986 (UNESCO, 2010) in recognition of the singularity and the magnificence of the cataracts, alongside the ecological relevance of the forest ecosystem protected there.

The Iguaçu Falls form an outstanding sequence of waterfalls in the Iguaçu River, a long u-shape rim, about 75 meters high. The Falls encompass over 200 waterfalls with

an average volume of over 60 thousand cubic feet/sec per second. The region marks the triple border among Paraguay, Argentina and Brazil, being the Iguaçu River the natural divide between the latter two. The Falls spread over the two sides of the border, and are protected by national parks in both countries. In the Brazilian side an early land acquisition of a core area of 1,008 hectares was made in 1916 by the State Government of Paraná for the establishment of a park (Andrew J. Cowell & Kay M. Stanney, 2003) but only in 1939 a national park was effectively created in the surroundings of the Falls. After successive additions to its original area, the park currently has a continuous area of 185,262.5 hectares (457,791.73 acres) with perimeter of 420 km (IBAMA, 1999).

The park is located within the Atlantic Forest Biome and is coterminous to the Argentinean Iguazu National Park, compounding a mosaic that preserves the most significant patch of continuous forests in interior lands of the southern region. The Atlantic Forest is considered one of the world's most threatened mega-diversity zones and its overall coverage in Brazil is currently reduced to only 7% of its original area. Iguaçu National park had is visitation substantially increased as consequence of a revitalization plan put forward in 1998, consolidating its position as the most visited park in Brazil.

3.1.3 Visiting the Park

What the visitors actually experience while visiting the park was assessed through field observation carried out during the study's initial phase (Figure 3.3). The author also repeatedly experienced all visitation options available to the public in different days of week and tourism season, as well as different weather and river flow conditions. This baseline knowledge provided the basis to develop the pilot study that fitted perfectly on the visiting processes typical of Iguaçu National Park. The

Figure 3.3: Photos taken in the Park during the fieldwork showing prevalent aspects of the visitor experience: Visitation begins at the visitor center (A); from where thematic buses (B) take visitors to the Cataratas' Trail trailhead. Walking this trail (C) is the main way the Falls can be seen, along with encounters with Park's wildlife (D). The trail's last stretch goes aerial up to the brink of Floriano Fall rim (E), which crossing means being soaked by fall's almost permanently spraying aerosol (F).

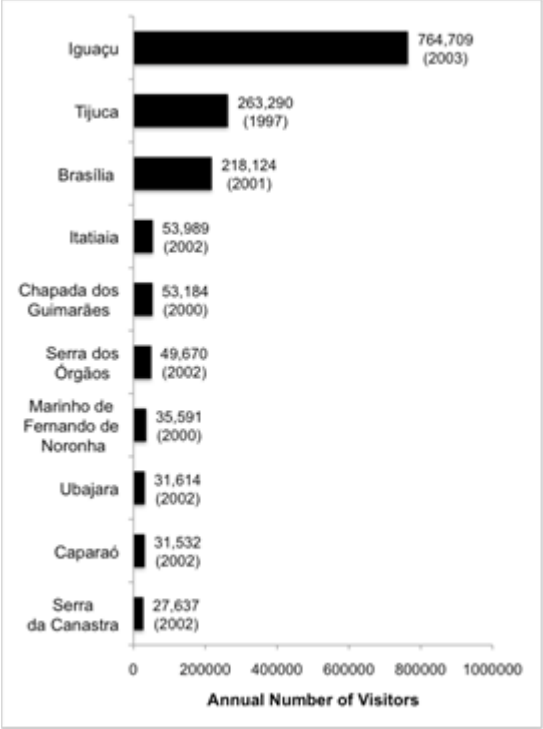
visitation areas can be divided between those operated under concession and those that are park operated. Most concessions are new to the park; they were implemented after a major revitalization

plan carried out in 1998. Although providing a wider spectrum of recreational opportunities, to take part on these activities one has to pay fees that are not included in the park entrance fee. Visitor attending the concessions usually also hike the Catarata's Trail, the park's flag attraction, without paying any extra. This attraction was considered the most representative experience of visiting Iguaçu National Park and is part of the description of park visitation.

The Cataratas' Trail, a cement paved walkway (Figure 3.3 C) running along the edge of Iguaçu Canyon, provides a sequence of look-out points just off of a long stretch of the Falls and passing in front and on top of several waterfalls. The trail has a branch, a panoramic elevator and look out points very near the Floriano Fall (Figure 3.3 E), which is the main fall in the Brazilian side. Along this stretch it is most likely all visitors will experience being soaked by the waterfall's abundant spray, even in a sunny day (Figure 3.3 F). Along with the bus service, this trail is the only feature included in the Park's entrance fee. The park's fee policy has four different categories for entrance fees depending on the visitor origin. The value increases based on being a local, national, international from nearby neighbor countries or general international visitor.

3.1.4 Park's Visitation

Figure 3.4A contains the number of visitors at each of the top 10 most visited National Parks in Brazil. The figure clearly illustrates the popularity of Iguacu National Park with well over 700 thousand visitors in 2003 and up to circa 1 million in 2007 (Figure 3.4 B). Tijuca National Park came in second, with significantly less visitors (263,290) in 1997. Despite some variation, the number of visitors at Iguacu over the past 8 years has remained well above all other parks in Brazil (Figure 3.4 B). From 2000 to 2007, the maximum visitation occurred in 2005 (1,084,239 visitors) and the minimum in 2002 (645,832). A marked increase in visitation occurred from 2002 through 2005 with the total number of visitors increasing by 67% during this time.



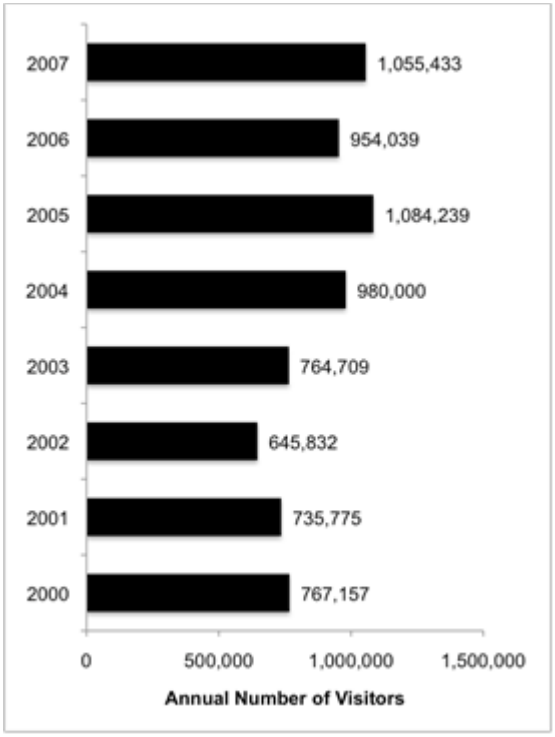


Figure 3.4: (A) Yearly number of visitors at the top 10 most visited National Parks in Brazil (MMA, 2004) (B) Number of visitors at Iguaçu National Park per year (Parque Nacional do Iguaçu, 2007)

3.1.5 Local Collaboration

The design phase, as well as the subsequent survey development and implementation, was carried out within the Iguaçu National Park. The strategy adopted for designing the new survey system involved extensive interaction with protected area managers, at both park and system levels. Most of the development work was carried out during one-year in residence in the park. The interaction with the managers began with an initial meeting held at the IBAMA's Brasília headquarter office with the Director of Ecosystems and the General Coordinator of Protected Areas. Managers provided input as to how the proposed system of collecting visitor information could improve system level PA management. Additionally, the prospect of using the tool to support the planning of activities that could be offered both to visitors within the park and as part of a broader regional integrated

ecotourism development strategy were highlighted. This type of functionality, which is to be contemplated in subsequent methodological developments, should incorporate strong multimedia capabilities that can portray life-like depictions of future recreation scenarios, thus allowing researchers and managers to gauge visitors' appreciation and interest. Another point highlighted in this meeting was the possibility for real-time monitoring of the outcomes of visitor surveys. An ideal condition pinpointed would be to have an electronic park system panel that shows in real time how visitors to a number of parks evaluate their experiences. Such information would allow system level managers to direct actions and resources to where they are most needed.

At the park level three formal meetings where held with the park's chief, the chief of management affairs, and visitor management specialists. Case study goals and implementation strategies were presented and visitation characteristics and problems were discussed. Park officials considered the survey to help plan for remodeling the Catarata's trail, the main park attraction and one of the few infrastructure components that was not revamped in the 1997 park revitalization. Another meeting was held prior to initiating the survey with the general visitors where the final questionnaire was evaluated and approved. Latter many park and concessionaire employees and officials, including the chief of management affairs, took the survey. A third meeting was held prior to the researcher's departure for a prolonged stay in the US to explain the system's automation capabilities and how the researcher would be able to manage most of the terminal's functionalities remotely and to discuss support for any necessary action that requires physical intervention at the survey site. A similar meeting was held with the director of

Cataratas S/A, the company that holds the concession to manage most of the services and infrastructure associated with the visitation.

Beside the formal meetings, the proximity carrying out the work from an office in the park's administration building enabled almost daily informal contact with park managers and staff. Such interaction provided a deeper understanding of the opportunities, constraints and orientation that ultimately shape the overall park management. This interaction helped researchers to design a survey system that incorporated subtle issues of interest to managers. While in residence, both the park area and its buffer zone were field-surveyed. The primary researcher took in many visitor activities by following groups or observing them at specific points of interest having the potential as survey locations.

3.2 DEVELOPMENT OF METHODS

This section describes which survey method or combination of methods (multimode) best fulfills the study's three core operational goals:

- To increase the availability of information about PA visitors to for managers;
- To increase visitor survey data quality and density, while making the data multidimensional;
- To decrease visitor survey costs and, broadly, to decrease the operational survey burden;

In support of the first goal, the literature review about survey application in PA management has pointed out the importance of visitor information for decision making processes regarding resource allocation and the quality of visitor's experience. The literature also provided many examples where social surveys were conducted in different

contexts in parks and in ecotourism studies. Despite some instances where surveys are systematically carried out, the literature review flagged the overall gap in availability of such information for managers, particularly in Brazil, which faces structural scarcity of funding and human resources to conduct survey studies.

The literature also revealed that survey research has not evenly benefited from technological advancements. While computer-aided survey methods have revolutionized automated processes of survey data collection, as in web surveys, on-site surveys remain largely reliant on paper and pencil, face to face interviewing. The versatility and programmability of computers improves the ways socio-psychological information can be acquired, by seamlessly integrating respondent's cognitive data to affective psycho-physiological inputs as well as site-specific environmental events and conditions.

Finally, the literature in the fields of kiosk-based services and marketing research on one side and virtual characters, talking heads, and embodied agents on the other side provided the foundation for idealizing computer-run site interviews that do not rely on the traditional human interviewer. The potential to use multimedia resources and virtual reality to run fully automated kiosk-based survey stations was made evident.

To operationalize the stated goals, the suitability of the predominant automated visitor survey methods was evaluated. Four parameters were established to assess the functionality of the survey methods:

Fully Automated: requires no interviewer, or manual data entry; runs standalone; is remotely controllable; and allows real-time data retrieval—increasing data availability through the reduction of cost and other operational burdens;

Multimedia Support: allows for the use of text, pictures, panoramas, audio, video, animation, Virtual Reality, and 3-D videos in rich interactive environments—allowing for a complex depiction of the survey's subject and a reduction in the questionnaire burden (with implications for automation).

Multi-sensing Support: allows the attachment and control of environmental and biophysical sensors (affective computing), whose data dynamically integrates with the data from the cognitive surveys—increasing the quality and information of survey data.

On-site random sampling: has the capability of performing randomized sampling (or reliably equivalent sampling) on the actual population of interest (the park visitors)—increasing the generalizability of estimates and yielding tailored social information for PA management.

Survey Methods Considered

Though a mail survey does not require an interviewer, it entails extensive manual data entry and data preparation. It has minimal multimedia support and relies on the use of printed pictures as response eliciting arguments. Mail surveys are commonly preceded by a brief face to face interview at study sites, aggregating on-site random sampling capability to this mixed method. However, mail surveys are not multi-sensory nor can they provide a sustained sampling of the whole population of PA visitors over time.

In parks and tourism destinations, the adoption of face to face paper-based interviewing is still a frequent choice. This method has its strength in establishing a robust random sampling of visitors. A technologically-updated variation of this method is the computer-aided personal interviewing (CAPI) which entails multimedia support and

limited multi-sensing support. Common to both, however, is the need for a costly interviewing staff, a strong limiting factor when considering making survey studies more commonly available.

Computer-aided telephone interviewing (CATI) did not show any characteristic that intersects the study goals. Computerized self-administered questionnaire (CSAQ) usually is not a standalone method, rather a way a survey is completed in different modes of survey applications. Nevertheless, it holds the essential capability for questionnaire and data collection automation and multimedia support.

Kiosk-based survey methods have the strength of being fully automatable and supportive of multimedia-rich survey designs. Multi-sensing capability has not typically been included with kiosks, despite the potential to do so. Multi-sensing support was not found for survey methods intended for application with the general public and is typically restricted to laboratory settings in experiments with individuals or small groups, such as those involved in the Implicit Association Test (IAT). An important shortcoming of these systems is the general inability to draw samples that are representative of the population due to their inherent passivity and dependence on volunteer respondents.

Video surveys sent as VHS or DVDs are capable of supporting multimedia elements such as still imagery, video footage and audio cues. Web surveys, also referred to as on-line surveys or even computer-assisted web interviewing (CAWI), incorporated the most advanced technological developments to date. They are fully automated and deliver real-time survey data over the internet; they support a variety of multimedia elements, which are, however, limited by the respondent's computing experience, computer type and internet connection speed. Also web-based, e-mail surveys can be

fully automated but have limited multimedia capability. Table 3.1 shows all the survey methods considered and their characteristics regarding the functionality demanded by this study. Cells marked with "yes" identify characteristics of current methods that were, to varying extents, incorporated in this study's method development.

Table 3.1: Survey methods with potential utility for meeting study objectives

Survey Method(s)	Characteristics			
	Fully Automatable	**Multimedia Support**	**Multi-sensing Support**	**On-site Random Sampling**
Mail Survey	No	No	No	No
Face to Face (on-site paper-based)	No	No	No	Yes
Face to Face + Mail Survey	No	No	No	Yes
Computer-Aided Telephone Interviewing - CATI	No	No	No	No
Computer-Aided Personal Interviewing - CAPI	No	Yes	No	Yes
Computerized Self-Administered Questionnaire (CSAQ)	Yes	Yes	No	No
Kiosk-based	Yes	Yes	No	No
Video Survey (by Mail)	No	Yes	No	No
E-mail Survey	Yes	No	No	No
Web Survey (on-line)	Yes	Yes	No	No

No single method or mixed mode survey could accomplish all of the functions to fulfill this study's operational goals. As a result, the study develops an integrated survey methodology that incorporates all the required functions. The new method can be referred

to as computer-aided kiosk interviewing (CAKI) which aims to integrate the characteristics of existing methods and innovates where necessary, to handle complex multidimensional, automated survey tasks. The operationalized pilot survey in Iguaçu National Park in 2008 required the development of needed software consisting of a suite of specialized survey program modules, which make up the kiosk interviewing software suite (KISS). It was also necessary to design and manufacture the kiosk with its demonstrative automated survey machine (AIM) (Figure 3.5). A comprehensive explanation of CAKI's conceptualization and development is presented in Chapter 4.

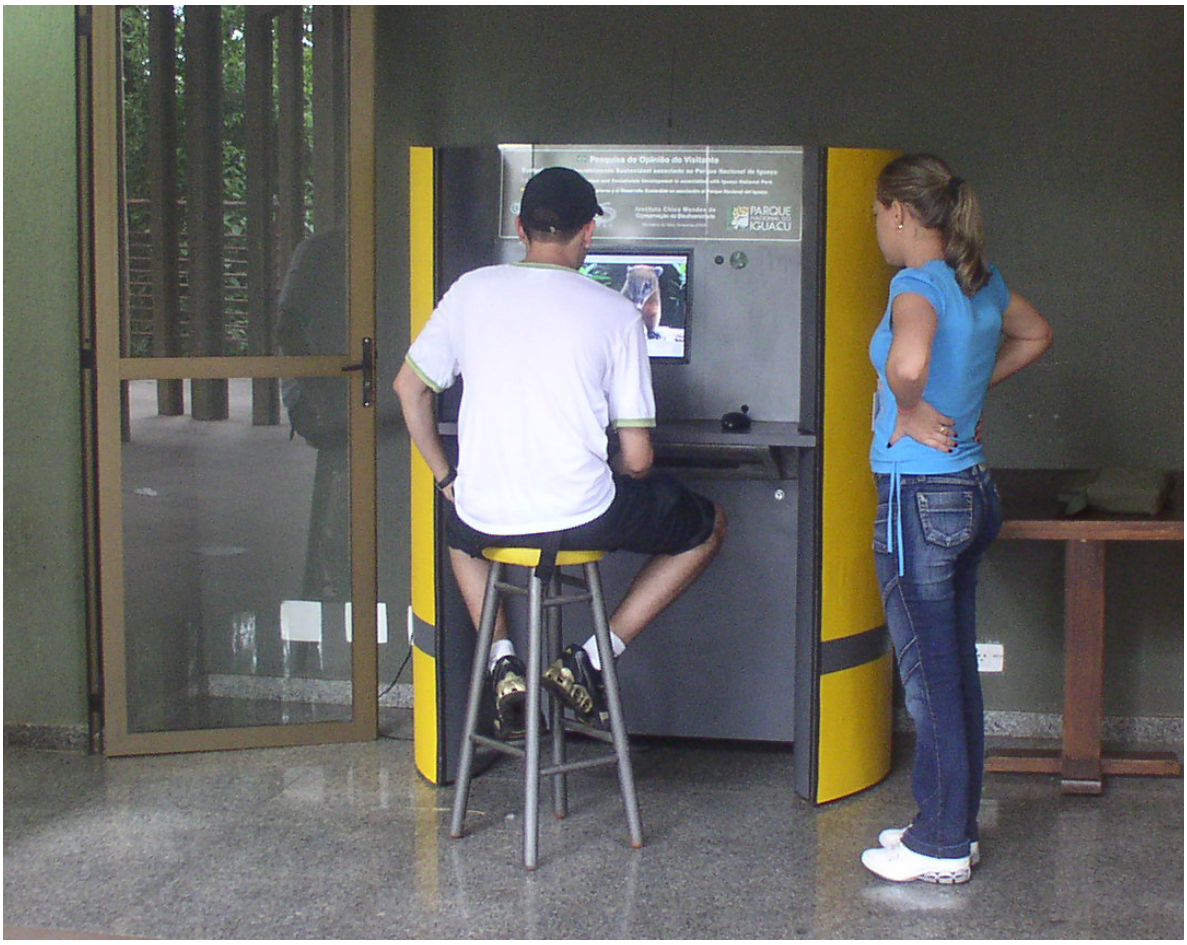


Figure 3.5: Automated interviewing machine tested in Iguaçu National Park carries out visitor survey based on the CAKI method, developed in this study and fully described in Chapter 4.

3.3 SURVEY DEVELOPMENT

The survey development process had three phases: the definition of the questionnaire content and length; the design of the questionnaire layout, which included multimedia elements; and the electronic application of the questionnaire, involving navigation design and usability issues. All three aspects were intertwined for on-site survey automation. The latter two involve core solutions that form the base for CAKI and the survey application. These are explained in detail in Chapter 4, sections 4.1 and 4.2.

The content of the questionnaire developed for the pilot-survey had the main goal of testing the overall functionality of the automated survey system by testing variables in the cognitive, environmental and affective realms. The choice of questions included in the questionnaire followed the content of well-established park visitor and ecotourism surveys (Moore et al., 2009; National Park Service, 2007; Wallace & Pierce, 1996). The questions were those that managers invariably seek answers for such as satisfaction, activity participation and demographics. The questionnaire also included questions linked to a meta-survey (see Item 3.6.2). To test different types of survey items, close-ended with single and multiple response as well as open-ended question formats were included. Table 3.2 shows the characteristics of the items used in the pilot survey.

The survey utilized of 12 questions, chosen from a universe of approximately 70 pre-developed electronic questions designed to take a total of about five minutes to complete. On-site personal interviews usually take from 5 to 15 minutes (Burns & Graefe, 2002; Moore, et al., 2009). Given limitations intrinsic to the automation process, a conservative approach was adopted where the total survey time was in the lower end of this range.

Table 3.2: Questionnaire's contents by subjects, group and type of questions

#	Content	Group	Type
1	Participation in recreation activities currently offered to park visitors	Participation level	Close-ended, multiple answers
2	Visitor's overall satisfaction in visiting Iguaçu National Park	Perceived experience	Close-ended, single answer
3	Fulfillment of visitor's expectations in visiting of Iguaçu National Park	"	"
4	Visitor's possibility in visiting Iguaçu National Park again in the future	"	"
5	Recommending a trip to the park to visitor's relatives, friends or acquaintances	"	"
6	Participation in tourism activities currently offered to visitors in the region of Foz do Iguaçu	Participation level	Close-ended, multiple answers
7	Visitor's overall satisfaction with the visiting of Foz do Iguaçu, the gateway to visit the Park	Perceived experience	Close-ended, single answer
8	Visitor's origin	Demographics	"
9	Visitor's age	"	Open-ended, numeric keying
10	Visitor's gender	"	Close-ended, single answer
11	Visitor's feelings regarding the simplicity, or complexity, in operating the electronic terminal	Meta-survey	Close-ended, single answer
12	Visitor's assessment regarding the time actually spent in answering the electronic survey	"	Close-ended, single answer

[1] Textual and multimedia depictions of the used questionnaire can be found in Appendixes 1 and 7 respectively

The process of survey development involved five phases: conception; appraisal; tests; corrections; and application. The draft questionnaire was presented to graduate academic committee members during meeting held at the Colorado State University. Revisions were incorporated and a quasi-functional version of the survey system and its questionnaire was demonstrated to a group of Faculty who happened to be social scientists who visited the study site in July 2007. Their comments and suggestions guided the final version of the instrument that was subsequently tested with the public.

Testing with park visitors had two phases. As each question was tested in a pre-release terminal installed inside the Iguaçu National Park administration building with park staff and invited visitors. The researcher observed, asked and answered questions and was able to establish standards for the complexity levels of navigation and screen instructions. Observation and questions, among other things, probed the effectiveness of media used as well as respondent motivations and reactions to the way answers were displayed and might be considered by respondent.

A final revised version of the survey was submitted to general public pilot testing during January 2008. A sample of over 800 respondents provided qualitative and quantitative data to assess the effectiveness of the instrument before it was used in survey the year-long study. Programming and coding errors were found and corrected by analyzing early generated data and comparing screen shots with binary answered data, an auditing feature of the system. Another issue dealt with was an undesired navigation effect triggered by frenetic pressing of the "Next" button (not done by pre-test participants) throughout the questionnaire. The system reacted by skipping several questions at once. A programming solution was implemented.

Because of the type of questions and survey design chosen, some features that are used elsewhere were not included in the final questionnaire. These include the "no answer" option; the option to skip questions; branching; random assignment of questions, question order and alternatives; and range and consistency check.

The 12-question survey contains over 50 variables, considering the system variables (paradata) and the variables associated with the multi-sensing capability of CAKI. A depiction of the final questionnaire can be found in Appendix 1.

The automated survey application was designed to start the interactive process with a language choice. The beginning screen featured 3 large buttons for the languages Portuguese, English and Spanish. Upon choosing one language the questionnaire was then presented by a virtual character who introduced the survey with the following script:

> Hello! Welcome and thanks for participating in this research for the visitors of Iguaçu National Park. Before we begin, let me introduce myself: my name is Quiii!, I am a virtual Multilanguage speaking raccoon. Not many like me around here. I am here to make this computer interview a bit more human, well, ok, a bit more animal. So, dear visitor, it's very important to the park to know more about you, your experiences here and your expectations about possible new experiences for the future. The interview is quick and easy, you can keep track of your progress by looking at the panel at the bottom of the screen. So, let's go! See you at the end, ok? Bye-bye for now!

After the introduction, the interview began with the 12-question questionnaire which took an average of 4 minutes to complete. After all the questions were answered,

the survey program displayed the virtual character again, who ended the survey with the following script:

> Thank you for your time and willingness to help us out with this research. Your opinion is a fundamental ingredient for us to make the park increasingly more efficient in environmental conservation and to offer you the ideal opportunity to live your best moments in Nature. Thanks again and bye-bye. See you around!

Afterward, a silent credits screen was displayed briefly and the survey was recycled to the beginning screen again (language choice), ready for a new interview. The kiosk version of the survey can be seen in Appendix 7.

3.4 SAMPLING STRATEGY

3.4.1 Sampling the Population of Park Visitors

The sampling schemes – The population of interest in this study was defined the as being the visitors of Iguaçu National Park. The sampling strategy used on-site sampling mixed methods aimed at preserving randomness. On-site computer-automation poses challenges. One can conceive four ways in which an automated survey system can approach a population sample (Table 3.3). This research employed the human-mediated sampling mechanism to establish baseline referential survey data that could be compared with an unmanaged option. Interview protocols were followed to assure a Systematic Sampling scheme with the mediator (host) inviting participation of the first person approaching the terminal after previous survey was completed.

Table 3.3: Characteristics of sampling mechanism suitable for on-site automated interviewing

Sampling mechanism	Characteristics
Human-mediated [1]	A trained survey facilitator approaches the population members following a pre-defined sampling scheme like Systematic Sampling and directs selected subjects to the automated interviewing booth.
Survey Voucher [2]	A coded voucher is handed out to members of the population in entrance gates, ticket counters, permit receipts, etc., by staff that is not strictly related to the survey process. The distribution follows a pre-defined sampling scheme like Systematic Sampling. The automated survey terminal records the voucher's code to track the randomly selected subset within the interviewed grand sample.
Unmanaged [1]	The automated terminal is left alone and the population members voluntarily approach it after an enticement strategy performed by multimedia communication resources that involves a charismatic virtual host or interviewer.
AI-mediated [2]	Similar to unmanaged but with the active participation of the terminal program in randomly defining the selected sample. It can be supported by presence sensors, people counters and employ a more sophisticated mode to address the passersby in a personal, artificially intelligent way.

[1] mechanisms implemented in the research; [2] envisioned complementary mechanisms

Lottery sampling was employed to define the days the terminal would operate under either mediated or unmanaged sampling mechanism to assure the data sets could be compared under the randomness assumption.

Intrinsic sampling limitations – Due to budget limitations and difficulty of moving the kiosk, only one interviewing station and location were available for this experiment. In an ideal scenario there would be multiple survey stations and locations.

Additionally, another concern was the time each visitor would spend completing the interview, and consequently the time the equipment would be unavailable for another interviewee. In order to determine the duration of the interview, it became important to understand the visitor flow in the location. Iguaçu National Park does not allow visitors to

enter the park with their own vehicles. There is an internal bus service, with buses departing at 15 minute intervals. Additionally, a small number of visitors use charter buses to get to the main attraction zone. This transportation scheme resulted in waves of visitors making their way to specific locations. Groups of visitors tend to pass followed by intervals with little or no visitors passing thru. This means the terminal could be idle for 15 minutes and then be occupied when a busload of visitors pass by.

Population and sample sizes – A three week test sample was compared to visitor totals from past years (derived from monthly averages) (Table 3.4) and then compared to pre-computed sample sizes needed for given population sizes. For the 95% confidence level and a 5% sampling error a population of 100,000 would require a sample of 383 individuals (Vaske, 2008). The number of interviews yielded between January 4 and 27, 2008 was over 800, which indicated the terminal was more than capable of generating adequate population samples. The survey was planned to take an average 6 minutes so it would yield about 10 interviews per hour if the kiosk terminal had no idle period. This is an unlikely situation given the bus intervals, explained above.

Table 3.4: Visitation at Iguaçu National Park

	2007	**2006**	**2005**
Total annual visitors	1,055,433	954,039	1,084,239
Total monthly visitors *	88,868	90,927	94,878
Daily average *	3,173	3,247	3,388

* Monthly and daily visitors for February (Parque Nacional do Iguaçu, 2008, personal communication)

Table 3.5 shows the actual number of visitors that were sampled during an 8 hour day over a 22 day period.

Table 3.5: Park visitation and sampled visitors during February 2008 (Experimental sample)

		Visitors		
			Sampled	
Day	**Date**	**Total (N)***	**(n)**	**(%)**
1	2/02/2008	4,336	57	1.3
2	2/03/2008	9,572	69	0.7
3	2/04/2008	5,064	51	1.0
4	2/05/2008	5,573	53	1.0
5	2/07/2008	4,352	03	0.1**
6	2/10/2008	3,788	08	0.2**
7	2/11/2008	2,735	42	1.5
8	2/12/2008	4,701	50	1.1
9	2/14/2008	2,928	40	1.4
10	2/15/2008	3,120	46	1.5
11	2/16/2008	3,635	36	1.0
12	2/17/2008	4,069	47	1.2
13	2/18/2008	2,311	46	2.0
14	2/19/2008	3,492	41	1.2
15	2/21/2008	3,132	40	1.3
16	2/22/2008	2,197	41	1.9
17	2/23/2008	3,762	49	1.3
18	2/24/2008	3,226	50	1.5
19	2/25/2008	2,223	34	1.5
20	2/26/2008	2,909	36	1.2
21	2/28/2008	2,570	46	1.8
22	2/29/2008	2,167	24	1.1
Totals		81,862	909	1.1

* Visitor count; data from the Park's only entrance gate (Parque Nacional do Iguaçu 2008, personal communication);
** Outlier sampling day due to technical operational problems, yielding an atypical sample.

Population sampling was then calculated based on park entrance data and the terminal performance. Equation 3.1 gives estimates of the sample sizes based on population and study parameters and Equation 3.2 estimates the margin of error (Dilman, 2007; J. Vaske, 2008).

$$n = \frac{(N)\,(p)\,(1-p)}{(N-1)\,(B/C)^2+(p)\,(1-p)}$$ Equation 3.1

Where:

n = completed sample size needed

N = size of population

p = proportion expected to answer a certain way (0.5)

B = level of sampling error (0.05)

C = Z statistic (1.960 for 95% confidence level)

Resolving Equation 3.1 for February's total population of 81,862 visitors resulted in an estimated sample of 382 interviews for 95% confidence level and sampling error of 5%. Since 909 interviews were obtained in that same period the larger sample represented an actual margin of error of 3.2%, which was calculated using Equation 3.2.

$$B = C\sqrt{\frac{p\,(1-p)}{n} - \frac{p\,(1-p)}{N}}$$ Equation 3.2

The above figures are based on the assumption that each visit corresponds to a different person in the considered populations, which may not be the case if one person were to visit the park multiple times over several days. Official Park's statistics do not differentiate visits from visitors, labeling it "visitation." After initial tests, the expected sample and margin of error were also calculated for the data collected between January and December 2008, for high and low seasons, as well as for weekdays, weekends and holidays. The Year-round sample yielded 3,995 interviews for an annual park visitation of 1,154,046 people. The expected n for a margin of error of 5% at 95% confidence level for an expected

population of 1,018,427 (averaged visitation of the last 4 years) would be 384 interviews. With extended sampling period, the margin of error was reduced to 2.9%.

Response rate – Calculation of non-response for automated on-site interviewing poses some theoretical challenges since it is not well defined when a potential respondent decides not to take the survey. Three scenarios were devised: (A) the denial occurs when a person identifies the terminal as a research venue and simply ignores it; (B) the denial occurs when the prospective respondent triggers the interview, begins watching the multimedia automated invitation and instructions and leaves the terminal before the presentation ends; and (C) the prospective respondent stays at the terminal till the first questions shows up and then leaves without marking any answer. Each case conveys a slight different type of rejection. The CAKI survey method allows us to sort out non-respondents types B and C from survey respondents. Blignaut (2004) acknowledged the fact that, when faced with a computerized self-administered questionnaire, many respondents simply open the survey screen to see what it entails and then either walk away without clicking on anything or after a few random mouse clicks. Notwithstanding, he acknowledges and summarizes the validity of self-administered electronic surveys by stating that:

> "a computerized self-administered questionnaire can give valuable feedback with regard to the usability of a touchscreen-based information kiosk, provided that only those surveys that are filled out completely are taken into account. One is even tempted to assert that, if analyzed this way; a CSAQ can be even more representative of users' true feelings regarding the system than a paper-based survey under supervision of a surveyor"

Blignaut (2004) considers that only the records of respondents who filled out the survey form completely or skipped only one item should be considered when analyzing the feedback. The author of the present study contends that the consideration of a survey response with only one incomplete item seems arbitrary, since depending of the type of study

and questionnaire structure, it could be argued that a response which addresses only one item can provide valuable information. An example would be a first question of a park survey assessing the impact on visitation of a temporary trail closure for planned long-term maintenance. Should visitor's opinion on that specific matter be requested and yield the collection of 400 responses, it would be enough to support a decision-making process, regardless of whether some respondents did not answer further questions on same topic or other on aspects. The point to be further explored is to what extent traditional response rate assessment holds significance with on-site automated interviewing.

Given these considerations, CAKI response rate was tentatively estimated based on the number of people who began and abandoned the survey and the people who completed all or part of it.

3.4.2 Placement of the Survey Kiosk

As with face-to-face surveys, the decision of where to contact the public to conduct the interview is a key factor for a representative sample. Iguaçu National Park has multiple attraction locations besides the Visitor Center (VC) that is also the park's main entrance.

A human can walk a few steps and approach a person or group that is targeted while a kiosk machine will always be sitting at the same spot, hence the specific positioning of the survey terminal is important for adequate sampling – especially since only one kiosk terminal was utilized.

The Visitor Center (VC) might seem a logical choice but three problems ruled it out: 1) charter buses and vans from local tourism agencies do not pass through the VC and may represent a profile that differs from the visitors that do not purchase the services of local tourism agencies; 2) visitors arriving at the VC have not yet experienced the

park, limiting the range of questions that can be asked; and 3) when the visitors are exiting the park at the VC there is a rush to board departing vehicles, especially those who are ushered by a tourism guide.

The second place evaluated for kiosk location was the outbound bus stop (Figures 3.7 and 3.8) near a visitor complex with restaurants, snack shop, souvenirs shop, restrooms, and other services. This area is called Porto Canoas (PC) and the dynamics of visitors was observed for several days. In PC visitors have just finished visiting the Iguaçu Falls, are relaxed, immersed in the visit, and there is typically a waiting period for bus. Some bus departures would randomly preclude visitor participation. Although promising, Porto Canoas also had some problems: 1) handicapped visitors tend to go to the accessible main falls' lookout point without necessarily going to PC afterwards; 2) a portion of the visitors that did not use the park's internal bus system tend to embark in their outbound transport before going to PC, and 3) the visitor experience is not complete until after the bus ride out of the park, and 4) the critical location for deploying the kiosk terminal was outdoors, requiring a much more robust—and expensive—terminal construction.

The third place possible location was a facility that sits near the main fall's lookout point (Figures 3.8, 3.9, and 3.10), the Espaço Naipi (EN). Observation of visitor behavior at the EN showed this spot as having a set of optimal conditions. Virtually all visitors pass thought the place either because it intercepts the much used and pre-paid Catarata's Trail, or because it is the access point to the park's the main lookout points. Near this point the handicapped that cannot walk the trail can still enjoy a handicapped accessible popular view of the falls. Espaço Naipi is also frequented by those that do not

use the park's bus system and is enclosed under a roof, making it possible to build a system using non-weatherized computer components.

There are two downsides to the EN location: 1) it is close to the most breathtaking view of the Falls visitors may be overwhelmed by nature's spectacle possibly making it difficult to obtain unbiased judgments about problems that might have been experienced and 2) the visit is not yet finished. These issues were judged to cause minor impact for the specific survey. The EN is considered by many to be the visit's grand finale and the bus system has been already experienced coming into the park. Evaluating the feasibility of the automated survey system did not seem to be affected by any of these factors.

At other potential sites, additional costs not included in the entrance fee were thought to affect the representativeness of the sample, especially for Brazilians who make less than foreign visitors. Espaço Naipi was selected as the sampling location. Once the site selection was made, a fine tuned internal location was selected that had: lower noise levels, was visible to visitors leaving the overlook and close enough to make its purpose visible, and which was not intrusive to the overall experience.

The system was designed and built so that it could be moved should a selected location reveal any flaw. The cabinet, though sturdy and heavy, was equipped with a set of casters and the network connection was wireless-based. An extended observation of the visitor flow in Espaço Naipi and kiosk utilization ratified the location. Figures (3.6 to 3.10) show the macro and micro-location of the tested automated survey system.

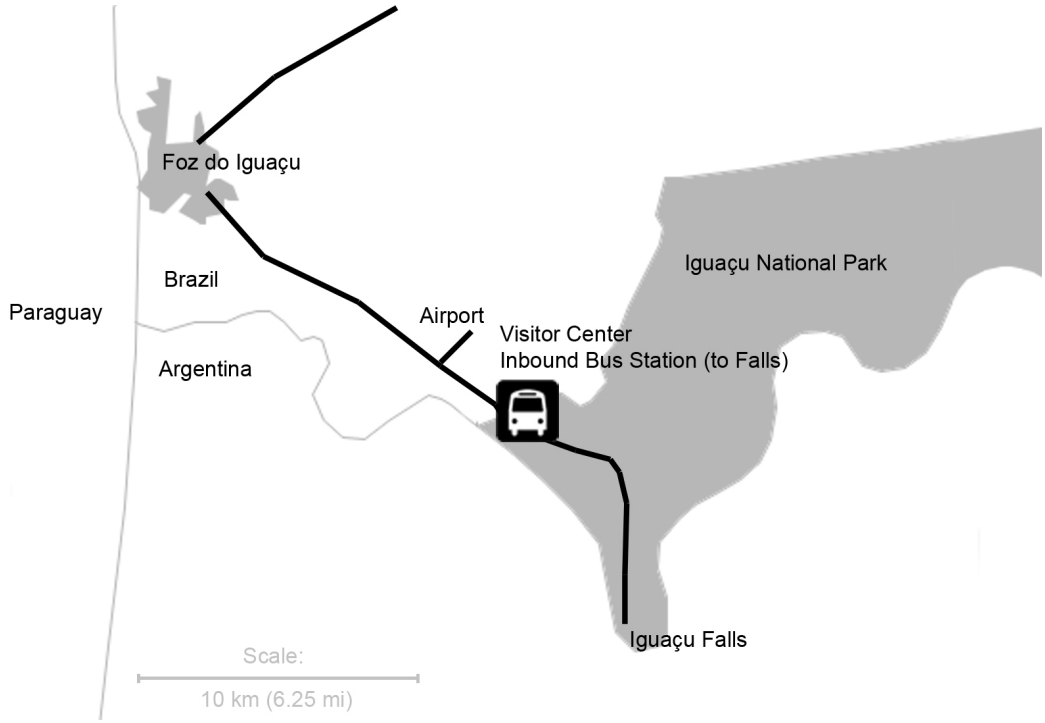


Figure 3.6: Localization diagram showing the study area relative to the city of Foz do Iguaçu.

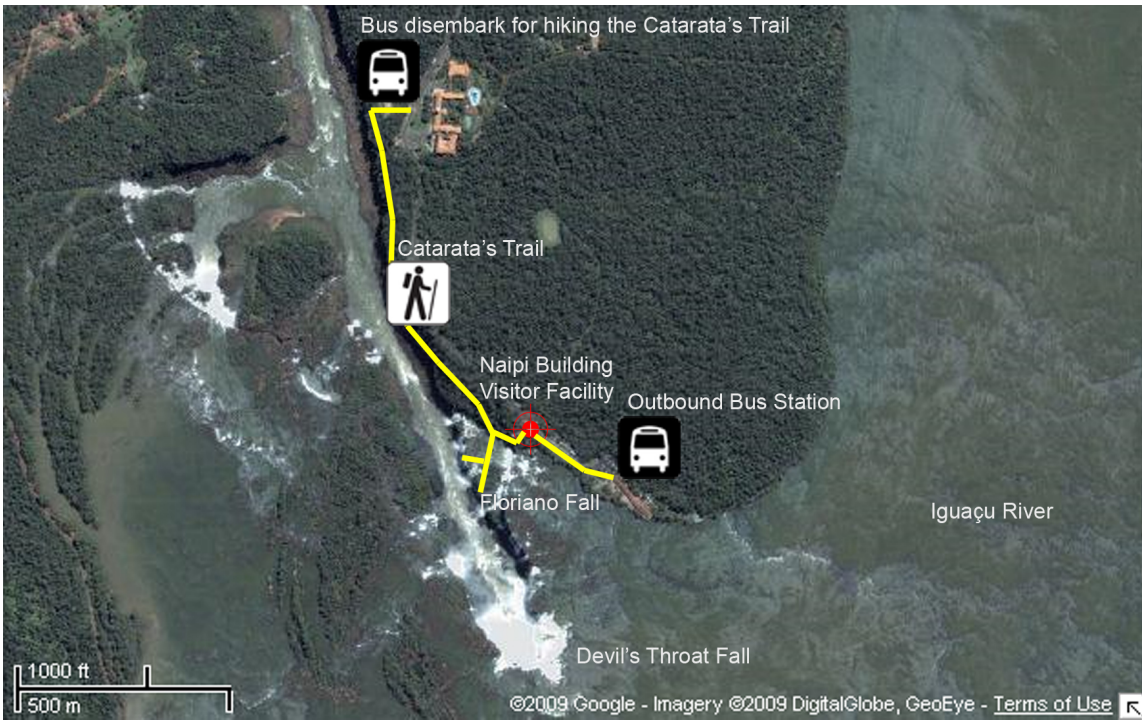


Figure 3.7: Localization diagram showing the survey terminal placement (target sign) relative to the Catarata's Trail.

Figure 3.8: Localization diagram showing the survey terminal placement (target sign) relative to the Espaço Naipi.

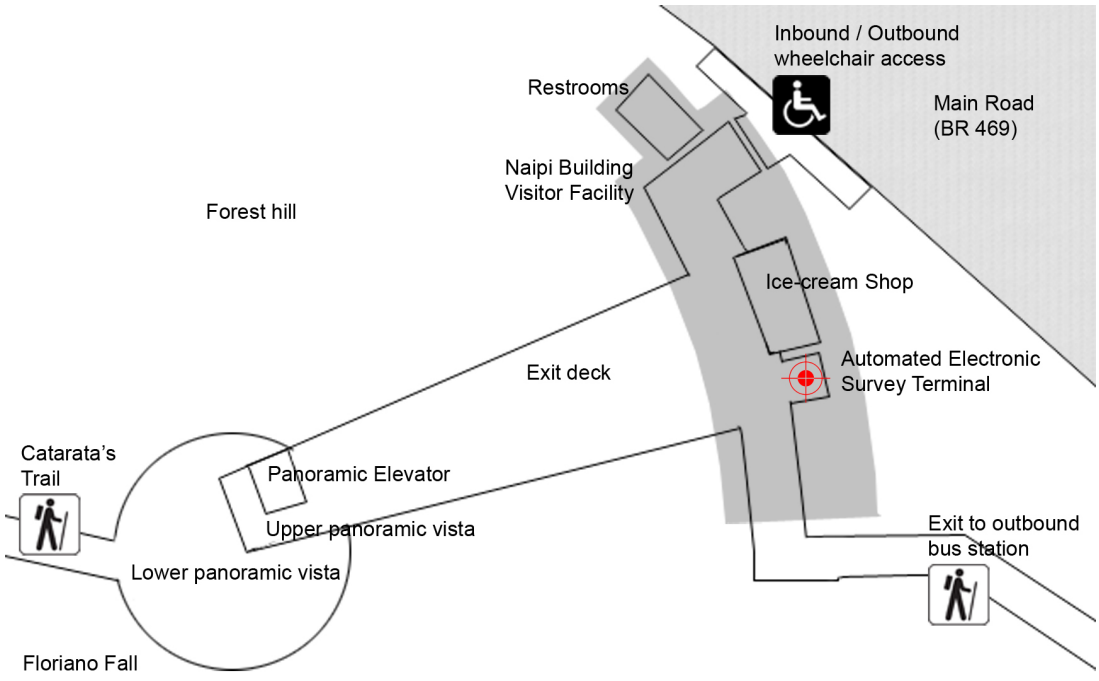


Figure 3.9: Localization diagram showing the survey terminal placement (target sign) relative to the interior of the Espaço Naipi

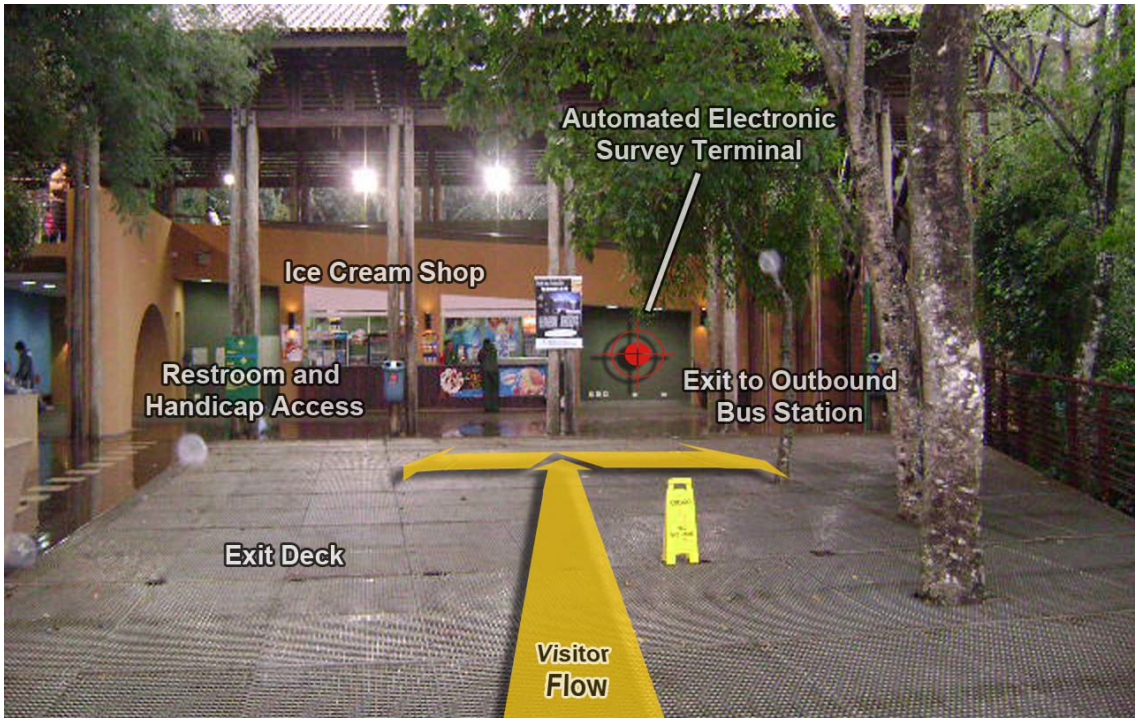


Figure 3.10: Localization diagram showing the survey terminal placement (target sign) relative to the visitor flow within of the Espaço Naipi

3.5 DATA ANALYSIS

3.5.1 Introduction

The objectives of the study required three principal areas of data analysis: (i) the effect of terminal operation mode or terminal management on study's variables, which tested the feasibility and effectiveness of a fully automated electronic survey terminal. (ii) the evaluation of questionnaire burden, for which descriptive statistics were calculated and presented in table, charts and scatterplots. And, (iii) the determination of the effect of environmental variables on social cognitive variables. Table 3.6 shows an overview of the tasks, the prescribed statistical analysis, the programs and functionalities used to perform them and the chapters in this Dissertation where the corresponding results are shown.

Table 3.6: Overview of statistical analysis, computer program and results location for each task

Task	Statistical Analysis	Program	Results
Determination of the effect of terminal management (dichotomous IV) on the frequency of study's categorical DVs[1]	Hypothesis testing using Chi-square Test of Independence (*Pearson's χ2*)	IBM SPSS 19 / Bivariate Cross-tabulations	Chapter 5
Determination of the effect of terminal management (dichotomous IV) on the means of study's continuous DVs[2]	Hypothesis testing using F test (*Levene's*) and *t*-test (*Student's t*) and strength of association	IBM SPSS 19 / Independent Samples t-tests	Chapter 5
Baseline information on questionnaire burden and respondent's behavior toward the survey terminal	Descriptive statistics	IBM SPSS 19 / Frequencies; MS Excel 2010/ Scatterplots	Chapter 6
Computation of Heat Index (HI) from continuous IVs Temperature and Humidity	Arithmetic operations of the Heath Index formula	IBM SPSS 19 / Compute new variable	Chapter 7
Computation of a 3-level categorical variable (Heat Index physiological effects) from continuous variable HI	Data transformation	IBM SPSS 19 / Recode into different variable	Chapter 7
Computation of a 3-level categorical variable (River water level ranges) from a continuous variable	Data transformation	IBM SPSS 19 / Recode into different variable	Chapter 7
Determination of the effect of environmental physical variables[3] (categorical IVs) on the means of study's continuous DVs[4]	Hypothesis testing using Analysis of Variance and Post hoc test (*Scheffé's S*)	IBM SPSS 19 / One-Way ANOVA	Chapter 7

[1] Gender, origin, behavior characteristic toward the survey taking, and language choice;

[2] Overall satisfaction with the Park, expectation effectively met, probability of return in future, degree of referring to others, overall satisfaction with the region, age and survey taking runtime;

[3] Sky conditions, heat index and river water level;

[4] Overall satisfaction with the Park, expectation effectively met, probability of return in future, degree of referring to others, and overall satisfaction with the region.

Nominal Dependent variables included respondent's gender, place of origin, survey taking tenacity, and choice of language. The hypotheses can be restated based on the above variables:

H_0: Variables in the group are not affected by the terminal management mode.

H_1: Variables in the group are affected by the terminal management mode.

The chi-square ($\chi 2$) statistic was used to test the independence (or strength of association) of each variable with hosted or unhosted modalities.

Interval variables measured respondent's overall satisfaction with the Park, whether expectations were effectively met, probability of return in the future, likelihood of referring to others, and overall satisfaction with the region. Ratio variables measured respondent's age and survey taking runtime, in seconds. Frequencies, means, variances and standard deviation were calculated for each variable in the group for each of the two levels of the independent variable Terminal Management. Considering μ means in the respondent's population, the hypotheses were restated based on the variables that measured the respondent's characteristics:

H_0: $\mu_1 = \mu_2$

H_1: $\mu_1 \neq \mu_2$

The null hypothesis state that the mean for each variable in the group would be equal for either the Unhosted and Hosted modalities. The alternative hypothesis states that the mean of each dependent variable would be different for each level of the independent variable. Since the dependent variables are continuous and the independent

variable is dichotomous, the Student's t statistic to test the equivalence of means was used. An independent samples t-test to compare the means of the study variables was included in this analysis ($p \leq .05$). Equality of variance was tested for each variable using an F test (*Levene's*) prior to calculating the t-test, which provided parameters for rejecting or failing to reject the null hypothesis.

3.5.3 Effect of environmental variables

The data utilized in this part of the analysis comprised three categorical independent variables: a 5-level nominal variable related to sky conditions and two 3-level ordinal variables related to heat index and river water level. The dependent's overall satisfaction with the Park; whether expectations were met; the probability of returning in the future; likelihood of referring others to Iguaçu National Park; and overall satisfaction with the region are all continuous interval variables. Considering μ means in the respondent's population, the hypotheses were defined for the variables that measured the respondent's perceptions under the varying environmental conditions 1, 2 … n:

H_0: $\mu_1 = \mu_{2\ldots} = \mu_n$

H_1: $\mu_1 \neq \mu_{2\ldots} \neq \mu_n$

The null hypothesis states that the mean for each variable in the group is the same for all environmental conditions. The alternative hypothesis states that the mean of each dependent variable differs for each environmental condition. Since the dependent variables are continuous and the independent variables are level 3 and level 5 categorical variables, a one-way ANOVA was used to compare the means. This test is based on the significance of the *F-ratio* (Means Squares between groups/Means Squares within

groups) that is compared to a theoretical *F* distribution. The Statistical Package for Social Science (SPSS) was used to do the comparisons ($p \leq .05$). In findings where the null hypothesis was rejected, i.e., there was an effect of the independent variable on the dependent variable, a *Scheffé* Post Hoc test was performed to identify the origins of the differences.

Two of the above independent variables; Heat Index and River Water Level were computed from precursor's variables. Heat Index (HI) (Steadman, 1979) is computed from measures of temperature and humidity based on equation 3.3:

$$HI = -42.379 + 2.04901523T + 10.14333127R - 0.22475541TR - 6.83783x10^{-3}T^2 - 5.481717x10^{-2}R^2 + 1.22874x10^{-3}T^2R + 8.5282x10^{-4}TR^2 - 1.99x10^{-6}T^2R^2$$

Equation 3.3 (Steadman, 1979)

Where

HI = Heath Index of apparent temperature

T = ambient dry bulb temperature (°F)

R = relative humidity (integer percentage).

The resulting continuous Heath Index variable was recoded into a 3-level categorical variable that represents the physiological effects caused by the combination of the original variables (Table 3.7) (NOAA, 2010).

River water levels vary in response to seasonal patterns and daily water releases of upstream hydroelectric power generation and were measured daily (Itaipu, 2008) from riverside gauges (Figure 3.15). The survey measured visitors' perceptions during all time of the visitation hours. To minimize the mismatch the water river level changes were computed and rated as "High, "Medium" and "Low" variables.

Table 3.7: Heath Index classes, computed/ recoded HI variable and physiological effects

Variable value[1]	Heath Index value	Physiological effect
0	Less than 80 degrees	Comfortable by most standards
1	80 to 90 degrees	Fatigue with prolonged exposure and activity
2	90 to 104 degrees	Sunstroke, heat cramps, heat exhaustion possible
-	105 to 129	Heat cramps, heat exhaustion likely
-	Over 130 degrees	Will result in heatstroke or sunstroke quickly

[1] Weather conditions during the survey period yielded only HI values of 0, 1, and 2; Adapted from NOAA (2010)

3.6 ANALYSIS OF OVERALL SYSTEM EFFECTIVENESS

3.6.1 Probing the Data Quality of Fully Automated Kiosk Interviewing

A fundamental concept within the CAKI framework is the automation of all steps involved in on-site interviewing, avoiding the use of a human interviewer or facilitator and making part of the data entry and analysis more efficient. This full automation looks to reduce the operational survey burden (OSB), thus increasing the availability of visitor's social data to protected area managers and social scientists. The second study question asks whether an automated survey station can yield data of comparable quality with that of traditional human administered surveys.

To do this, survey participants were randomly assigned to experimental or control groups, thereby suppressing possible bias and increasing internal validity. Both the control group (with face-to-face interviewer present) and the experimental group (automated survey only) were drawn randomly from visitor leaving the main waterfall

overlook. Individuals in the randomly selected control group (C) were given a standardized invitation and a brief explanation of purpose as a traditional face-to-face interviewing process might do. The interviewer led consenting visitor the kiosk and remained and offered help as people took the survey.

The experimental group (E) encountered the electronic terminal by themselves, learned about the survey, and decided to take part in it without any contact from a facilitator. These respondents interacted exclusively with the kiosk automated interface, and a built-in multimedia-based communication techniques that virtually facilitated the survey. Any differences for the dependent variable measures (the survey answers) can be assumed to be due to the survey mode.

Interviewing Protocols - A tri-lingual research assistant was hired to facilitate the interviewing process and trained to use a protocol for approaching and inviting potential respondents to take part in the survey. She consistently positioned herself about 10 ft. away from the survey terminal, facing the visitor flow, in order to intercept people before they associated her with the survey kiosk. Visitors were greeted with a short phase used to establish which language was the most suitable:

"Oi! FalaPortuguês? – Hi! Do you speak English? – ¡Hola! ¿HablaEspañol?"

Depending on the person's answer, she then extended the dialogue in that language. In rare occasions in which the visitor was unable to communicate in any of these languages, she released them with a smile and universal gesture that could be interpreted as "it is ok", or "never mind." Once the communication was established, the invitation followed:

> *"We are conducting a visitor survey to assist the park management to better know the visitors and their experiences while in the park. This is important for the future planning of the park's public use. Could you give us a moment of your attention to*

take part in this study? It is a very short questionnaire, won't take much more than 5 minutes."

She thanked and escorted accepting visitors to the terminal, offering him/her a seat and standing by to help if needed. The methodology used in this step was similar to Computer-Assisted Personal Interviewing (CAPI) in instances where, after a person-to-person approach, the interviewee is lead directly to the handheld or notebook computer. At the end of the survey, the facilitator thanked the respondent for participating and wished then an enjoyable visit. Visitors declining to participate in the survey were also thanked for their attention.

In summary, both datasets had random samples and were based on the exact same questions. Comparing the frequencies and means of each group will allow an analysis of the treatment's effect, i.e., the elimination of the human facilitators.

3.6.2 Evaluating respondent's burden

Another measure of effectiveness of the automated survey system is its ability to draw and maintain visitor interest through system design attempted to minimize respondent burden. Two types of burden were considered: survey-typical and technology-generated. Questionnaire burden is common to most survey applications (Haraldsen, 2002) and involves time spent, understanding of the meaning of questions, potential embarrassment regarding sensitive subjects, and difficulty to follow "navigation and skip" patterns. Technology induced burden relates to ease or difficulty in operating the computer hardware and interacting with the graphical user interface.

To assess the level of engagement and the burden on survey respondents (who are being surveyed in a leisure setting) both, a direct and an indirect approach were

employed. The direct assessment was done using 2 questions at the end of the survey. The first questions used a 9-point multimedia Likert scale ranging from extremely simple (+4) to extremely complex (-4) with neutral point (0) as neither simple nor complex (Figure 3.11). Visitors moved a lever in the survey program's graphical interface that changed a smiley face to represent a 9-point range of feelings related to survey burden or the lack of it. The next question evaluated visitor perceptions about the time spent on the

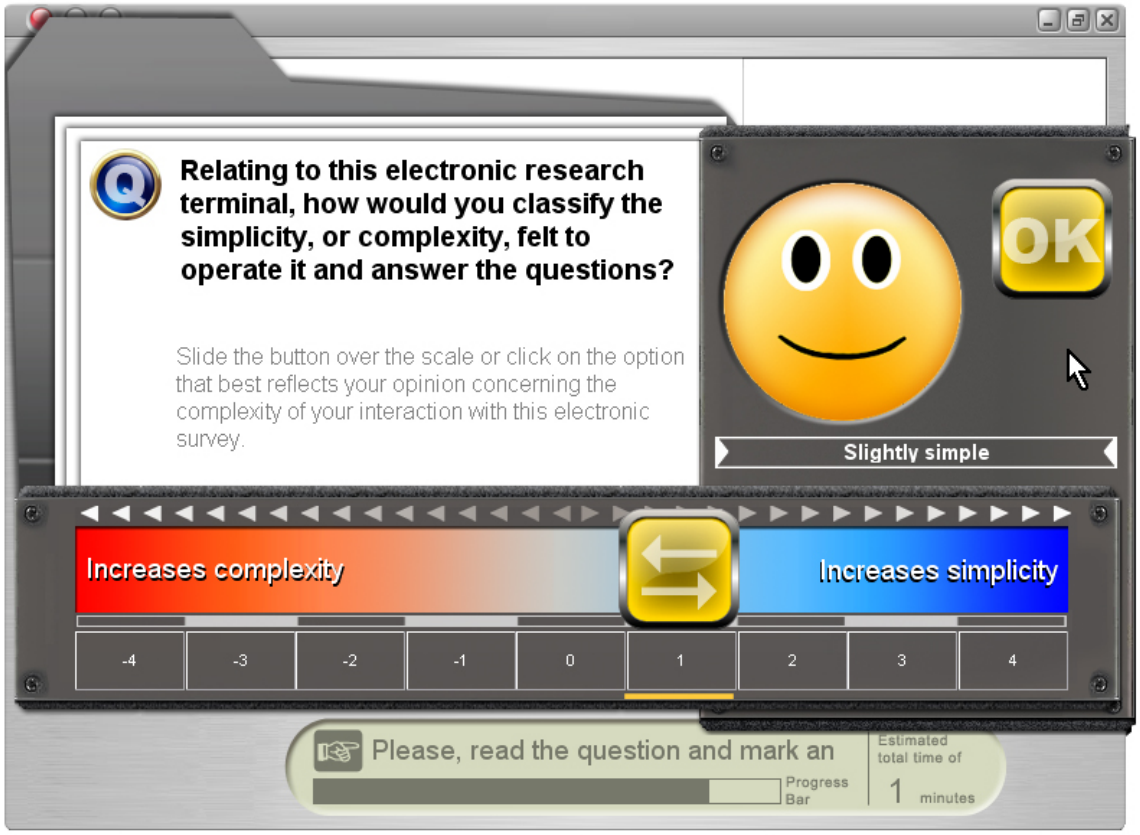


Figure 3.11: Screen shot of question related to evaluation of simplicity/complexity to operate the electronic terminal.

survey again using a multimedia 9-point Likert scale ranging from extremely short to extremely long with neutral point (0) as neither short nor long (Figure 3.12).

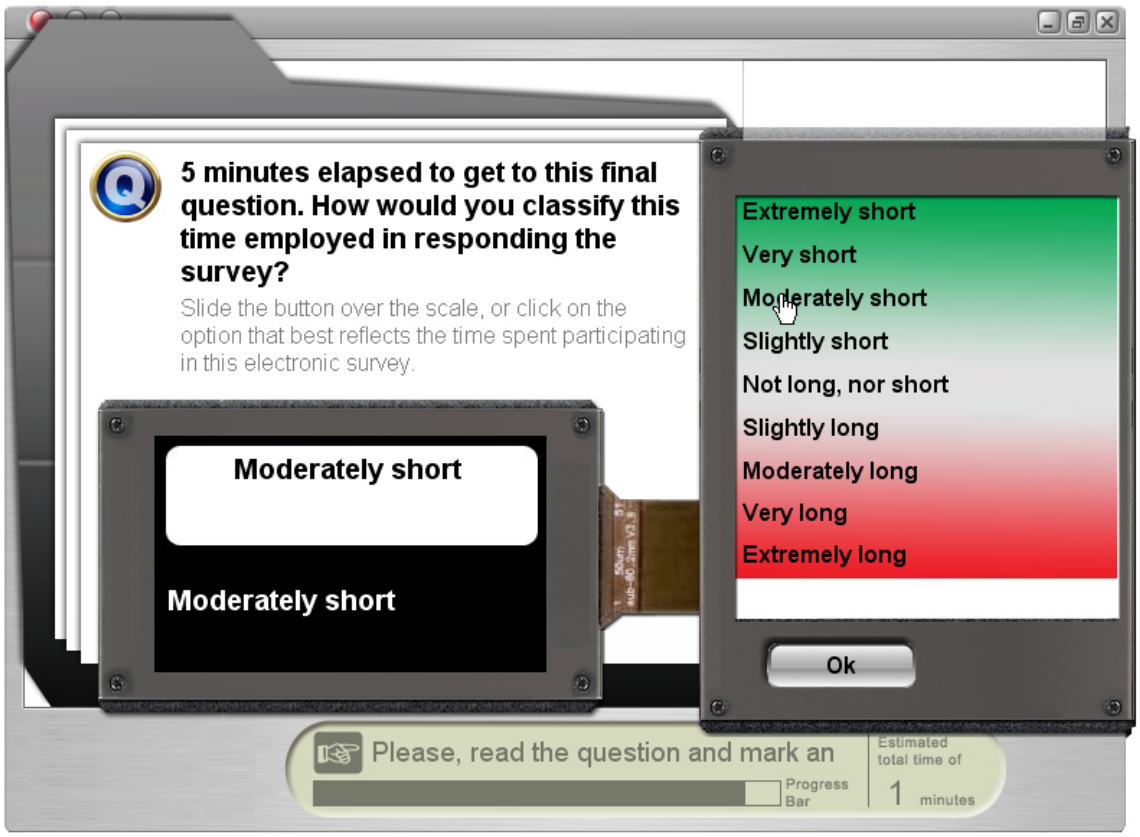


Figure 3.12: Screen shot of question related to evaluation of time spent to take the survey.

The indirect assessment collected paradata about the number of questions answered, and the actual time spent at the kiosk. The terminal software was programmed to record and analyze this information.

3.6.3 Combining Measurements of Social and Environmental Variables

In order to demonstrate CAKI's ability to measure environmental physical factors, weather and river flow, factors experienced by almost all visitors, were measured and later analyzed for their possible effect on the visitor experience. Visitors were not directly asked about environmental conditions. Uneven environmental conditions are acknowledged to affect reported mood (Schwarz & Strack, 1991) and influence social assessments of satisfaction (Crompton, MacKay, & Fesenmaier, 1991). Literature in this area show that these effects

are mostly accounted for when they are the focus of the study (de Freitas 2008). Most visitor surveys, however, still leave the effects of local physical variables as possible sources of unexplained variations on their social variables.

Since the waterfalls are major attractions, it might be expected that fluctuations in river flow (Figure 3.13) would affect visitor appreciation. Expected correlations, however, may not be linear, since variations of river flow are accompanied by other factors like more or less exposition of canyon walls and changes in water turbidity (Figure 3.13).

Although CAKI systems are intended to connect to environmental sensors, in this case the data were obtained through alternative strategies. The main reasons for this were strictly limited research funding and the availability of alternative ways to obtain the same type of data.

River flow was obtained through ad hoc data provided by Itaipu Hydro Electrical Power Plant that monitors the river daily (Itaipu, 2008) (Figure 3.15). CAKI systems are designed to use pressure sensors based on the height of the water column where external water level data sources are not available (Figure 3.14). Weather data was acquired by linking the terminal with a national weather center (CPTEC - INPE, 2008) from which the data were continuously downloaded through the Internet. CAKI systems are designed to use a mini-meteorological station where external data sources are not available (Figure 3.16).

Figure 3.13: Photographic depiction illustrating variations of Iguaçu river's water level over time. Gradient levels from low (A) to high (D) seen from Floriano Fall lookout point. Low level (E) versus high level (F) seen from the Catarata's Trail. Water color tends to change as the river level changes due to exogenous erosion.

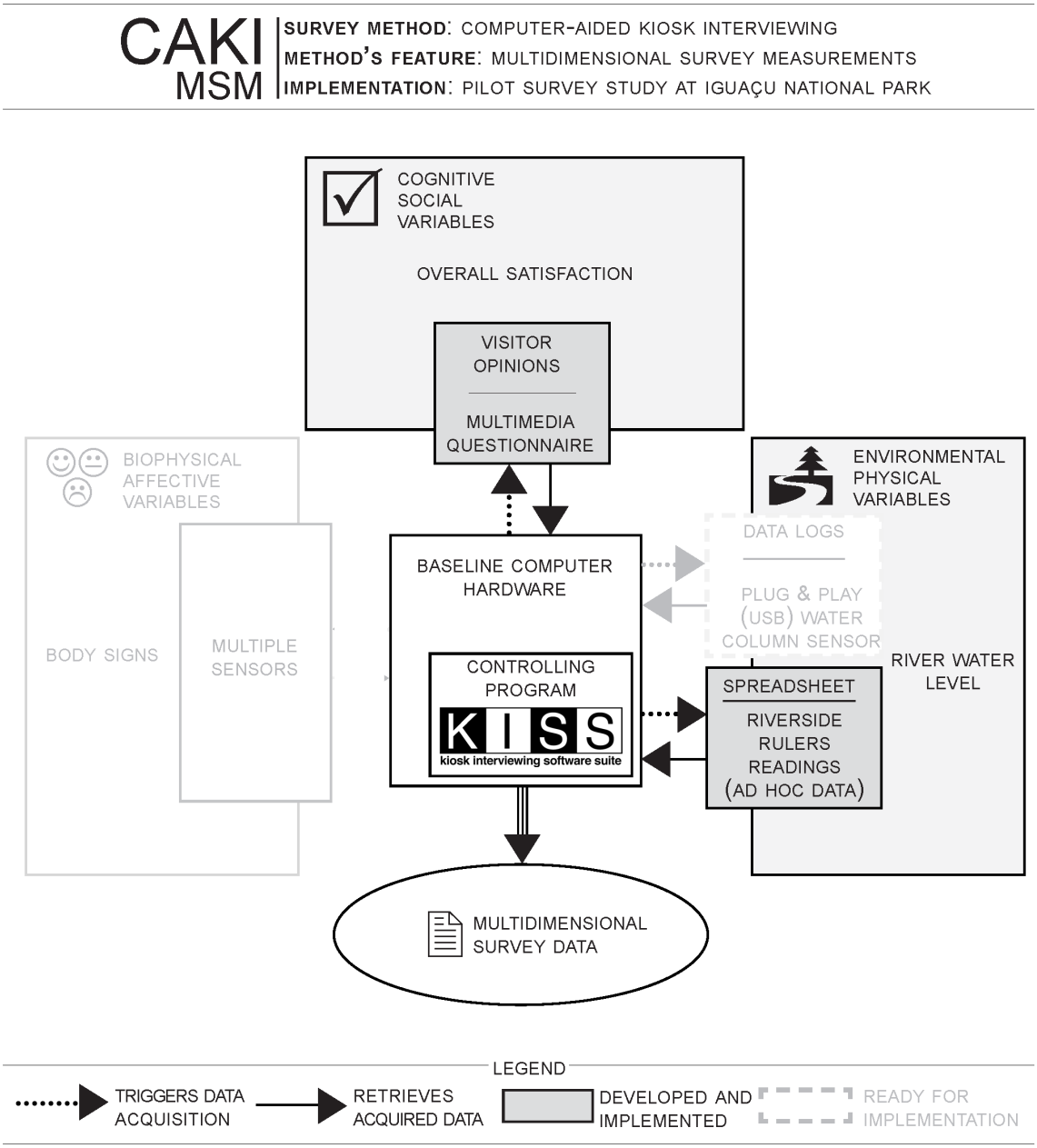


Figure 3.14: Schematic diagram showing actual and potential measurement instruments that operationalize river level variable, pertaining to the environmental domain

Figure 3.15: Iguaçu river's rulers that supplied the river level data utilized in the environmental effect analysis

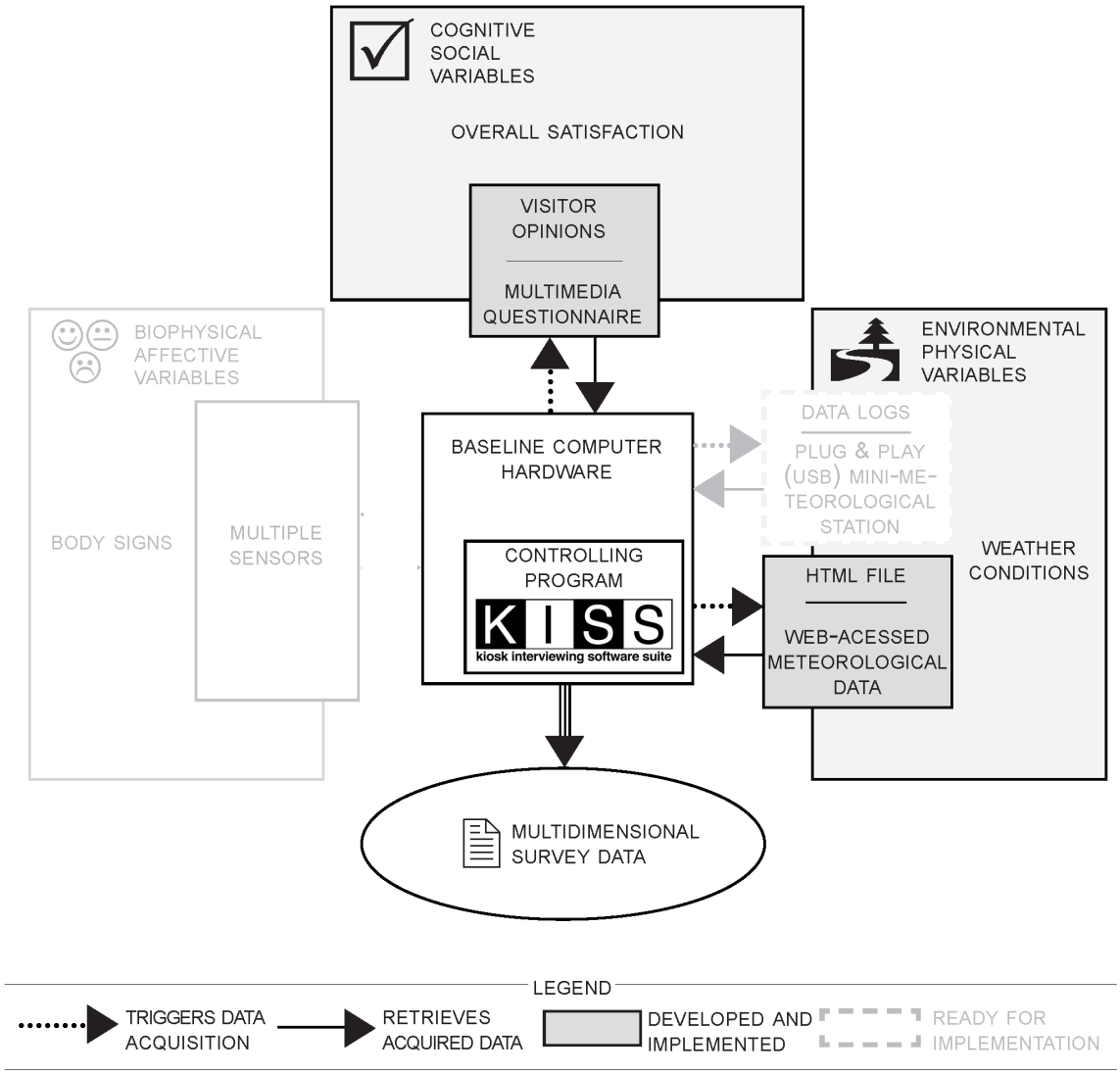


Figure 3.16: Schematic diagram showing actual and potential measurement instruments that operationalize weather conditions variables, pertaining to the environmental domain

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CHAPTER 4: DEVELOPMENT OF AN AUTOMATED, MULTIMEDIA, KIOSK-BASED SURVEY SYSTEM

This chapter describes the development of an automated, on-site multimedia visitor survey system, the integration of software and hardware, and the development of a social communication strategy. The survey system attempts to engage visitors, minimize the survey burden for respondents, being surveyed in a leisure setting, and collect environmental data, such as real-time weather conditions and river flow.

The development of the survey system encompassed three complementary approaches: a methodological exploration of survey methods; the definition of a framework for a new proposed survey method; and the development of the automated survey terminal.

4.1 DEFINING COMPUTER-AIDED KIOSK INTERVIEWING

4.1.1 The Methodological Scope and Referential Survey Methods

As a broad methodological approach this study targets on-site interviewing because such surveys are commonly utilized in protected areas, as illustrated by the Visitor Services Project (National Park Service, 2007). This survey was identified in Chapter 2 as not having benefited from recent technology as much as other methods, thus offering an opportunity for surveys other than face-to-face interviews (FTF) or self-administered paper-and-pencil surveys.

To develop the kiosk survey used at Iguacu National Park, Computer-Assisted Interviewing (CAI) methods, particularly Computer-Assisted Self-Interviewing (CASI) and Computerized Self-Administered Questionnaire (CSAQ) methods were used and to a lesser extent, techniques from Computer-Assisted Personal Interviewing (CAPI), where part of the interview was conducted by a survey host or facilitator. Computer-Assisted Web Interviewing (CAWI) or web surveys provided parameters for self-administered applications and survey content with multimedia elements. The final product, however, was a standalone survey kiosk that does not depend on the Internet or any other network to provide basic surveying functionality. Kiosk-based surveys have been utilized in marketing research and customer satisfaction surveys. Usually implemented in-store with staff involvement, this study developed a methodology to conduct fully automated interviews with protected area visitors, taking full advantage of physically being in the same place as both the respondent and the environment being assessed to also collect non-cognitive data.

Social science, computer science, communication science, physical sciences, psychology, biology and philosophy formed the broad knowledge base from which this study was developed. Characteristics of the existing methods were combined, enhanced and complemented by unique characteristics developed to fulfill the specific functionality the study problem demands or suggests.

The automated on-site survey system developed in the course of this research was named Computer-Aided Kiosk Interviewing (CAKI). Although similar in nature, it differs from general kiosk-based interviewing in two defining characteristics: its capability of generating multidimensional data and its use of a virtual host or interviewer.

This later characteristic places it somewhere between kiosk-based and face-to-face survey methods.

In general, this study did not address questions that are not related to on-site methods—with the exception of web surveys, or those that have well established computer aided counterparts. The survey method developed in this study is intended for application in typical protected areas where visitors can be reached at trailheads or visitor centers—independent of any particular biophysical setting.

In order to conceptualize CAKI, a set of three guidelines were defined that were based on the analysis of the literature. They relate to the general availability of visitor social data, the techniques used in on-site surveys and the monotonousness nature of data type from most cognitive visitor surveys.

4.1.2 Coping with Increasing Demands for Visitor Social Information

Minimizing the "Operational Survey Burden" (OSB) in the Brazilian context means being able to conduct surveys with a minimal budget that does not require highly trained or specialized staff, while maintaining acceptable data quality. CAKI may be appealing to PA managers that have identified the need for social visitor data for planning and management but have not yet established a strong culture collecting and using this data.

The combination of methodological enhancements embedded in computerized surveys (Groves, Presser, & Dipko, 2004) were incorporated in the development of CAKI in order to decrease OSB. The methodological approach adopted regarding this issue was to completely forgo the interviewer or facilitator figure.

This use of kiosk-based surveys has been limited. Kiosk surveys conducted in conferences booths, targeting a highly homogeneous and computer literate public (Shirk,

1996) and in-store consumer satisfaction venues with staff invitation and lottery prize rewards did not provide evidence these systems would satisfactorily work for heterogeneous populations of PA visitors engaged in leisure time. Furthermore, giving away rewards implies in more costs and adds to survey management burden, a measure that is in opposition to minimizing OSB.

Eliminating the interviewer was an early methodological determination that shaped the subsequent developments of an automated survey process that incorporates more capabilities than most kiosk-based systems. As conceived, CAKI had to be a kiosk-type survey method that would autonomously apply all phases of the survey: from prospecting and approaching the respondents and managing the survey process, to sending the data sets back to the researchers ready for statistical analysis. The initial challenge in this context was to develop an automated system with the ability to attract prospective respondents and keep them committed to the interviewing event. An analysis of the social aspect of taking part in an on-site survey study was necessary to address this challenge.

4.1.3 On-Site Survey Dualism: A Scientific Investigation and a Social Experience

The actors in this investigation process are the respondents and the researchers, each operating from different ontological dimensions. Public opinion surveys can be thought of as scientific investigations that systematically translate information originally lying within the minds of subjects to a consistent set of social data for statistical analysis that will provide evidence (or not) that results can be generalized.

From the respondents' standpoint, on-site survey taking is viewed as a social experience similar to others they may experience during their time in the park. Interview

research theorists contend that the interview is a social encounter that must be analyzed in the same way as any other social encounter. The products of an interview are the outcomes of a socially situated activity where responses are passed through role-playing and impression management for both the interviewer and the respondent (Dingwall, 1997; Gubrium & Holstein, 2001). As on-site survey taking cannot be detached from the social phenomena under study (as expected in a laboratory setting) the strategy was to develop a survey which was intriguing, easy, and fun—in line with t other pleasant social experiences visitors expect to have in the park.

Data availability can be increased by drawing a representative sample of interested visitors to the automated survey kiosk, motivating them to properly answer the questionnaire.

Unlike participants in a focus group, CAKI respondents are not a priori engaged in any scientific activity or project and survey taking is inserted in the context of a park visit. Researchers operate in the scientific realm and should minimize interference with the visitor's experience.

The survey instrument is situated in the dimensional boundary between the scientific investigation and the social phenomena it prospects (Figure 4.1).

To yield data of acceptable quality, CAKI must motivate potential respondents to approach the interviewing machine and commit to answer the questionnaire in its entirety. The whole process has to be enjoyable and minimize respondent burden. Since it is competing with valued leisure time, motivating attention to the survey and minimizing response burden is the second development guideline.

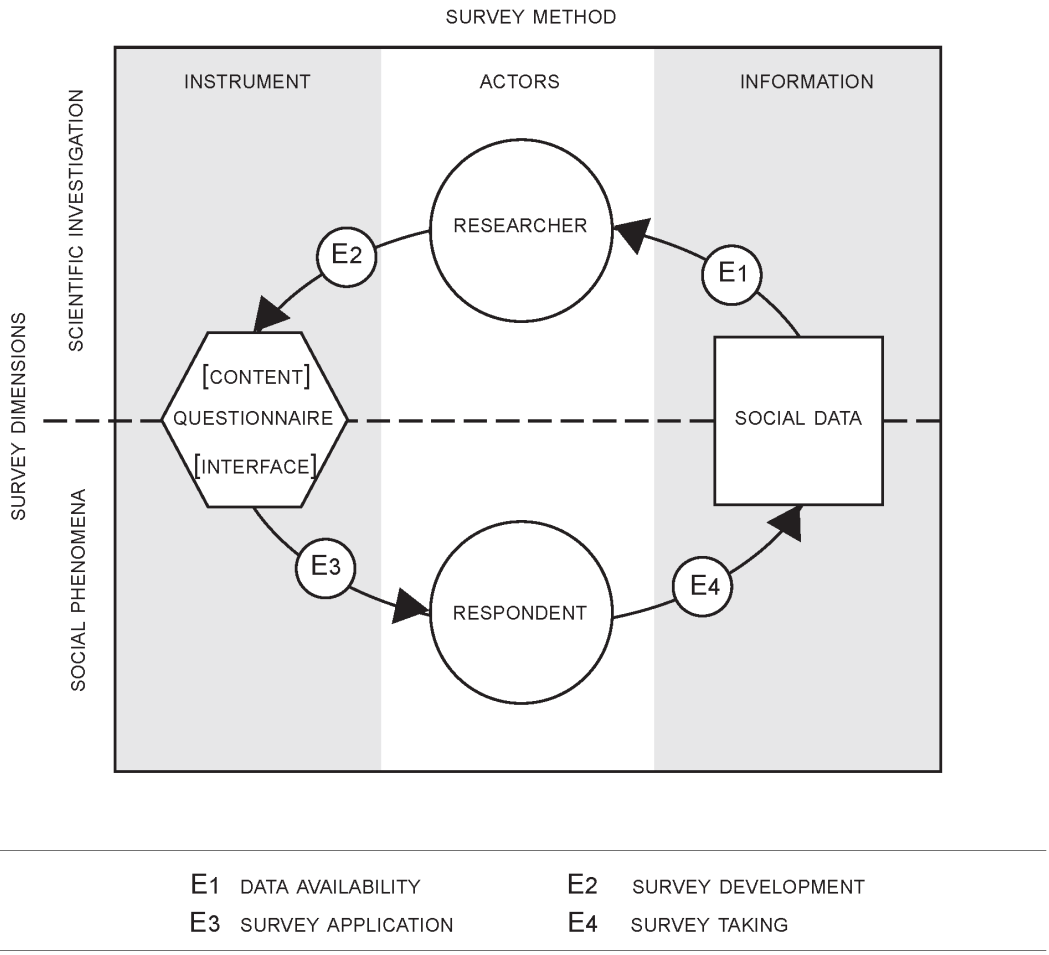

Figure 4.1: Generic on-site survey decomposition on selected methodological aspects

4.1.4 Going Beyond the Cognitive Paradigm of Social Survey Information

Physical, social or environmental conditions may change during a visitor survey. Stochastic variations in these conditions may affect measurements since the subject's perceptions are partially based on an experiential whole. There may be linkages between the weather and the perceptions or behavior of the recreationist but these are often difficult to demonstrate (Manning, 1999). This study hoped to probe the effects of

weather and river flow since a tropical climate can produce very different conditions for any period compared others in a time series (de Meuse, 1987).

On-site physical variables can also include noise, water turbidity, air pollution, or the number of other people at the time of an interview. For traditional survey research, to take these site-specific extraneous variables into account increases operational burden and it is done mainly in studies that investigate these specific effects (C. R. de Freitas, Scott, & McBoyle, 2008; Ekman & Friesen, 1981; Hauff & Milano, 2005). Cognitive information can be coupled with affective information revealed through facial expressions, skin conductivity, heart rate and pupil dilatation can be gauged via techniques of affective computing (Picard, 1997), but psychophysiological studies are commonly conducted in laboratory facilities and with selected groups that do not necessarily represent actual populations. The CAKI method makes it possible to account for the biophysical dimension of the social phenomena. Affective reactions or states can be assessed with direct and indirect sensors and data can be collected (Mandryk, 2005).

Computerized, environmental sensors can be attached to the survey terminal registering actual and environmental conditions incorporated that is complementary to the social information given by the respondent, and is the INFORMATION Methodological Development Axis.

4.1.5 Summarizing and Naming the Study's Methodological Guidelines

The development of CAKI included these guidelines:

- It should be easy and fun to take.
- It should have minimal operational burden due to lower cost and reduced need for specialized personnel.

- It should produce abundant data of good quality.
- It should be multi-sensing and generate multidimensional data.

These methodological fundamentals are depicted in Figure 4.2.

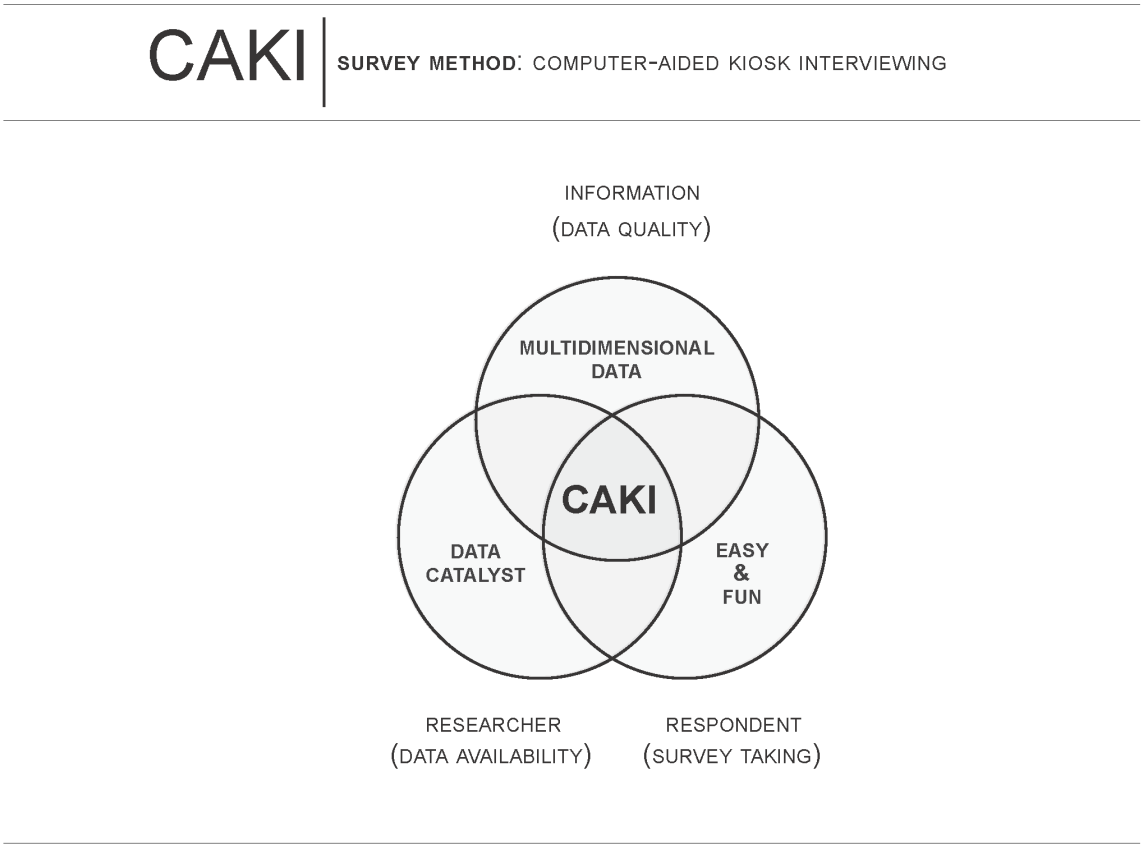

Figure 4.2: Venn diagram of CAKI's methodological fundaments with their conceptual labels

4.2 DEVELOPING A FRAMEWORK FOR CAKI SURVEY METHOD

4.2.1 Outlining the Functional Elements of the CAKI Survey System

This section describes the functional elements of the Computer-Assisted Kiosk Interviewing system. Functional elements are layered to fulfill specific tasks (Figure 4.3).

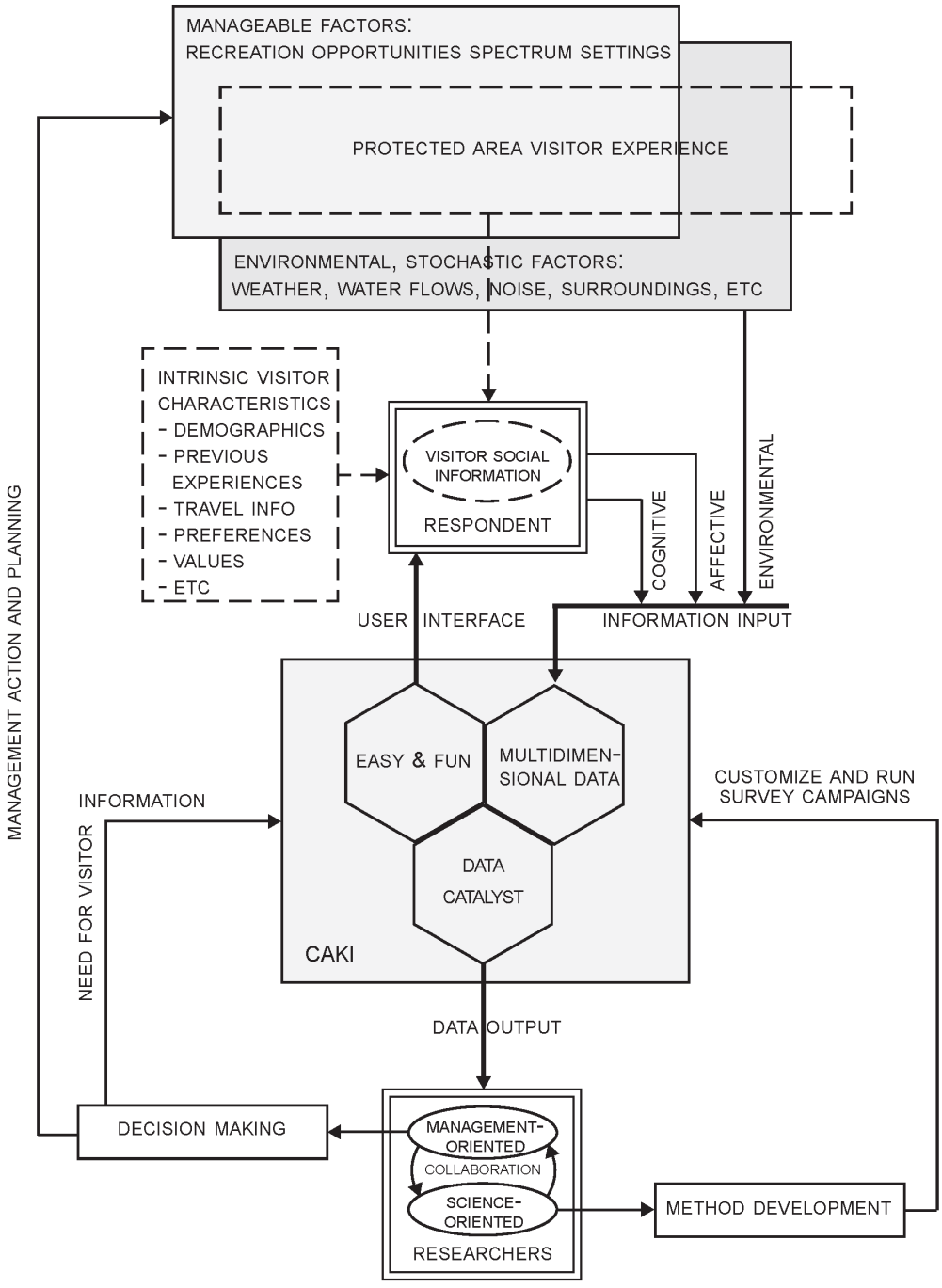

Figure 4.3: Flowchart of CAKI elements and related processes in the PA decision-making

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The kiosk system begins with a standard microcomputer as the baseline hardware platform that connects survey-specific hardware (i.e.: environmental sensors), another specialized functional layer. This hardware, in turn, is controlled by automation survey software developed during the study, which provides the logical platform upon which questionnaires are launched. Besides the survey-specific hardware, this level of functionality is common to most kiosk systems. CAKI software has an enhanced Human-Machine Interface (HMI), a built-in Communication Strategy considered a key element to allow an automated system to generate survey data that is comparable to data generated with the assistance of a human interviewer.

The conceptual innovation incorporated in this layer was to embed a virtual character that induces respondents to act much as if the interviewer were human. This feature breaks the inherent passive state of typical non-virtualized kiosks. The elements outlined so far are those involved in running the surveys on-site. CAKI, however, was planned to provide not only easy survey implementation but instant data availability for managers and researchers by networking with off-site systems. These off-site elements were designed and developed but were not yet tested in real settings. Figure 4.4 illustrates the functional elements developed by the author of the CAKI system.

4.2.2 Featuring the Computer-Assisted Kiosk Interviewing Survey Method

In this section ten major features of CAKI are described in greater detail.

A) User-centered design and functionality

CAKI was developed to be effective in engaging visitors in a machine-run interviewing process that competes with people's leisure time, and is accessible to general audiences, even those who are computer illiterate. It uses a graphical user interface (GUI) with

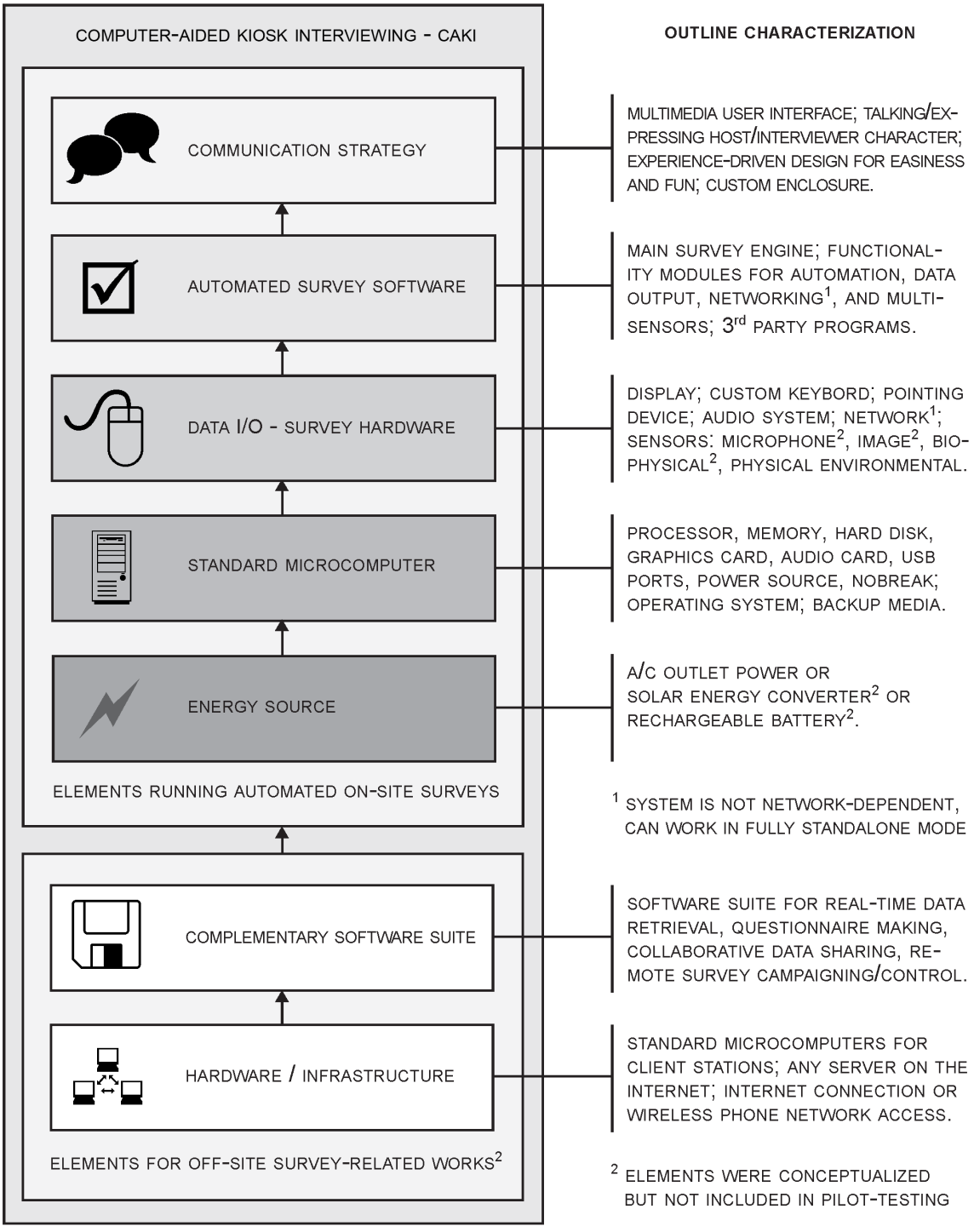


Figure 4.4: Layers of functional elements in the proposed CAKI survey system

intuitive navigation through screens, oversized buttons, non-verbal signs and an information panel on each screen with optional information for each action expected from the user at any given time. The interactive interface uses images of physical objects that tend to detach the experience from a computer-related to a more real-world familiar feeling. It employs "emoticons," abstract faces that convey emotions and enrich communications (Yuasa, Saito, & Mukawa, 2006) to indicate answers in a funny and effective way instead of the typically dull "Internet form" buttons and check boxes. The use of pictures to illustrate alternative options tends to lessen cognitive effort on interpreting less familiar subjects. It was used a minimalist layout for eye easiness and a congenial and sometimes humorous virtual animated/speaking character (Figure 4.5).

Figure 4.5: Screenshot showing the embodied human-like animated animal host that speaks out in the chosen language with lip synch, facial expressions, eyes, head and shoulders movement.

People develop expectations regarding the behavior of a computer system based on their first few interactions with the program (Vaske & Grantham, 1990). The method was designed with elements to create a positive first impression and avoid being able to predict how the rest of the survey will unfold. The virtual host thanks visitors after the survey is taken.

B) Embodied virtual host character

One of the major features of CAKI is the virtual host character with the ability to talk to the respondent. This social communication strategy allows for a "human-like" behavior from the virtual host such as smiling, nodding, humorous comments, and other behavioral cues which enable a better connection with the respondent. This type of visitor-host interaction can be designed to incorporate varying degrees of complexity, ranging from limited interaction to artificial intelligence (AI) where input from the respondent can serve to modulate the virtual host's behavior. In this study, pre-recorded movie clips featuring the virtual host were played in response to survey respondent's inputs in the system's GUI. Host-visitor interaction included the virtual host speaking the language chosen by the respondent, with an introductory clip in the beginning and a thanking clip at the end of the survey. This scheme included baseline virtualization functionality, meant to test the feasibility of on-site survey automation in park settings, rather than explore its further potentials.

C) Self-administered electronic survey instrument efficiency

Self-administered electronic surveys have the ability to convert visitor responses to binary format, thus eliminating the need to manually enter the data. The multimedia format allowed the author to use videos, photos, panoramic images, audio cues, all of

which tend to decrease perceived survey burden and permit a more in-depth perspective to be presented. This form of surveying also allows for the branching, skipping, and randomization of questions. The survey was developed for completion in a relatively short period of time, which allows the sampling pool to be much larger in a given time frame than a traditional human-based survey process.

Additionally, sensitive information can be requested, presenting either an agreement clause to the respondent or the option of skipping the question altogether. Should sensitive data be collected, CAKI systems promptly encrypt the data for storage and transmission, thus allowing access only to the senior scientist through a password-protected interface.

D) Multilingual-capable hosting / interviewing

CAKI was designed to be language-independent and to attract visitors using only behavioral cues and body language. The lack of speech in the initial stages allows visitors from any nationality to approach the kiosk and select their language of choice. Once a visitor begins to take the survey, the software has native multilingual support, and is able to interact with the use in the three languages (Portuguese, English and Spanish) necessary to successfully communicate with the majority of the target population. In human-based surveys where polyglot interviewers are able to speak more than one language, varying skill in these languages may affect survey quality. CAKI has incorporated native speakers into the software which allows for a uniform survey quality, regardless of language.

E) Multidimensional Data Collection Capability and Ethical Considerations

The ability to collect data that go beyond the typical social cognitive questionnaire's answers is one of the distinctive characteristics of CAKI, which is capable of collecting information from the cognitive, environmental and affective domains. The information is translated to computer binary data through specific instruments attached or running in the system, including sensors that can be attached to the terminal or located at remote points and connected wirelessly to the kiosk computer. Affective data can be gathered thru body signs that can be measured by sensors installed in the terminal. This study chose not to utilize affective data because of the sensitive issues that hold potential ethical implications. Figures 3.14, 3.16 and 4.6 contextualize the Multidimensional Survey Measurements characteristic of CAKI.

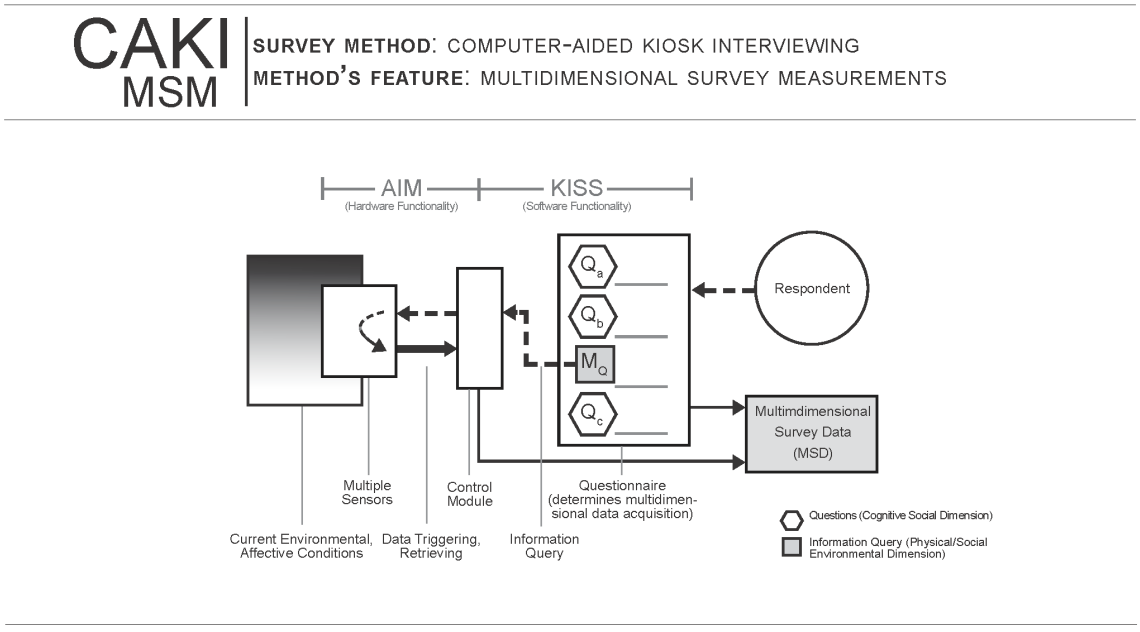


Figure 4.6: Schematic depiction of the basic functionality of CAKI's Multidimensional Survey Measurements feature

The developed pilot-system was equipped with an 8 megapixel, autofocus photo/video camera (Logitech Webcam Pro 9000) installed in the survey terminal front

panel beside the display. The camera was protected by a small round mirror glass window and was connected to the computer via a USB port. The survey system software had built in capability to control the camera at pre-determined questionnaire events. At these events, a picture can be taken and the data encrypted and recorded in the hard disk with a file name that encompasses both the unique respondent identifier code and the event to which it refers. The same information is imprinted in readable text at the bottom of the picture and can optionally be recorded in the picture's Exif metadata. The picture recording functionality could be turned on or off through a switch in the survey software control panel. In the study, the feature was only functionally tested. Extensive use with the general public has to be preceded by the establishment of method-specific ethical protocols to which the research can hereafter abide to.

The development of this functionality was driven by the need to evaluate what type of affective reaction the virtual character was causing on respondents. It was set to acquire images at two sequential events: (1) at the language choice (button click), intended to capture a neutral condition and (2) two seconds after the humanized animal began to speak (timed action), intended to capture the respondent's feelings toward the host's performance. Some of the results of this experiment are featured in Appendix 2.

The system's imaging and audio capturing capabilities were actually used in streaming video mode in the first few days of testing with the public. Live video streams from both the camera and the desktop activity were transmitted on-line to a remote terminal installed in the park's headquarters. The camera's video and audio signals were received using *Skype Video Call* and the real-time desktop sharing and control was made through *RemotePC*, both 3rd party internet communication services. A qualitative

assessment of the affective impact of the virtual host, the performances of the system, and survey burden was done from the remore terminal. The evaluations indicated that the large majority of the respondents smiled just after the virtual host began speaking, interpreted as a positive mood change which corroborated to create some bond with the automated survey process. This was in line with the planned functionality and performance. On the other hand, people's expressions, comments and real-time screen analysis revealed that the time the system was taking to refresh and the way it was occurring was generating varying degrees of frustration and confusion. Due to the multimedia contents, the next question was loading relatively slow, line by line, while the previous question was also disappearing from screen line by line. This caused elements of both questions to be simultaneously displayed for very brief periods. This characteristic was immediately modified making the answered question disappear completely before the new question began to load. The timing problem was minimized by making the question text appear first in the loading process, allowing respondents to begin reading it while the multimedia elements continued to load, eliminating the burdensome feeling of waiting for the system. These changes were adequate to run the pilot-system but it was learned that for the next development phase the page change speed has to undergo substantial improvement through software algorithm and code restructuring.

The multimedia questionnaire was designed with cues to record weather and river flow, enabling researchers to measure their effect on visitor satisfaction. In the developed system, real environmental physical sensors data were substituted by alternative data that were readily available at the survey site and at no cost.

Near real-time weather data were downloaded from CPTEC/INPE's website (updated hourly) and parsed by the system weather data module. The variables of interest were recorded in real-time on the respondent's answer form. River flow information was acquired from a local source that took daily measurements. The data were entered in the dataset after the experiment was finished and attributed to each survey respondent. These substitutions were made due to budget limitations and were used as proxies of the same functionalities that could be available if physical sensors were present. The use of alternative data served to demonstrate the intended functionalities but revealed some shortcomings. Since weather information came through the internet, every time the system faced connection interruption, no data was collected. Multiple factors affected the connection, including power shortages. The survey system was equipped with an Uninterrupted Power Supply (UPS) unit capable of keeping the system on for about 3 hours in case of power shortages. The local internet signal usually did not last that long. Since the system is standalone, it did not interrupt working and generated social survey data without the corresponding weather data. Another event detected and corrected was a major website layout change in the weather data source, interrupting the data collection that was crafted to another specification. Once the problem was detected, a solution was provided by modifying the weather program module to obtain the data from the new website format. A final shortcoming of using external weather data source was the local airport location of the real-time meteorological station, located about 12 km (7.5 mi) from the survey terminal, allowing a slight imprecision of the actual weather at the terminal.

With regard to the ad hoc river flow data, the major problem faced was the inability to account for real-time changes in the water flow since the data was based on daily measurements. Using dedicated sensors could have avoided this problem. Additionally, an experimental wireless image sensor was installed on top of the elevator tower to continually record pictures of the appearance of the falls, mostly to gauge changes in water color that could be related to visitor satisfaction. Once installed, the purchased color camera was only capable of providing black and white images due to the falls' extremely bright lighting condition, and was therefore eliminated from the experiment.

F) Dual mode automation

The research terminal was designed as a robust, yet simple operation, thus allowing non-specialized protected area staff to run survey studies on their own. The system does not have to rely on any external infrastructure such as internet or cellular network. It was designed to be used in a wide range of protected area settings where these services are not available. In the standalone mode, data is manually retrieved simply by inserting a memory stick in the terminal.

The early version of this feature was accessed through a simple dialogue window triggered by typing a code in the terminal's keyboard and then selecting the option "download data to memory stick." To make this feature yet simpler for park staff to operate, a second generation was developed in which any habilitated memory stick plugged in is automatically sensed by the system, which triggers the data download interface. The download initiates automatically after the habilitated operator scans her/his ID card featuring a bar code. A password can be optionally required for added security.

In each section all new data accumulated in the survey terminal since the last download is downloaded.

The download transfer time for a typical survey day (30-50 interviews) was about 10 seconds and a week of data took circa 1 minute to transfer to the memory stick. If internet/network is available, as it was in Iguacu National Park, the primary data outlets can be automated to instantly e-mail the survey answers and data to a remote control session. The manual data download option was therefore developed but used only for testing purposes. In either manual or web-based data download, the data in the terminal is never erased during routine operation. The survey terminal capacity to accumulate data is only limited by the size and the number of hard disks installed. The size of generated data can vary depending on the type and diversity of collected data. The simplest survey data contains only a binary file per respondent with coded answers in text form (digital data that is generated during the electronic survey application). In the tested questionnaire it occupied 8 KB of disk space. All data generated in the year-long survey used 30 MB of an 80 GB primary hard disk. A survey which dataset encompass other types of digital data such as pictures from imaging sensors and audio or video clips will use considerably more space. This was not considered a concern since current hard disk capacity is around 2 TB and the system can have many parallel units if necessary.

Beyond real-time data retrieval and remote monitoring and control, this study also utilized the internet connection to upload new survey versions with corrections to the terminal without physically going to the site. Another benefit of the internet connection at the survey site is that managers and scientists can collaborate closely by simultaneously sharing collected data. This feature allows studies to be carried out from anywhere in the

world. This feature was the main way the survey was conducted between August and December 2008. During this period the researcher operated from the USA the automated survey terminal in Brazil. The survey software contemplates a network-watch module that checks for internet connectivity and, once available, it makes the system remotely controllable. This does not require the researcher to login on to each survey terminal (should there be many) to control them (e.g. using *RemotePC*). Commands can be indirectly passed to the survey terminals using a single control file hosted on a website. Once the network-watch module detects these codes in the target website it launches the corresponding action that is already pre-programmed in the survey software suite, such as to start or stop interviewing, retrieve data, update survey program and modules, change questionnaire, change terminal settings, etc. The system, however, can work with restricted internet availability through cell phone or satellite networks, by re-programming it to connect at predefined intervals to send and receive data and commands. Indirect web-based control and alternative connection types were developed and tested but not effectively used to access and control the system.

G) Flexible study designs

Unlike human-based surveys, where the interviewer is trained to conduct a given survey repeatedly, CAKI's system allows for flexible study designs, presenting several different surveys interchangeably and simultaneously. CAKI is also able to develop studies of longer time spans, such as monthly or yearly periods, treatment groups and mixed mode surveys. Conjoint analysis with alternative states depiction is also supported by the system.

H) Streamlined data generation archiving and delivery

Data inputted into the CAKI System was coded into ascii files, which hold a closer resemblance to traditional survey data entry. This ensured greater reliability as the data was tracked from the moment it was received to the final archiving. At the end of each day of operation the system compresses all new data into a zip file, that is stored apart from the individual ascii files. Another layer of data protection implemented was the daily backup feature, to an attached memory stickThis backup has a 3-day latency, which means it create 3 complete independent backups and only in the fourth day it will erase the first day's content, giving time to catch system errors and prevent eventual corrupted data to corrupt the backup data. This backup system allows recovering from system failures to the latest data and updated survey. It was successfully used when the primary hard disk failed and had to be replaced. The disk content was restored using a previously prepared system rescue DVD and the survey system, including all recent data was restored using the independent memory stick.

An additional tool which ensured data reliability is the print screen. This feature archives an image with the exact screen contents at any given moment, which can be compared to the stored electronic data. This feature can be used as a data-auditing tool and is of optional activation through a software switch in the control panel. It was briefly used after a coding error was detected in the first sampling day to verify it was repaired. Since the electronic questionnaire was working correctly, it was not necessary to continue using it. It could be useful again if new changes were made to the questionnaire or the survey be updated or replaced.

As shown in item F all the data stored at the kiosk can be easily manually retrieved by inserting a programmed memory stick. Beside operator identification, no additional interaction with the system was necessary for complete data retrieval. Data was retrieved in real-time by e-mail or by web data post. E-mail was used as the primary data retrieval system through a specific survey system module. The early software version had incorporated the e-mail functionality in the same program as the main survey module, which caused the whole questionnaire application to become irresponsive if there was a problem sending out the e-mail, due to slow or instable internet connection. Though this did not impact the current respondent since the e-mail was only sent out after survey completion, the terminal became irresponsive until the e-mail was sent. This issue was repaired by creating an independent module (program) for the e-mail service that did not affect the main survey module, retaining the ability to trigger the e-mail delivery after each survey is completed. In addition to real-time answer forms, the e-mail module also sent the zip file with all surveys of the day and the terminal's log file, which recorded all survey and system events of the day. The e-mail module was set to send all messages to three different e-mail addresses creating additional automated data backup at remote sites. The e-mail was also used to monitor the terminal's functionality. An absence or low rate of e-mails meant the internet was down or the terminal was facing problems and triggered troubleshooting actions. Since the internet connection was of high quality, to actually retrieve the data used in the analysis it was preferred to log in the machine weekly using remote control sessions (*RemotePC*) and transfer the whole batch of new data directly between the computers.

4.2.4 Bypassing Kiosk's Passive State with Machine-Human Communication

As mentioned, the interviewing system developed at Iguaçu National Park was designed with a machine-human communication strategy with three main goals of this communication are: (I) to invite and engage visitors as a human facilitator might do, (II) to keep them motivated throughout the survey, (III) to promote long term public acceptance of automated electronic survey taking in protected areas.

As developed, communication interaction embodied in the system has six main phases: Enticement, Stimulation, Adherence, Stamina, Gratitude, and Crediting. A summarized description of each communication phase is shown in Figure 4.7.

1. Enticement - Its function is to catch visitors' attention to the survey terminal, to make a potential respondent approach the machine, using silent signals and messages. Two options were initially considered for the virtual host: a filmed or animated park ranger or employee that represents the institution, and an animated animal typical of the native fauna. Since contact with park rangers is limited the "park ranger" does not have the same positive image found in the US and other countries. It was felt that an animal would be a better virtual host.The real animal, in this case, would be the departing concept to a final anthropomorphic creation, in the form of a speaking animal. Most recreation opportunities offered in the park were observed and experienced by the author. This process revealed that visitors show enjoyment with the abundant contacts with groups of coatimundi (Nasua nasua) (Figure 3.3 D). This animal provides frequent encounters and was considered more appealing than the Jaguar which symbolized the park but is very rarely seen.

The animated character performed antics, eye blinks, ears sways, tongue show,

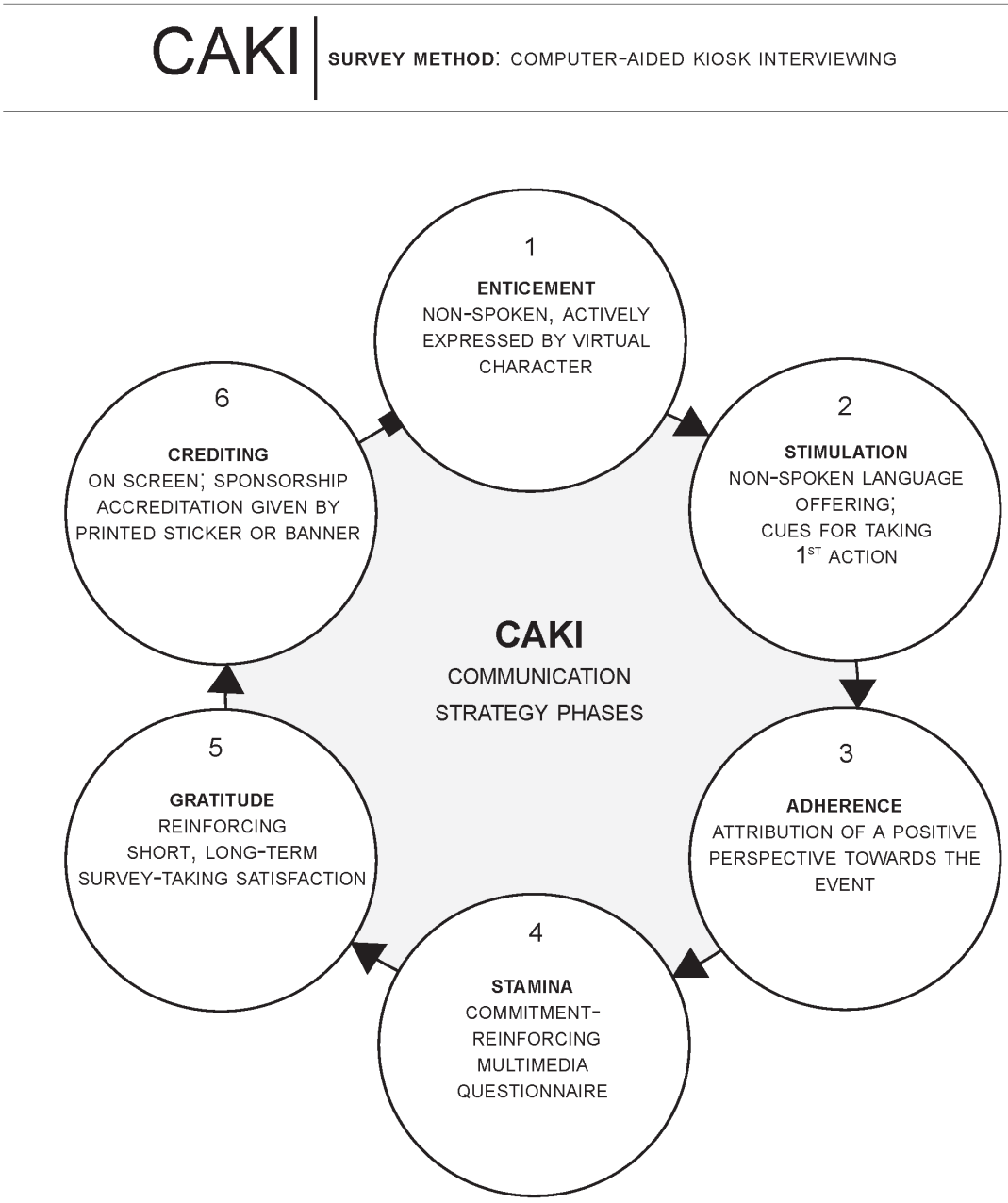


Figure 4.7: The six phases of CAKI's communication strategy

and head waves, all purposefully funny and intriguing (Figure 4.7). Her performance can be checked by installing and running in a personal computer the survey software that is in the CD-ROM contained in the Appendix 7. There were three steps involved in giving the

virtual host animation and facial expressions: (1) selecting an animal talent and taking a head on picture at eye-level; (2) have human talents to record the dialogue in three languages; and (3) compose the audio, the picture and the gestures in the computer program *Realusion Crazy Talk*, which generates movie clips which resembles an actual footage of a live talent. The animation program lip-synchs the talk with the image and allows a vast repertoire of gestures and expressions to be precisely controlled in a timeline editing interface. The resulting product was a loop film shown in the terminal's screen of an animated character making funny facial expressions (Figure 4.8).

Figure 4.8: Snapshots from the 30-second opening looping film showing the animated character acting as a survey host in charge of attracting visitors to the survey terminal. It remains silent, performing human-like facial expressions, eyes, head and shoulders movement. It acts funny, intentionally to catch visitors' attention.

2. Stimulation – In order to personalize and induce the prospective visitor to do the initial click that triggered the next phase of the electronic survey, the visitor is given a set of 3 languages to choose from by pressing a button. The language selection strategically gives the visitor the needed confidence to start interacting because "it speaks my language." To make it very noticeable, the language options were displayed beside the animated character with large buttons captioned with the names of the languages. The buttons' surface areas show stylized flags of the countries that are symbols of each language and that better relates with the intended audience. In the Iguaçu case the language options were Portuguese, English and Spanish represented by the flags of

Brazil, USA and Spain, respectively (Figure 4.9). These languages were chosen based on the Park's visitation pattern of 2007. According to park data collected at the ticket counter, the park had a total of 1,055,433 visitors (Parque Nacional do Iguaçu, 2007). From these, 43% were from Brazil or Portugal; 32% were from Spain, Mexico, Argentina and six other South America Spanish-speaking countries; and 7% from the US, UK, Australia and Canada, summing up 82% of all visitors. Among the remainder major visiting countries, many have English as a second language, like Germany (3%), which makes the selection of these three languages encompassing for communicating with the park visitor population.

Figure 4.9: The virtual host created out of an actual Nasua nasua, a mammal that is typical of the Iguaçu National Park's fauna. This is the starting screen showing embodied social communication elements like a language choice panel and an LCD-like status panel. Featured items were connected by a clean brushed metal frame and neutral background color.

Another element used in this communication phase was the message panel at the bottom of the screen. It was designed to resemble an LCD-like status screen that shows typewriter-like animated text messages. The message phrases were "Welcome to the visitor's survey" followed by "Use the mouse to choose a language". Concomitantly to each phrase there were exhibited icons of a smiling face and a pointing device, respectively. After brief period of exposition, enough for reading out, the phrases were sequentially changed in a loop cycle to the next language available. All that dynamics takes place while the character continually performs attractively in the screen, creating induction and confidence to give the survey a button push.

3. Adherence – In order to create a positive expectancy that encourages the visitor to go ahead and take the survey, the virtual host now speaks to the visitor using the pronoun "you."

The message begins with a "welcome" and "thanks for the interest" followed by a humorous self-introduction and a serious introduction of the survey and its importance. Then it continues with simple instructions about the survey-taking emphasizing its easiness and shortness and finalizes with "settling" to meet again with the respondent at the survey's completion. The announced new opportunity to see and hear it served as an added motivation to complete the questionnaire. Verbatim, the virtual host says:

> "Hello! Welcome and thanks for participating in this research for the visitors of Iguaçu National Park. Before we begin, let me introduce myself: my name is Quiii!, I am a virtual Multilanguage speaking raccoon. Not many like me around here. I am here to make this computer interview a bit more human, well, ok, a bit

more animal. So, dear visitor, it's very important to the park to know more about you, your experiences here and your expectations about possible new experiences for the future. The interview is quick and easy, you can keep track of your progress by looking at the panel at the bottom of the screen. So, let's go! See you at the end, ok? Bye-bye for now!"

4. Stamina - Due to the lack of moral obligation visitors feel to stay engaged in a machine-run interview, a set of interactive arguments were designed to boost the respondent's commitment to answer the questionnaire to the very end.

The system incorporated a design with graphical solution that included non-verbal signs to help the respondent in expressing their answers. These signs were presented as part of metaphors of hypothetical "answering devices" with screens and gauges that could be loaded with pictures of depicted question's subjects or mood cues through large icons of changing faces, ranging, in nine steps, from extreme happiness to extreme sadness expressions (also known as smiley or emoticon) as well as sequences of thumbs up/down (Figures 4.10 and 4.11).

Respondents are kept well informed about what immediate action is expected from them at any given time. It is important to note that in methods that employ a personal interviewer or facilitator the degree of assistance throughout the survey directed to the respondent is adjusted to de demand of each subject based on the interaction between them. While in the automated method the assistance level has to encompass those more in need of instruction without bothering with "obvious" information those that

Figure 4.10: Visual cue with a sequence of smileys to convey satisfaction and happiness.

are more intellectually trained to perform such tasks. The message panel at the bottom of the screen showing baseline instructions is optional for "expert" takers. The messages are: *Welcome to the visitor survey; Use the mouse to choose a language; Meet Quiii!, our interviewer; Please, read the question and mark an answer;* and *Ending survey and recording answers* (Figure 4.12 G). The message panel resembles an LCD display and was developed with graphic designs that depict real objects and devices in order to make the computer use attractive and easy even for computer-illiterate individuals. Three major development guidelines – minimalism, aesthetic design and depiction of known objects – embed all elements in the GUI. This rationale informed the design of the following GUI elements: large tridimensional captioned buttons instead of standard computer "radio" buttons, the word "OK" or arrow signs in the answer confirmation button, which also

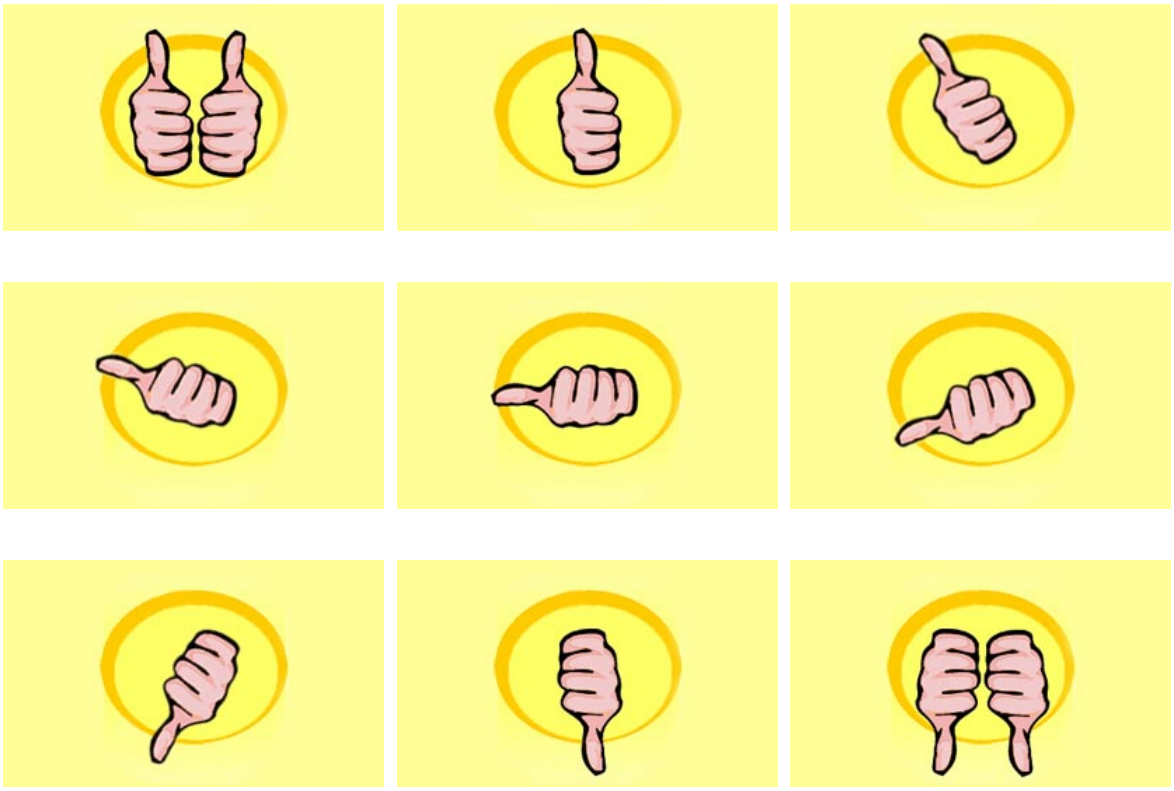


Figure 4.11: Visual cue with a sequences of thumbs up/down to convey approval or fulfillment.

prompts the next question (Figure 4.12 B, C and D) and the "start over" button that can be used to reset the survey terminal, allowing for a new survey application (Figure 4.12 E).

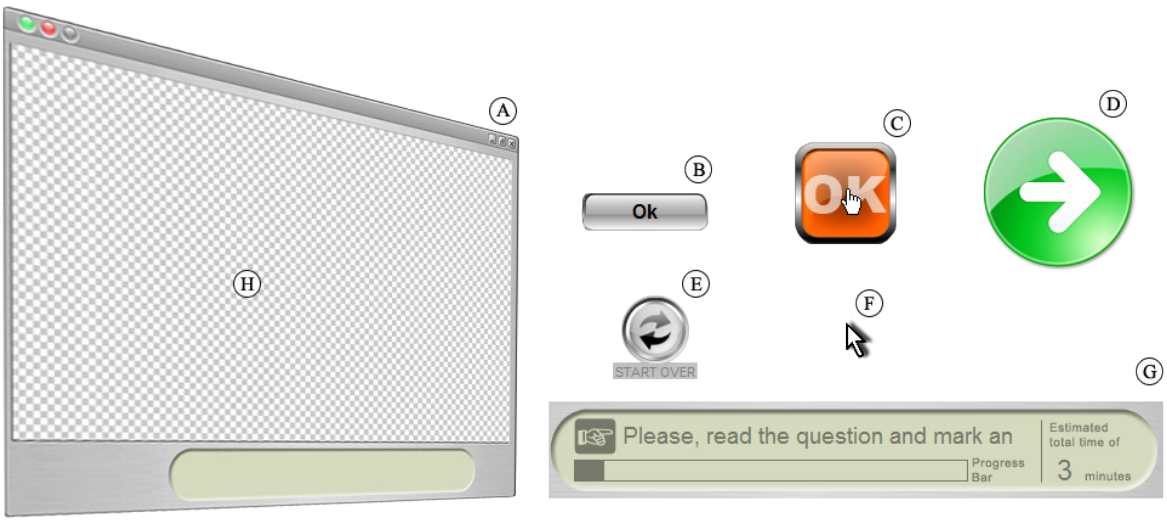


Figure 4.12: Design of core GUI elements (A-G) for navigation and communication.

The interface used in the version for public survey testing resembles a brushed-metal video-device front bezel (Figure 4.12 A). This frame holds both the survey stage (Figures 4.12 H) and the LCD-like bottom panel (Figure 4.12 G). An enlarged mouse cursor was used on the GUI allowing users to easily locate the pointing device in the screen (Figure 4.12 F). Additionally, for easy mouse cursor initial localization, its position on each new survey was programmatically set. Finally, the survey questions (Figure 4.12 A) are shown in the central stage (Figure 4.12 H). Other designs include numeric keypad (Figures 4.13 B), multiple choice questions (Figures 4.13 C), sliding buttons associated with the Likert scale (Figures 4.13 D), and single choice questions (Figures 4.13 E).

Figure 4.13: Design of core GUI elements (A-E) for multimedia questionnaire.

5. Gratitude - The objective here was to reinforce the perception that the participation was worthwhile both by the personal experience itself and the purpose it served. Researchers hoped to build long term public acceptance toward automated survey kiosks in parks. It is expected that after some experiences with the survey system visitors will

feel comfortable with such surveys and not discourage other people from taking part in automated interviewing, hypotheses that have to be addressed in future studies.

In this step, the previously announced return of the coatimundi takes place. She shows up in the main screen with the following script:

> "Thank you for your time and willingness to help us out with this research. Your opinion is a fundamental ingredient for us to make the park increasingly more efficient in environmental conservation and to offer you the ideal opportunity to live your best moments in Nature. Thanks again and bye-bye. See you around!"

The suggestion that they may meet again somewhere in the park is based on the fact that the character is actually one of the "resident" animals that the visitors see frequently.

6. Crediting - This last step in the overall communication strategy presents the complete authorship, sponsorship and institutional support behind the research. The credits silently present the names and logos of all involved and thanks all people that have collaborated to the research effort, including the local park staff. Survey credibility benefits from presenting trusted names and institutions (Dilman, 2007). Ideally, this could be done at the beginning of the process, but it was felt that the length of the credit screens would detract from establishing the subtle commitment that is possible between the prospective respondent and the machine. Response time is considered a scarce resource to be parsimoniously administered. The full credits are presented at the end (Figure 4.11), after the "good bye," making it clear the survey has ended. To counterbalance the late credits, a printed banner was put on the upper part of the kiosk front panel, with color logos and the names of the main institutions involved in the research project (in this case

IBAMA/ICMBio, CAPES and CSU) along with the survey title and a one line description of the research in all three offered languages. Figure 4.14 shows the crediting screen used in the pilot study at Iguaçu National Park.

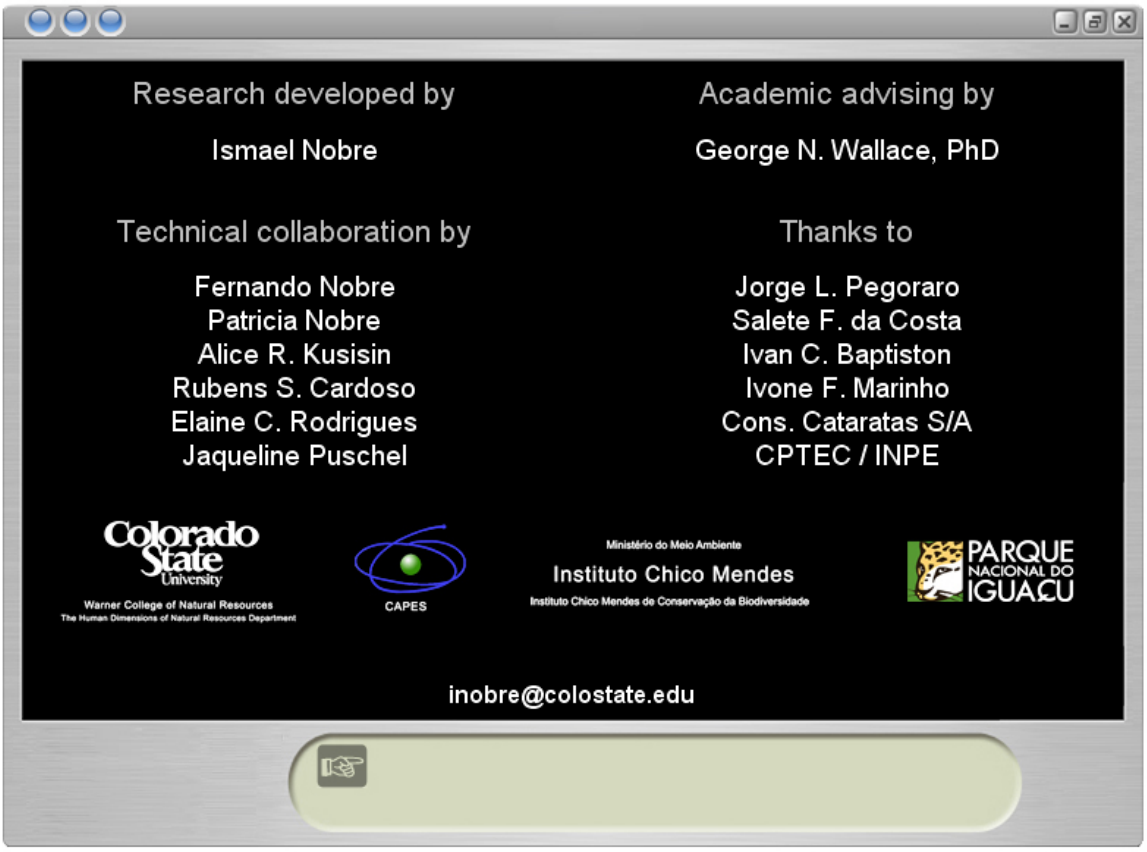


Figure 4.14: Crediting screen exhibited at the end of the interview

4.3 DESIGNING AND DEVELOPING THE CAKI SOFTWARE SUITE

A methodological concern dealt with in the beginning was to determine whether it was necessary to develop custom software for CAKI or to employ ready-to-use products available on the market. Although commercial software might seem like a shorter path, a survey of available software showed that using proprietary software would limit the ability to include the functionalities that characterize and identify CAKI in the pilot system developed for this study. Specifically, none of the software found offered the

level of control necessary to provide a system that concurrently is automated, standalone (independent of Internet), capable of integrating questionnaire-driven data with advanced multimedia features (e.g., physical environmental and biometric information), essential to the level of machine-human communication the survey kiosks would require.

Commercial software tended to offer good solutions for one or some but not all of CAKI's requirements. Integration of multiple packages in order to cover all necessary features was assessed as too demanding and unreliable, and was found to have very limited flexibility for customization. Considering all of the aspects mentioned above, specialized programs developed constitute a major contribution of this study. The software encompasses four program groups: On-Site Survey Client; Off-Site Control Server; Off-Site Control Client; and Questionnaire Maker. On-Site Survey Client was divided in ten modules: Main Survey Application; System Launcher; Time Scheduler; Instant Answer Sender; Day Answers Filer; System Backup; Stability Sentinel; Remote Control Watcher; Biophysical Recorder; and Weather Data Retriever (Table 4.1). All them form the pilot software suite, which was labeled the **Kiosk Interviewing Software Suite** (KISS). To develop these programs, a programming platform was chosen based on scripting language, which allows for advanced programming without resourcing on more complex programming languages like C^{++}. All programming was made using NeoBook® Rapid Application Builder from Neosoft®, a Windows® programming tool that has proprietary scripting language and is streamlined for multimedia-oriented developments. NeoBook® yields to applications that compares to those made with more expensive tools like Adobe® Flash which also has its own scripting language, the object-oriented ActionScript. The survey software development encompassed four major phases:

translation of CAKI features to program functionality; design of dedicated program modules with integrated suite functionality; writing the computer code for each program; and testing the programs in regard to stability, functionality and usability. Among the modules, the Main Survey Application is the principal engine of the software bundle. It carries out tasks such as run the multimedia questionnaire, record respondent-entered answers and correlated data on individual text files and commands the other modules' actions. All modules included in this first development of KISS, the corresponding functionalities and the degrees of implementation are show in Table 4.1. The integration of all on-site modules is presented in Figure 4.15. A stable and fully functional version of KISS can be evaluated though the software copy included in the CD-ROM that accompany this Dissertation.

Table 4.1: Program modules and functionalities included in KISS development

Developed Software	Function
A) On-Site Survey Client	Automatically runs surveys in a site-based terminal. It comprises 10 subprograms for specialized tasks:
1. Main Survey Application	Manages and presents the multimedia questionnaire, records answers and correlated data in a uniquely identified ASCII form, triggers modules functionality;
2. System Launcher	Manually launches the survey and sets run preferences;
3. Time Scheduler	Automates time-dependent actions like daily survey application beginning and ending, daily sending of filed answers, daily system backup, sets computer in public protected mode, sets the terminal in standby mode;
4. Instant Answer Sender	E-mails each answer form right after it is finalized;
5. Day Answers Filer	Compresses (zip) all answer and log forms for the day;
6. System Backup	Backs up the whole survey system to an attached memory stick for avoiding data loss in case of hard disk failure;

7. Stability Sentinel	Continual monitoring of survey program and computer's operational system stability, sends e-mail and SMS alerts and attempts to fix some types of detected problems;
8. Remote Control Watcher	Continual monitoring of inbound commands sent to the survey terminal via internet for instant machine response;
9. Biophysical Recorder[1]	Optionally records and encrypts pictures of the respondents at different stages of the questionnaire answering process with an imprinted information line;
10. Weather Data Retriever	Periodically extracts and logs weather data from internet;
B) Off-Site Control Server[2]	Receive continuous monitoring information and answer data from multiple survey terminals via internet, sort the information and makes it available for download by multiple control clients;
C) Off-Site Control Client[2]	Retrieves and displays real-time monitoring information and answer forms from multiple survey terminals, extracts survey data from individual answer forms and pools it into CSV data sets ready for reading with SPSS;
D) Questionnaire Maker[3]	Assistant for changing questionnaire content and language translations.

[1] Module tested only for qualitative analysis, no data were recorded; [2] Modules were developed but not tested; [3] Questionnaire Maker was developed as an aide for preparing the tested questionnaire and at present it allows changing question's text and images but did not allow structural changes beyond the types of questions actually present in the used survey instrument. This limitation did not affect the ability to include any number of questions in any order or randomization when building new survey instruments.

4.3.1 Conceiving, Designing and Building the System's Enclosure

As its core, the developed kiosk survey system uses a regular PC running KISS. Because fitting a protected area experience is important, the CAKI system was enclosed so it could be put unattended in public areas and fit in with other elements of the setting. A combination of subjective and objective factors entered in to inform the design. It had to be eye-catching, pleasant, and use shapes and colors that conformed to the location used. To some degree there are subjective appraisals that can undergo specific evaluation

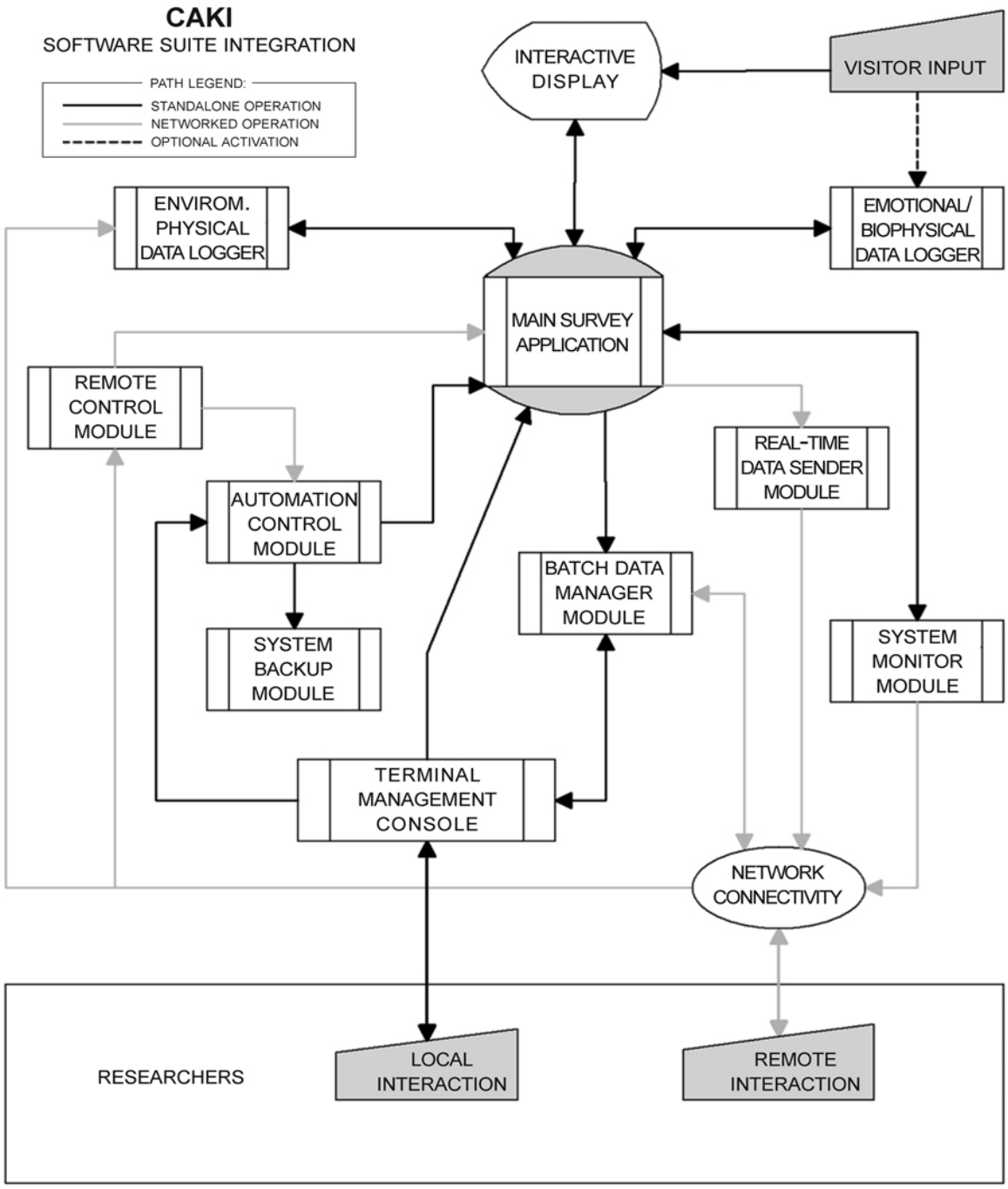


Figure 4.15: Diagram showing the integrated functionality of on-site program and modules

experiments in the future. Development of the kiosk had four objective requirements: visibility, survey environment, ergonomics and institutional appropriateness.

(1) it had to be easily visible from a distance so to avoid passing unnoticed by potential respondents. This characteristic ties to sampling requirements since a terminal that is seen by everyone gives anyone the same chance to be interviewed. This impacts the design of its volume and color scheme (Figure 4.16);

(2) it had to provide a non-distractive environment to the respondent, minimizing disturbances once one is engaged in an electronic interview;

(3) it had to be ergonomic and provide respondents a place to sit (Figure 4.17). The seat is an invitation to a comfortable place and ergonomics would provide optimized screen distance and angle for easy reading and comfortable neck position, stereo speakers positioned so to provide the respondent a rich audio experience that at the same time minimizes sound "leak" away from the kiosk. This acoustical criteria was considered necessary to reduce the auditory footprint of the equipment while in use.

(4) The enclosure had to have adequate room for fitting the legs comfortably and places to rest hands and arms; and finally

(5) there needed to be space identifying and therefore legitimizing the sponsoring institutions.

There are many commercial enclosures, offered in a variety of sizes, shapes and levels of weather proofing and security from tampering. Selected models may come outfitted with the computer, adapted to the specificities of the kiosk. Commercial enclosures were evaluated as viable but would demand a varying degree of adaptations. Cosmetics adaptations, depending of model of choice, were considered potentially less demanding to be made than assembling a custom one.

Nevertheless, the prices of these commercial units available in the Brazilian market were considered beyond the research budget, prompting the decision to make a CAKI-specific model. This option gave the researcher the ability to incorporate, in an uncompromised way, the exact concepts proposed under the CAKI framework, which was considered an advantage in a pilot study. Figure 4.18 shows the built pilot survey terminal, ready for interviewing. The terminal's blueprints are shown in Appendix 4.

Figure 4.16: Image of kiosk as seen by visitors approaching the site.

Figure 4.17: Image of kiosk and stool, as seen by visitors at short distance.

Figure 4.18: User interaction with the kiosk

CHAPTER 5: ASSESSING THE EFFECTIVENESS OF AN AUTOMATED MULTIMEDIA COMPUTER-AIDED SELF-INTERVIEWING SYSTEM FOR ON-SITE VISITOR SURVEYS

This chapter covers the part of the study that inquires whether an automated survey station and procedures used in this study can yield results that are comparable with traditional, on-site survey methods which require the presence of interviewers or facilitators. The survey data analysis was performed following statistical procedures outlined in Chapter 3, Item 3.5.1. The automated survey terminal intends to reduce the burden on both managers and visitors, while still collecting quality information in protected areas. The Computer-Assisted Kiosk (CAKI), described in Chapter 4, collected a total sample of 896 electronic questionnaires taken by the visitors to Iguaçu National Park in February of 2008 (Chapter 3, item 3.4.1). The two levels of the Independent Variable (IV) consist of the terminal operation modes *hosted*, where a human host conducted part of the interviewing process, and *unhosted*, where the terminal handled the interviewing process was fully automated. The experimental design separated the 896 respondents in two groups during the February sampling period with each group taking the survey using one of the operational modes. The sampling was done by randomly switching between *hosted* and *unhosted* days of operation. This sampling strategy allowed researcher to see if

the Independent Variable "operation mode" had an effect on a set of Dependent Variables included in the study.

5.1 EFFECT OF OPERATIONAL MODE ON STUDY'S CATEGORICAL DEPENDENT VARIABLES

The first analysis involved a group of nominal dependent variables composed of respondent's gender, origin, level of commitment to the survey, and language choice. Frequencies and percentages were calculated for each dependent variable group for each operational mode (Unhosted and Hosted). It was hypothesized that each variable in the group would be unaffected or independent of the mode of Terminal Management. The null hypothesis stated that variables in the group would be independent of terminal management mode. The Chi-square values and their respective significance levels (p) were calculated using the SPSS statistical package and are shown on Table 5.1.

Table 5.1: Crosstab of respondents' characteristics by operational mode

		Survey Station Operation Mode[1]			
Dependent Variable	N	Unhosted (%)	Hosted (%)	df	$\chi 2^2$
Gender	538			1	.663
Male	312	189 (35.1)	123 (22.9)		
Female	226	129 (24.0)	97 (18.0)		
Origin	546			2	.772
Local	59	33 (6.0)	26 (4.8)		
National	196	113 (20.7)	83 (15.2)		
International	291	177 (32.4)	114 (20.9)		
Level of Commitment	908			2	2.932
Committed	510	305 (33.6)	205 (22.6)		
Partially Committed	244	136 (15.0)	108 (11.9)		

Uncommitted	154	81 (8.9)	73 (8.0)		
Language Choice	908			2	3.197
Portuguese	386	219 (24.1)	167 (18.4)		
English	227	122 (13.4)	105 (11.6)		
Spanish	295	181 (19.9)	114 (12.6)		

[1] Cells show case count, Hosted and Unhosted are levels of the independent variable; [2] all $\chi 2$ values are not significant at $p < .05$

Table 5.1 shows that Chi-square statistics for all variables in the study were not found to be significant ($p < .05$). As no statistical relationship was shown to exist between the dependent and independent variables in the sample under study, then any variation in the frequencies found in the table are based on chance. Thereby it fails to reject the null hypothesis that the variables in the group are independent of terminal management mode. The results show that for the variables included in the analysis, differences between hosted and unhosted interview responses were not significantly different, thereby supporting the validity of data obtained through automated CAKI survey method. Complete frequencies can be found in Appendix 6.

5.2 EFFECT OF OPERATION MODE ON STUDY'S CONTINUOUS DEPENDENT VARIABLES

The second analysis involved a group of dependent interval and ratio variables and the same nominal independent variable, the terminal's operational mode. Interval variables measured respondent's overall satisfaction with the Park, whether their expectations were effectively met, the probability of a return visit, likelihood they would suggest to others that they visit the Park, and their overall satisfaction with the region. Ratio variables measured respondent's age and survey taking runtime in seconds. Frequencies, means and variances were calculated for each variable for each operational mode (Unhosted and

Hosted). It was hypothesized that the means for each variable in the group would be equal for either operational mode. The null hypothesis stated that the means of each dependent variable would not differ for each operational mode (Unhosted and Hosted). Values for *t* and the respective significance levels (p) were calculated and are shown on Table 5.2.

None of the *t*-values for these variables was significant ($p < .05$) thereby failing to reject the null hypothesis. Again results show that based on the variables included, hosted and unhosted survey results do not differ significantly and that the data obtained using the automated CAKI survey are validated. Complete frequencies can be found in Appendix 6.

Table 5.2: t-Tests of respondents' characteristics by operational mode

	Survey Station Operation Mode[1]					
	Hosted		Unhosted			
Dependent Variable	N	Mean	N	Mean	Diff.	*t*-value[2]
Overall Satisfaction (Park)[3]	308	7.91	439	7.76	-.16	-1.253
Expectation Effectively Met[3]	274	7.55	387	7.55	-.00	-.013
Probability of Return in Future[3]	254	7.21	364	7.26	.05	.290
Degree of Referring to Others[3]	238	8.31	346	8.31	.00	-.003
Overall Satisfaction (Region)[3]	231	7.91	337	7.93	.02	.148
Respondent Age	221	28.79	317	28.75	-.04	-.030
Runtime (seconds)	376	267.77	520	272.73	4.97	.738

[1] Hosted and Unhosted are levels of the independent variable; [2] all values are not significant at $p < .05$; [3] values are levels in a 1-9 likert scale.

In sum, results from the group that participated in the interview through a human facilitator (Hosted) cannot be said to be different from those of the group that only

interacted with the CAKI terminal (Unhosted). The feasibility of automated operation was further validated in that the machine-specific sampling scheme resembles other randomized systematic sampling schemes since between-group means or case distribution for all variables included in the study showed no significant difference. The "unhosted" mode is in fact "machine-hosted". This result reinforces the effectiveness of the machine's communication strategy that uses a virtual character as a substitute for a human and targets the visitor population much as a personal invitation randomized systematic sampling might do. The approach seems to off-set an otherwise expected volunteering attendance bias. A more extensive investigation could be conducted to validate these preliminary results.

5.3 ESTIMATING COST EFFECTIVENESS

Once researchers were sure that the CAKI system did not affect the reliability of survey data or sampling effectiveness, a comparison between personal versus automated interview methods was made in order to estimate the actual costs of each. Typical costs involved in on-site face-to-face surveys include: training the field interviewers; travel and lodging near the survey sites; wages of the field supervisor and the interviewers; costs for printing the survey forms; and those for manually entering data to generate the binary datasets. Automated CAKI costs include the basic computer hardware and the cabinet (industrial kiosks have these usually available in one piece); the Human Interface Devices (display, pointing devices, audio system, etc.); the set of Multidimensional Survey Sensors (weather, river flow, water quality, environmental noise, crowd, psychophysiological gaugers, etc.); the software that runs the system; and electricity. Besides individual item costs for both methods, three other potential costs are considered:

(I) a survey application in a park; (II) a second application in the same park, consecutively; and (III) the cost of additional interviews for either survey application. The later situation would become more significant for parks with lower levels of visitation wanting a probability sample or for long-term studies. Table 5.3 shows the types and frequency of costs typically associated to these two survey methods.

Table 5.3: Types and frequency of costs incurred on traditional and automated survey methods

Method and cost item	**1st Campaign**	**2nd+ Campaign**	**Additional Interview**
Face-to-Face / Paper-and-Pencil			
Training	X		
Travel	X	X	
Local Stay (lodging, food)	X	X	X
Supervisor (wages)	X	X	X
Interviewers (wages)	X	X	X
Forms Printing	X	X	X
Data Entry (digitalization)	X	X	X
Automated CAKI			
Computer	X		
Cabinet	X		
Interface (HID and MSS)*	X		
Software	X		
Electricity	X	X	X

* HID = Human Interface Devices; MSS = Multidimensional Survey Sensors;

After initial implementation costs for CAKI, the only recursive cost is for electricity, which is marginal due to the low power consumption of electronic devices. On the other hand, traditional interviewer-based surveys have upfront costs that occur repeatedly all the way down the chain of data collection and processing.

The actual initial cost involved in the pilot survey system developed in this study was about US$ 2,700.00. Considering a yield of 35 interviews per day and the electricity cost in the survey site, each interview's net cost was of only US$ 0.05, equivalent to US$ 20.00 for a sample of 400 respondents and US$ 202.00 for the total sample of 4,047 visitors. The initial investment, however, does not diminish and can be used many subsequent times. During the pilot survey the cabinet did not suffer any damage or need any repairs. But the computer hardware had to be repaired or parts exchanged (hard disk, keyboard, mouse, motherboard, graphics board) which represented about 15% of the initial cost. An initial investment in better hardware could lower costs further. Adding up all the kiosk items, the CAKI implementation in Iguaçu National Park had a total cost of US$ 3,300.00. CAKI costs, however, can vary depending on the types of HID equipment used (ex.: displays can be normal, extra-large, or even capable of 3D vision); the type and amount of MSS devices that are loaded in the system (a mini-meteorological station, a wireless water column pressure sensor, a wireless trailside people counter, a high-fidelity microphone, a wireless landscape imaging camera, a high quality facial imaging camera, a skin conductivity gauger, among others); and the level of connectivity desired (local area network, cell phone network or satellite link). Including the sensors that were substituted by alternative data sources (weather and river flow), the total cost was estimated to be around US$ 5,000.00.

By comparison, surveys done by the Visitor Services Project (VSP) provide a snapshot of the overall visitor population in a US park during a 7-10 day study period and cost approximately US$ 15,000 to US$ 30,000 to administer (National Park Service, 2007). CAKI's cost effectiveness appears to be three to six times less expensive—and is

reusable. These costs, however, did not contemplate an expected cost for development of the main software (KISS), which was done by this Author as part of his academic work and are now available. Comparable but non-specific survey programs currently available in the market have prices around US$ 2,000.00 (per single user license/unlimited surveys). A final survey cost consideration regards the usually lower cost of human labor in developing countries, which would make traditional surveys more cost-effective than in the US. In the case of Brazil, the changes associated with economic globalization, including a steady increase in wages, make the overall cost for carrying out surveys comparable to that in the US. It is worthy to note, however, that despite CAKI being more cost effective, it cannot replace traditional face-to-face surveys in all circumstances, as will be discussed in Chapter 8.

CHAPTER 6: EVALUATION OF RESPONDENT TIME AND EFFORT AND PERCEPTION OF SURVEY BURDEN

This chapter examines the engagement of visitors who took the automated survey device as well as their perceptions about the survey difficulty and length. CAKI utilized multimedia interaction, a streamlined graphical user interface design and user-centered functionality in an attempt to minimize survey burden for visitors. A sample of 3,995 surveys were taken by visitors to Iguaçu National Park between January and November 2008. The sampling scheme was machine specific and comparable to randomized systematic sampling. Internal system variables collected metadata that described the number of answered questions as well as the time spent on each question and total time in the survey for each respondent. Two meta-survey questions explored the participant's perception of time spent with the survey and the easiness or difficulty to operate the electronic terminal. Both factors are directly associated with questionnaire burden. Appendix 1 contains detailed information about the survey questionnaire.

6.1 RESULTS

Respondents were aggregated into three groups based on their persistence while answering the questionnaire. Those who selected a language but went no further were considered to be *"uncommitted"*; those who answered some but not all of the questions were considered to be *"partially committed"*; and those who answered all questions were considered to be *"committed."*

Figure 6.1 gives the percentages for each as a function of commitment as well as the number responding. Approximately 81% of those who began the survey remained partially or fully committed. (Chapter 3, Item 3.4 provides an introductory discussion about response rate in automated on-site survey.)

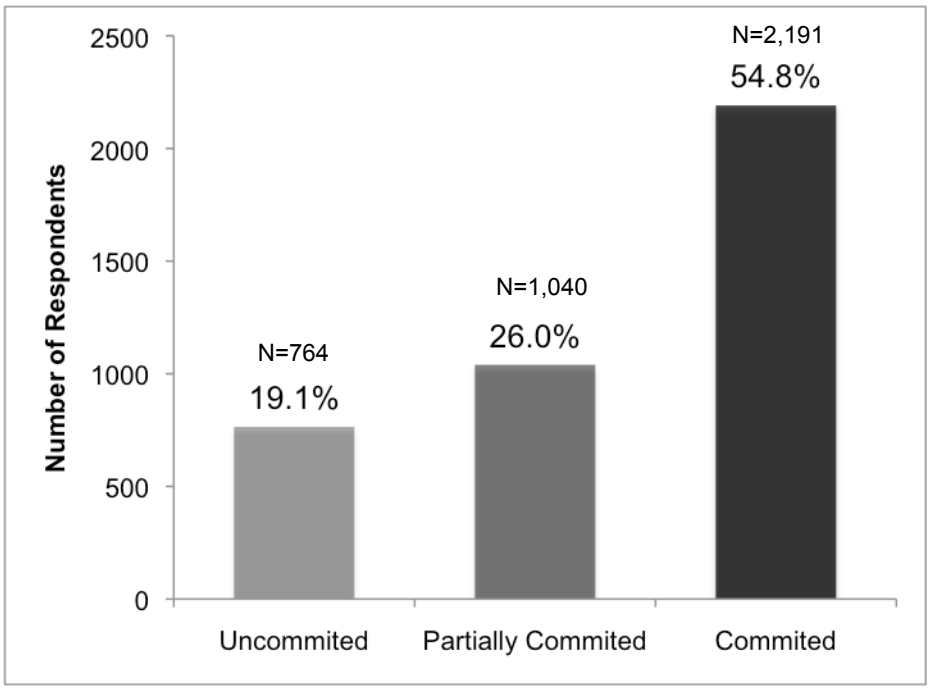


Figure 6.1**: Percentage and frequencies for uncommitted, partially committed, and committed respondents.**

The respondent drop-out rate (Figure 6.2) is a function of the number of questions answered in the survey. Once respondents have answered question 2, the drop rate declines and respondents show a greater commitment as they progresses further into the survey. The highest percentage (30.3%) of partially committed respondents answered only 1 question, before abandoning the survey (Figure 6.3). This most likely represents visitors who did not become strongly engaged by the kiosk. Potential reasons include time constraints, younger children, and lack of involvement with the survey. The smallest

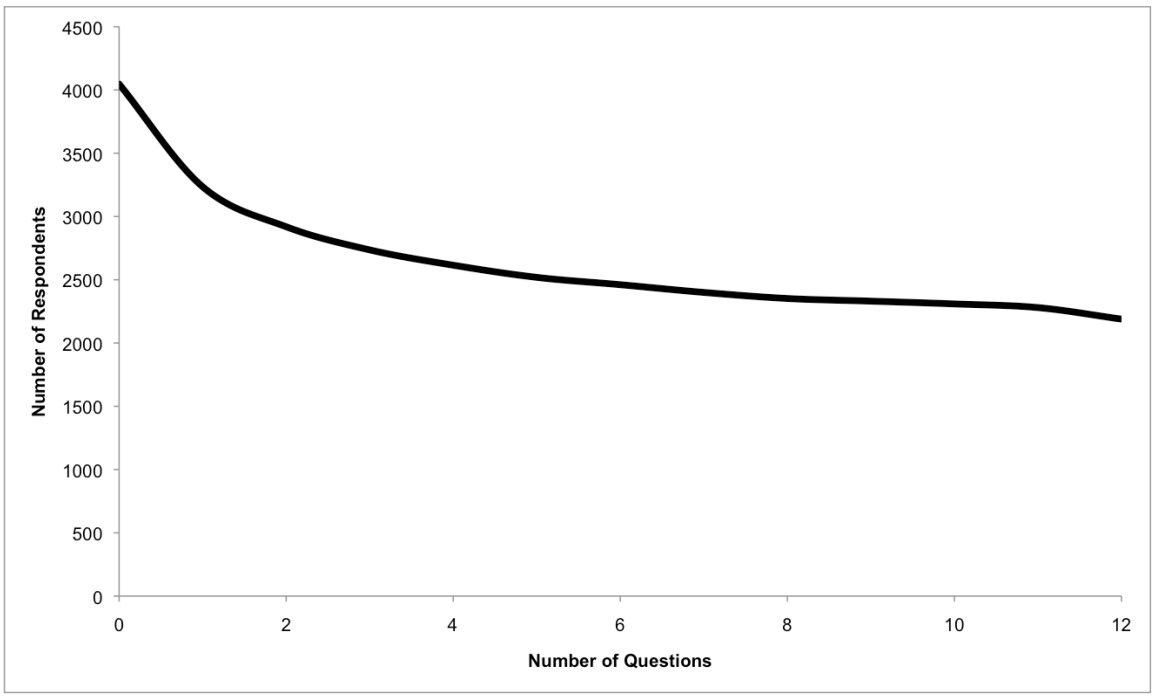
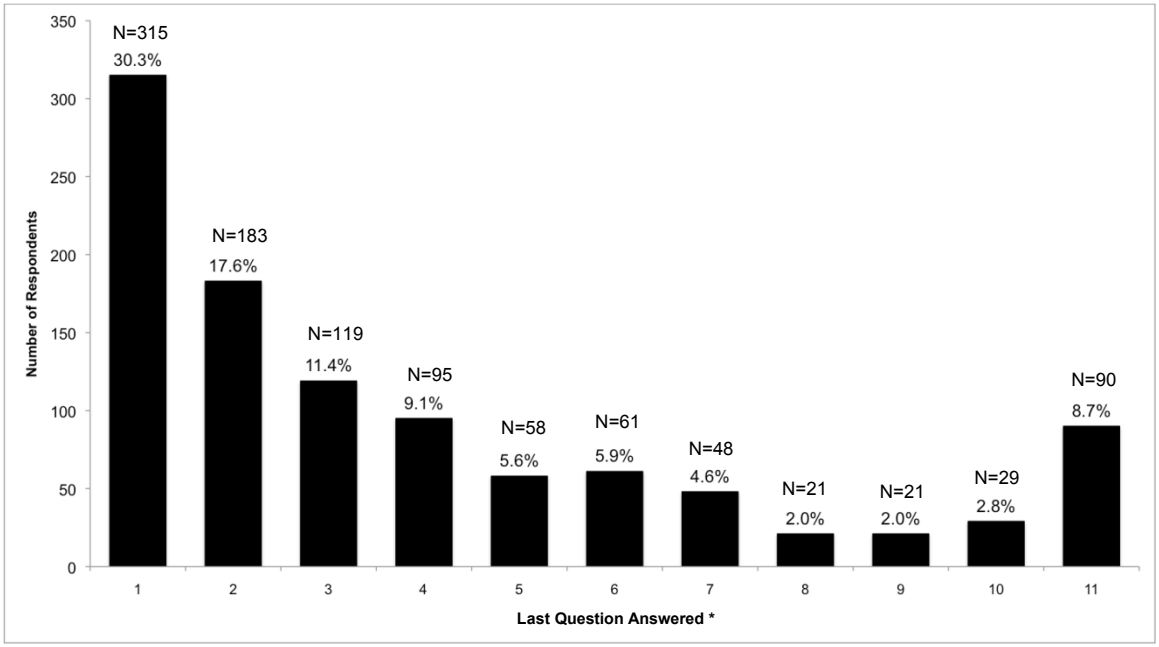


Figure 6.2**: User drop-out rate as a function of number of questions answered in the survey.**



* 1 to 11 mean question numbers; Because the chosen questionnaire design did not offer a skip option, the n^{th} answered question represents also the total number of answered questions.

Figure 6.3: Distribution and Frequency of Last Question Answered by Partially Committed respondents

percentages were reported during questions 8 and 9 at 2.0 %. These results suggest that very few of the respondents left the kiosk after completing either of the two questions. Question 8 refers to the visitor's nationality, and question 9 is in regard to his gender. A relatively high percentage of people responded a total of 11 questions, suggesting that this question was better suited to visitor interaction than the following, at number 12. The greatest drop in questions answered is observed within the first 5 questions, suggesting less commitment to the survey during this time. The drop rate is reduced after question 6 when the respondent is presented with the second multiple-choice question.

Another way of analyzing both commitment and survey burden is to look at the time respondents spent on the survey before dropping out or finishing (Figure 6.4). Respondents rarely took more than 6 minutes to complete the survey. This suggests that respondents had an efficient interaction with CAKI and the survey, encountering few, if any, problems. This, in turn, suggests that survey burden was minimal. The number of people who took more than 6 minutes to complete the survey represents less than 0.2 % of the total number of respondents.

Figure 6.5 shows the frequencies and percentages for partially committed respondents by time spent in minutes. The 26.9% of the partially committed who spent under 1 minute are representative of the group of visitors who were initially attracted to the kiosk, but were unable to successfully engage with either the machine or the activity. A total of approximately 65% of respondents in the partially committed category abandoned the survey in less than 2 minutes.

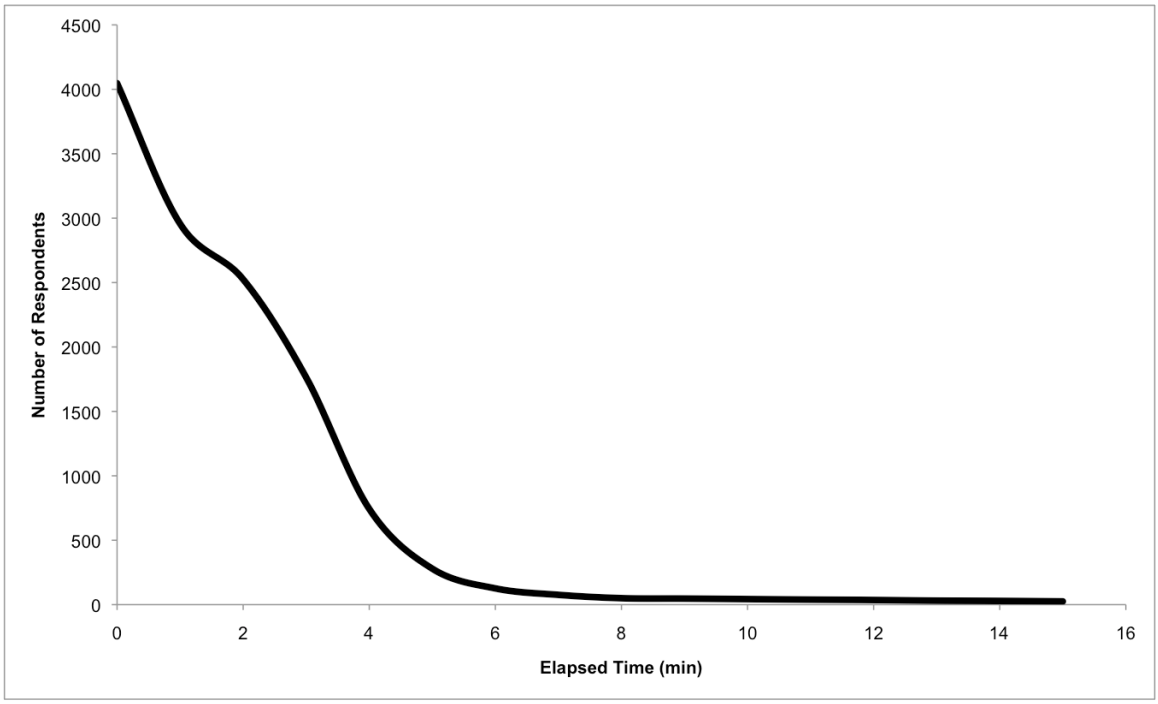
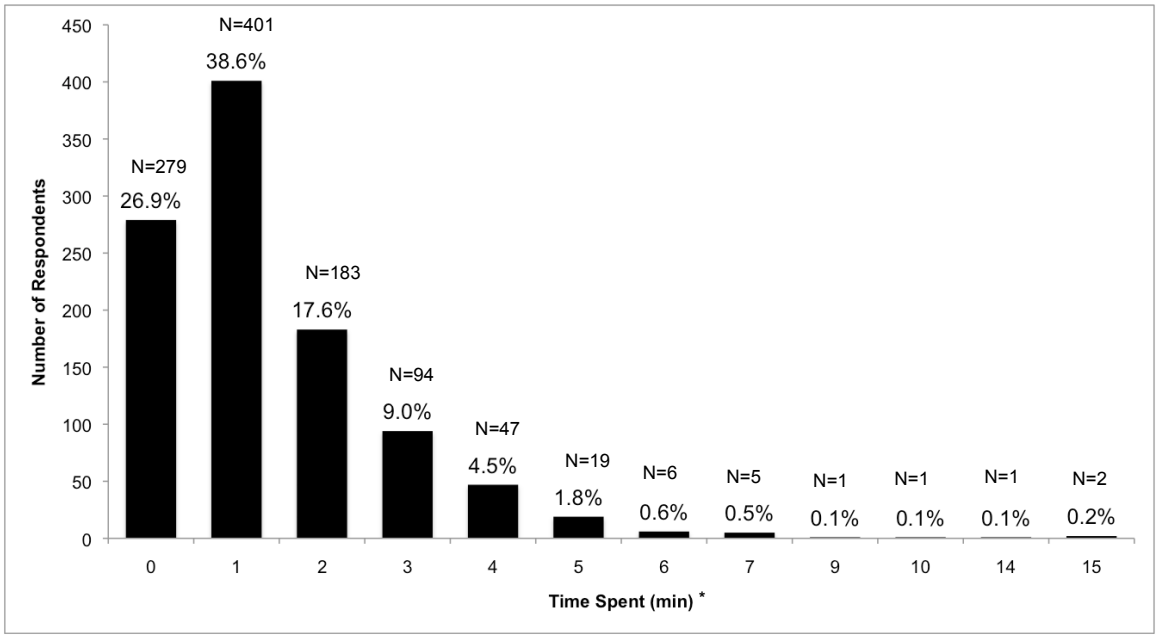


Figure 6.4: Overall respondent drop-out rate by time spent answering questions



* Minutes before giving up answering; + cases taking ten or more minutes: one 10, one 14, two 15 and one 33, which was considered an outlier, likely due to technical issues with the electronic system.

Figure 6.5: Distribution of Partially Committed respondent by time spent in minutes

The skewed distribution toward abandonment in the early stages of the survey suggests that it was not a time burden that caused respondents to disengage with the survey. Two items on the survey provide a more direct evaluation of the survey burden associated with CAKI. Respondents were asked to evaluate both the difficulty of taking the survey and its length on 9 point Likert scales. Table 6.1 shows the frequencies and percentages for the evaluation of difficulty and time spent (length) and table 6.2 summarizes descriptive statistics for time spent and the respondent's evaluation of difficulty and length.

Table 6.1: Frequencies and scores about using the electronic survey system

	Difficulty*				**Time Evaluation***		
Scale	**L**	**N**	**%**	**Scale**	**L**	**N**	**%**
Extremely Complex	1	44	1.9	Extremely Long	1	82	3.6
Very Complex	2	6	0.3	Very Long	2	89	4.0
Moderately Complex	3	8	0.3	Moderately Long	3	94	4.2
Slightly Complex	4	23	1.0	Slightly Long	4	203	9.0
Neutral	5	58	2.5	Neutral	5	683	30.4
Slightly Simple	6	185	8.0	Slightly Short	6	151	6.7
Moderately Simple	7	233	10.1	Moderately Short	7	385	17.1
Very Simple	8	506	21.9	Very Short	8	321	14.3
Extremely Simple	9	1,247	54.0	Extremely Short	9	242	10.8
Total		2,310	100	Total		2,250	100

* L = scale item value; N = frequency; % = percent

Table 6.2: Frequencies of respondents' responses on using the electronic system

	Meta-survey assessment*		
Statistics	**Difficulty****	**Time Spent*****	**Time Evaluation**
N	2,310	2,225	2,250
Mean	8.0	4.74	5.8
Median	9.0	4.0	5.0
Mode	9	4	5
SD	1.6	1.8	2.1
Variance	2.5	3.3	4.3
Range	8	29	8
Minimum	1	0	1
Maximum	9	29	9

* These variables came from the questionnaire's ending, aimed at assessing the survey taking process; ** Difficulty for dealing with the electronic terminal (9-point Likert scale: 1 – extremely difficult to 9 – extremely easy); *** "Time Spent" is a dynamic variable with the actual time (minutes) spent so far working on the survey, shown to each respondent in the context of time evaluation (9-point Likert scale: 1 – extremely long to 9 – extremely short).

The data indicate over 94% of respondents rated the electronic system as 6 or higher on this scale. These results indicate very little survey burden, as evaluated by the respondents themselves.

Respondents perceived their time investment either as short (48%), or to be neither long nor short (30.4%). The remaining 21.6% evaluated the time spent as long. These results provide further support for the premise that the survey administered posed little survey burden to the respondents.

6.2 DISCUSSION

Minimizing questionnaire burden is a core characteristic of CAKI and is paramount for the overall feasibility of any automated survey kiosk. The results attest to the fact that the solutions adopted to lessen burden were largely effective and yielded data from over 80% of the respondents. Other options not utilized in this study are available that can help to maintain the respondent's interest in the survey and a high engagement level throughout the entire questionnaire. This will be discussed further in the concluding chapter.

Overall, the data suggests that in the case of partially committed respondents, the abandonment usually occurs within the first 2 minutes or 2 questions. The acute drop rate in respondent adherence observed up to question 2 might be explained by factors such as large groups and young children. Also, sometimes visitors who come with commercial groups may find they have limited time as the group rushes through the area. Children are also naturally attracted to the kiosk, due mostly to the virtual character, as opposed to the survey itself. A possible way of minimizing the initial drop observed is to develop a branch of the survey geared towards children and young adults, which would not only captivate their interest but contain less questions and a smaller time investment. The initial drop is most likely not a time related burden as it occurred within the first few minutes of the survey, and is probably related to lack of interest (children), lack of time (excursion groups), or lack of interest of the viewer. Intervention by a virtual surveyor is a possible solution to further engage the respondent and avoid abandonment.

CHAPTER 7: THE EFFECT OF ENVIRONMENTAL CONDITIONS ON THE VISITOR EXPERIENCE AT IGUAÇU NATIONAL PARK, BRAZIL

The survey kiosk has multidimensional measurement capabilities and automatically recorded real-time weather conditions as independent variables during each instance of a visitor responding to the electronic questionnaire (Chapter 3, Item 3.6.3). The survey itself had no question regarding visitor perceptions about weather patterns. This allowed researchers to look for the effect of independent environmental variables, like sky conditions and temperature, on the study's dependent social variables, such as visitor satisfaction with the park, satisfaction with the region, the degree to which expectations were met, the probability of returning in the future, and the likelihood of recommending the park experience to others. A third environmental variable, Iguaçu River water level flow, was also recorded and the effect on the aforementioned dependent variables analyzed (Chapter 3, Item 3.5.3).

7.1 RESULTS

Atmospheric conditions affected respondents' overall satisfaction with the park experience (Table 7.1). Satisfaction tended to decrease under rainy conditions and increase under all other weather conditions. The application of the Scheffe test to the stratified data verified that the effect of partly cloudy and rainy conditions on satisfaction was statistically significant ($P<.05$).

On the other hand, the mean differences of other atmospheric sky conditions were not statistically significant for the other four social variables: the degree to which the visitors' expectations were met; the probability of their future return; the likelihood they would recommend the experience to others; and the overall satisfaction toward the broader region.

It should be pointed out that the real-time meteorological data collected by the surveying machine was retrieved from a base station located 7.5 miles from the study site. It is expected that slight variations in weather can occur within this distance that cannot be evaluated from the broadcasted meteorological data. The utilization of local instruments directly attached to the survey terminal could provide more accurate measurements.

The Heat Index, a variable that is a function of air temperature and humidity, did not affect any of the social variables analyzed (Table 7.2). This might be attributed to the small range among the data obtained (highlighted in bold in Table 7.3), which did not include Heat Indexes above 100, which can cause discomfort and adverse physiological effects (NOAA, 2010). Therefore, within this range, it was not expected that the Heat Index significantly affect the perception of visitors about the park and the region.

River water level is the environmental variable that most strongly affected the social variables included in the analysis (Table 7.4). The application of the Scheffe test to the stratified data verified that satisfaction with the park experience increased with higher river flows and decreased with lower flows ($P<.05$).

These results are in line with the findings of Hudson (2002) who found that the visitors to waterfalls are often disappointed to find the flow much less than they were led

Table 7.1: Effect of the atmospheric conditions on five dependent social perception variables on visitors to Iguaçu National Park

Perception Variables	Atmospheric Conditions	N	Mean*	F	p
Overall Satisfaction (Park)		2,041	8.01	2.71	**.029**
	Clear sky	324	8,03		
	Partly cloudy[a]	789	8.07		
	Cloudy	810	8.00		
	Heavy cloudy	24	7.75		
	Rainy[a]	94	7.53		
Expectation Effectively Met		1,846	7.61	.19	.942
	Clear sky	295	7.58		
	Partly cloudy	715	7.65		
	Cloudy	731	7.59		
	Heavy cloudy	22	7.59		
	Rainy	83	7.52		
Probability of Return in Future		1,767	7.30	.52	.725
	Clear sky	285	7.45		
	Partly cloudy	678	7.27		
	Cloudy	700	7.28		
	Heavy cloudy	22	7.05		
	Rainy	82	7.27		
Recommendation to Others		1,691	8.26	.19	.944
	Clear sky	273	8.30		
	Partly cloudy	645	8.29		
	Cloudy	671	8.23		
	Heavy cloudy	21	8.14		
	Rainy	81	8.25		
Overall Satisfaction (Region)		1,611	7.96	1.37	.242
	Clear sky	258	8.09		
	Partly cloudy	614	7.99		
	Cloudy	642	7.87		
	Heavy cloudy	20	8.00		
	Rainy	77	8.09		

[a] Scheffe test verifies that the mean difference is significant at the 0.05 level.

* Means are scores in a 9-point Likert scale with 9 = extremely satisfactory; 5 = neither satisfactory nor dissatisfactory; and 1 = extremely dissatisfactory. All dependent variables follow similar scaling (see Appendix 1).

Table 7.2: Effect of the independent variable heat sensation levels on five dependent social perception variables on visitors to Iguaçu National Park

Perception Variables	Heat Index (°F)*	N	Mean**	F	p
Overall Satisfaction (Park)		2,345	7.98	2.26	.105
	≤ 80	809	8.06		
	80-89	1,129	7.91		
	90-104	809	8.06		
Expectation Effectively Met		2,130	7.55	.32	.725
	≤ 80	743	7.55		
	80-89	1,017	7.52		
	90-104	370	7.61		
Probability of Return in Future		2,032	7.24	1.28	.279
	≤ 80	713	7.13		
	80-89	965	7.28		
	90-104	354	7.31		
Recommendation to Others		1,940	8.24	1.33	.265
	≤ 80	674	8.17		
	80-89	921	8.29		
	90-104	345	8.25		
Overall Satisfaction (Region)		1,850	7.93	.35	.702
	≤ 80	637	7.92		
	80-89	880	7.92		
	90-104	333	7.99		

* Thermal sensation was computed from measurements of current air temperature and relative humidity using the Heat Index table and its derived equation (Steadman, 1979) (Chapter 3, Item 3.6.3).

** Means are scores in a 9-point Likert scale with 9 = extremely satisfactory; 5 = neither satisfactory nor dissatisfactory; and 1 = extremely dissatisfactory. All dependent variables follow similar scaling (see Appendix 1).

to expect by published descriptions and images. The results also agree with the findings of Whisman and Hollenhorst (1998), who found water flow level to be among the most important variables explaining satisfaction with river boating, which is also a common activity in Iguaçu National Park.

Table 7.3: Heat Index values obtained in the Iguaçu National Park survey plotted on a reference HI table (NOAA, 2010)

Air Temp (°F)[2]	Relative Humidity (%)[1]																			
	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
140	125																				
135	120	128																			
130	117	122	131																		
125	111	116	123	131	141																
120	107	111	116	123	130	139	148														
115	103	107	111	115	120	127	135	143	151												
110	99	102	105	108	112	117	123	130	137	143	150										
105	95	97	100	102	105	109	113	118	123	129	135	142	149								
100	91	93	95	97	99	101	104	107	110	115	120	126	132	138	144						
95	87	88	90	***91***	***93***	***94***	***96***	***98***	101	104	107	110	114	119	124	130	136				
90	83	84	85	***86***	***87***	***88***	***90***	***91***	***93***	***95***	***96***	***98***	***100***	102	106	109	113	117	122		
85	78	79	80	***81***	***82***	***83***	***84***	***85***	***86***	***87***	***88***	***89***	***90***	***91***	***93***	***95***	***97***	***99***	102	105	108
80	73	74	75	***76***	***77***	***77***	***78***	***79***	***79***	***80***	***81***	***81***	***82***	***83***	***85***	***86***	***86***	***87***	***88***	***89***	***91***
75	69	69	70	***71***	***72***	***72***	***73***	***73***	***74***	***74***	***75***	***75***	***76***	***76***	***77***	***77***	***78***	***78***	***79***	***79***	***80***
70	64	64	65	***65***	***66***	***66***	***67***	***67***	***68***	***68***	***69***	***69***	***70***	***70***	***70***	***71***	***71***	***71***	***71***	***71***	***72***

Values in the cells are Heat Index (HI); Baseline table data from (Steadman, 1979)

HI levels - cell shading key: ≥ 130; 105 – 129; 90 – 104; 80 – 89; ≤ 80;

Bold-italic values represent HI occurrences in the study period; Maximum HI = 100;

[1] Relative humidity in the study period ranged from 13% to 100%;

[2] Air temperatures in the study period ranged from 50 °F to 95 °F.

Likewise, river flow also affected the degree to which expectations were met, the probability of return in the future, and the degree to which visitors would recommend a park visit to others. The Scheffe test verified that, as with the satisfaction variable, both of the latter variables increased with higher river flows and decreased with lower flows ($P<.05$).

The variable on overall satisfaction regarding the broader region, however, was not affected by the river flow. This result was expected due to the many other attractions

Table 7.4: Effect of the independent variable river water level on the variation of five dependent variables related to social perceptions of visitors to Iguaçu National Park.

Perception Variables	River Water Level	N	Mean*	F	p
Overall Satisfaction (Park)		2,027	7.91	3.15	**.043**
	High[a]	791	8.02		
	Medium	502	7.91		
	Low[a]	734	7.80		
Expectation Effectively Met		1,843	7.54	3.01	**.049**
	High	738	7.67		
	Medium	455	7.49		
	Low	650	7.44		
Probability of Return in Future		1,765	7.25	3.74	**.024**
	High[b]	710	7.39		
	Medium	430	7.27		
	Low[b]	625	7.08		
Recommendation to Others		1,698	8.20	3.60	**.028**
	High[c]	683	8.31		
	Medium	411	8.19		
	Low[c]	604	8.09		
Overall Satisfaction (Region)		1,641	7.97	.54	.581
	High	662	8.02		
	Medium	396	7.94		
	Low	583	7.95		

Scheffe tests show the mean differences in [a], [b] and [c] are significant at the 0.05 level. * Means are scores in a 9-point Likert scale with 9 = extremely satisfactory; 5 = neither satisfactory nor dissatisfactory; and 1 = extremely dissatisfactory. All dependent variables follow similar scaling (see appendix 1).

that the broader touristic experience typically entails, such as the Itaipu dam and power plant, the Bird Park, purchases in Ciudad del Este, a tax-free city in Paraguay, folkloric shows, all of which are less affected by the river flows. The effect of flow on the visitor experience highlights the river's tremendous importance as a touristic attraction in the Iguaçu National Park.

7.2 DISCUSSION

The integrated collection of environmental variables and social data can be an asset to social science and park management as a whole. Tourism and outdoor recreation are highly dependent on climate and, in some parts of the world, climate itself is the main feature promoting these activities (Smith, 1993). Weather conditions vary both spatially and temporally around the world, with consequent implications on recreation. For example, Figure 7.1 shows the yearly variations in total rainfall for the month of March at Iguaçu National Park, in Brazil, where the pilot-test of the automated survey was done.

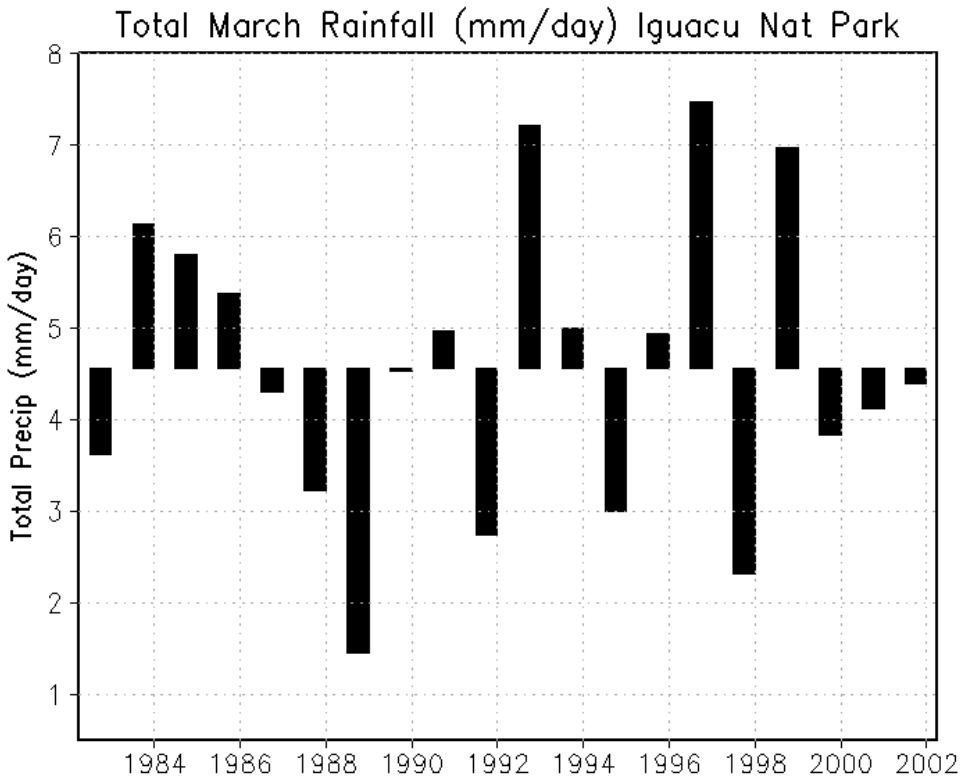


Figure 7.1: March's precipitation time series 1983-2002 for Iguaçu National Park area. Bars show deviation from long term month's average in mm/day (CPTEC - INPE, 2010).

As it can be readily noted, some years were considerably drier/wetter than others. Comparing the responses to the same set of questions taken during periods of contrasting weather patterns can allow the determination of systematic differences which are affected

by the kind of weather present during the outdoor experience being surveyed. This holds a variety of implications on visitor research in protected areas, such as allowing for the removal of weather induced biases, and for weather specific research. Additionally this integration holds complementary implications for park managers, allowing them to gauge and foresee visitors' responses to manifestations of global climate change and thus plan management solutions to accommodate or compensate these changes. Studies have shown that visitation levels may increase or decline depending on conditional scenarios (Jones & Scott, 2006; Loomis, 2004). Additionally, protection-oriented management may demand changes in resource reallocations (Scott, Malcolm, & Lemieux, 2002) visitor management, and increase the necessity to enhance public communications through interpretation, education, and outreach (Lillo, Boness, Maza, & Gonzalez, 2004; Welch, 2005).

Having MSM data automatically integrated in a social survey venue reduces or eliminates the operational burden of collecting site-specific variables. It opens more response time for asking study-specific questions.

Obviously, multidimensional measurements in a social survey context can be expanded beyond the three environmental variables measured in this pilot-test to demonstrate the feature's functionality. The same platform can collect site-specific data such as visitor density near the kiosk, local noise, air quality, water quality (i.e. turbidity), daylight, among others, by simply plugging in the specific sensors and setting the terminal software to carry out the measurements during each survey event or survey interval. The MSM platform, equipped with biometrical sensors, could also capture respondent-specific measurements of a non-cognitive nature such as facial expressions,

gestures, skin conductivity, or heart rate. Socio-psychological studies that rely on this level of information can additionally benefit from MSM systems by interviewing the population at the experience site and in a natural setting (avoiding bias sometimes found during laboratory research).

An example of a study that could potentially benefit from the use of MSM systems within the HDNR field is the measurement of people's implicit attitudes. The most predominant approach to measure implicit attitudes makes assumptions about a person's attitude toward an object based on the person's response time to a stimulus; response times are often measured using computer software (Manfredo, 2008; Ottaway, Hayden, & Oakes, 2001). A predominant measurement method is the Implicit Association Test (IAT) (Greenwald, McGhee, & Schwartz, 1998). IAT utilizes computer software and people's reaction times to measure the strength of association between categories of "pleasant" and "unpleasant." The assumption is that people react faster to associations that are more compatible with their attitudes. The survey system developed in this study can effortlessly implement implicit attitude measurements with visitors, while measuring explicit attitudes through the cognitive survey items. Measurements of attitude in human-dimensions research is important as the attitude is believed to be a causal factor of behavioral disposition (Manfredo, Vaske, & Decker, 1995).

While CAKI and MSM provide multiple possibilities for integrating environmental and physiological variables with social survey data, the more technologically advanced physiological data collection techniques hold philosophical and ethical implications that have to be thoroughly disclosed to visitors or otherwise dealt with before they can be adopted.

CHAPTER 8: CONCLUSIONS AND RECOMMENDATIONS

Although the main purpose of the study was to develop and evaluate a new survey methodology, the study did generate considerable data from a sample of 4,000+ visitors of interest to Iguaçu National Park managers. A summary of these findings appears in Appendix 6. The development of such methodology responds to the need to continue to improve visitor surveys in protected areas (Machlis, 1996; Manning, 1999)—especially in countries like Brazil (Ministério do Meio Ambiente, 2008) which has seen a dramatic increase in visits to its parks and other protected areas (Ministério do Meio Ambiente, 2003) but still has somewhat limited capacity and experience in conducting social science in its parks. The computer assisted kiosk survey system (CAKI) is a multi-media, automated, stand-alone way of collecting visitor information that is less expensive and more efficient for managers. Additionally, it is capable of taking multi-dimensional measurements such as physical or environmental conditions, group size or affective behaviors while visitors take a survey. All of these types of data can be recorded or dynamically used as part of the interview, in real time. CAKI can be administered at locations where the visitor is immersed in and experiencing the protected area environment. The CAKI components, including the computer software and its task modules (KISS), the hardware and the survey kiosk developed during the study, proved to be functional and were evaluated favorably by users during the study.

8.1 METHOD'S FEATURES AND PERFORMANCE

The tests performed so far conclusively demonstrated that the automated surveying system developed as part of this research can substitute for surveys using a human host and still produce a desired quantity and density of information. The system can outperform both surveys conducted by an interviewer and automated surveys completed off-site, in the sense that it can a) associate environmental variables (e.g. waterfall volume/rain/temperature) in real time with visitors' perceptions about their experiences in course; b) use an animated character chosen from the Park's fauna (in this work, the coatimundi Quiii!) as a part of a communication strategy; and c) be remotely programmed and monitored using a few easily configurable tables and variables, allowing researchers to implement diverse and prolonged sampling strategies with little extra labor or cost. Survey programming and monitoring can also be done remotely, from anywhere in the world (managed from a centralized location), using either the internet or cell phone technology.

A testing of this survey method conducted at Iguaçu National Park, Brazil, demonstrated the ability of the new methodology to complete an extensive survey campaign that would not have otherwise been feasible. Besides making visitor information more abundant and promptly available to assist PA managers in their decision-making processes, CAKI has the potential to provide real-world lab-like settings to more social-science researchers.

This study partially addresses three major factors associated with the low availability of social data in Brazil: the weak tradition of generating and using visitor data in PA management; the lack of technical expertise within the PA system to run or

coordinate survey studies; and the scarcity of funding to conduct costly traditional survey campaigns. Current survey methods usually either have a high operational burden or do not fit well as on-site surveys. To overcome the operational burden on-site interviewing was conducted without an interviewer and used a kiosk-based communication strategy that addressed the shortcomings of other survey booths.

This study utilized a virtual interviewer based on the reasoning that people relate to virtual human-like characters in a similar way that they relate to real humans. Virtualized kiosks can be fully automated, a condition that reduces or eliminates most of the administrative burden associated with conducting on-site surveys both during and after data collection. The CAKI approach faced some challenges while addressing the strengths of interviewer-mediated surveys: convincing members of the sampled population to take the survey, obtaining a valid randomized sample, and fostering the interviewer-interviewee personalization that establishes a type of social commitment which commonly yields higher rates of questionnaire completion. These appear to have been met by creating a virtual interviewer who exhibited personality traits that closely proxy the congeniality of a skilled survey host as opposed to the robotic face used by other applications.

The raccoon-like coatimundi was chosen as the virtual character because it inhabits the park and is frequently seen by the visitors. The speaking animated animal, who also expressed itself with facial and body gestures, was backed by a communication strategy that enticed the visitor to take part in the survey, encouraged continued participation and expressed gratitude for the participation. Results enable us to conclude that the pilot surveys conducted in Iguaçu National Park were effective using this

approach. Park visitors were sampled during a period of roughly five months in 2008 and this yielded 4,047 interviews, using a single automated terminal. Eighty one percent of the interviewees committed to answering part of the survey and roughly 55% completed all questions.

A large sample like this would be of little use if it were not obtained randomly allowing result to be generalized. Kiosk-based surveys have a greater potential for volunteer bias when compared to interviewer-mediated surveys, where the human host can exert a high degree of persuasion on the respondent's willingness to engage in the survey. This study hypothesized that the care taken and innovation used while creating a virtual host would compensate for volunteer bias and generate data that is comparable to that obtained by human conducted interviews. This was supported by results from the experimental design in which respondents were randomly split between a control group and a treatment group. The first group was approached by a trilingual trained host that invited and assisted in the interviewing process while the treatment group took the survey without human participation, e.g., the automated terminal was operated in fully standalone mode.

This experiment was done in February, 2008 and included 12 questions typically found in visitor satisfaction and profile studies (N=896). The comparison of the data from the control and treatment groups showed no significant differences. Hence, early evidence was obtained that demonstrates that the survey system yields valid data. CAKI's Multidimensional Survey Measurements was also tested during this pilot survey to see if social-cognitive data related to visitor satisfaction could be analyzed in relation to

environmental variables like weather conditions and river flow. Results indicate that these environmental variables could be related to perceptions of satisfaction.

Since on-site surveys in PAs compete with the respondent's leisure time, minimizing questionnaire burden was a pervasive guideline throughout all development phases, from methodological reasoning to human-machine interaction solutions when writing the survey software. Questionnaire burden was assessed in the pilot survey, revealing that most people who left the questionnaire incomplete gave up in the first two minutes, for reasons that were most likely not related to time. The more time people spent on the questionnaire, the less likely they were to abandon the survey. This was corroborated by specific survey meta-evaluation questions addressing difficulty with the electronic terminal and an evaluation of time spent.

The CAKI methodology should undergo more research to exhaustively test its strength and confirm this study's results. Traditional non-response bias needs to be tested; experiments have to be conducted to test the specific effect of a chosen layout, multimedia and virtualization solution on questionnaire burden; and the system's ability to draw random-like samples must be further verified.

All in all, the multi-sensor configurations and dynamically attributable questionnaires establish the CAKI methodology as breakthrough in the PA Management and Natural Resources Sciences, drastically reducing the survey burden and largely expanding the researchers' ability to capture subtle associations/perceptions not feasible before.

CAKI as a supplemental survey method

Despite CAKI's demonstrated ability to conduct interviews in standalone mode, it was developed to be one of several available survey methods for PA managers. CAKI complements traditional surveys with its ability to carry out multidimensional data measurements and to collect real-time visitor data for an extended sampling period. There may be instances in which CAKI survey terminals can effectively replace traditional survey methods in places with many visitors like visitor centers, popular trail heads and other attraction sites. There is a variety of situations where an automated survey machine has limited or no functionality. For surveys conducted in wilderness or dispersed use areas, or surveys that require observations of complex behaviors, traditional survey methods are more appropriate.

The supplementary nature of CAKI allows for convergence with other survey methods. For example, computer-assisted web interviewing (CAWI) and CAKI can be utilized in multimodal surveys where the on-site contact is confined to the enticement and commitment phases. After a few questions that include the establishment of e-mail or social networking contact, the remainder of the survey is applied on-line at a later time. This would allow for the administration of longer questionnaires which can look and feel the same as the CAKI experience initiated in the protected area. Such a design could have data piping in which the answers given in CAKI mode dynamically show or drive what is presented in the CAWI mode.

8.2 STUDY LIMITATIONS

Despite the demonstrated feasibility and advantages of CAKI, the system has a set of limitations that call for caution regarding some aspects of the attained results. Regarding

scope, the developed survey method was tested in only one National Park. Due to sampling randomization and budget limitations, the survey was applied in only one location within the Park. Moreover, satisfaction measurements were taken nearby the main waterfall's lookout point, which is the Park's attraction that most strongly impacts the visitors because of its scale and majestic beauty. This condition may have masked possible dissatisfaction with other aspects of the visit. Regarding sampling representativity, the electronic terminal had two operation modes (human hosted and automated) that were compared by keeping all other survey aspects constant. Although respondents randomly allotted in either group were found non distinguishable, a specific non-response assessment for each operation mode was not done during this study. Additionally, in order to keep the pilot-survey's questionnaire complexity as low as possible, the question about visitor's origin had only three categories: Local, National, and International. This classification was later found to misrepresent the actual variety of travel habits and preferences that characterizes visitors of very different origins. The problem stems the fact that Iguaçu National Park is situated at the border of Brazil, Argentina and Paraguay. Visitors from the latter two countries may be, in many ways, similar to Brazilians. They share cultural patterns and the distance travelled to visit the Park. Nevertheless, they correctly marked "International Visitor," the same class as visitors from Germany and the United States, or visitors that traveled from Asia to the Falls. Argentinians corresponded to roughly 20% of all visitors in the year prior to the study, making it difficult to associate visitor behavior with visitor origin. In addition to being specific about the country of origin, it would be advisable to ask Brazilian about the state of origin given Brazil's continental size.

8.3 ETHICAL ISSUES

8.3.1 Ethical implications of employing an anthropomorphic virtual host.

The communication strategy adopted used a virtual character so as to give the machine a sentient identity. This allowed the communication with survey respondents to more closely resemble an interaction between humans, instead of a typical human-machine interaction. In this initial development, a common mammal commonly seen by the visitors throughout the park was used as the virtual host emulating the traits of a person, including speech with a lip-synched articulation of words. The effect was paradoxically surreal and realistic given the use of advanced computer animation graphics. It intrigued the audience and fostered a bond between the public and the automated survey system.

The appropriateness of assigning human characteristics to animals, defined as anthropomorphism, has been the theme of philosophical debate. A possible negative implication is that a humanized animal can reinforce the notion that its value lies in the similarities it holds to us rather than being intrinsically valuable in and of itself. Animals maintain a valued self-identity as they cope with the world. Rolston (1994) would say that valuing is intrinsic to animal life

For operational matters, this ethical debate evokes an antagonism between wildlife conservation and animal welfare. For those primarily concerned with conservation interests, anthropomorphism is a grave error and, for those primarily concerned with the welfare and moral standing of non-human creatures, anthropodenial, the blindness to the humanlike characteristics of other animals (de Waal, 1997) is the grave error. Supporters in the first group argue that conservation action is important, even when it demands that some animals to be killed (e.g. to control super-populations) and

blame those defending the individual creatures as being anthropomorphizing. This argument is sometimes effective because it is a way of saying the conservation action is morally justified because the anthropomorphization creates a moral concern for the individual animals, where none is appropriate (Vucetich, 2009).

On the welfare side, anthropomorphism has been called the foundation of animal ethics. Wantanabe (2007) proposes that anthropomorphism is likely necessary for the social construction of animal welfare, and because animal ethics is an extension of human ethics, it is crucial to acknowledge the similarities between humans and animals. Harrison (2010), studying anthropomorphism, empathy, and perceived communicative ability in relation to phylogenetic relatedness to humans, concluded that it is likely that empathy evolved to promote social well-being among human beings, and anthropomorphism, a byproduct of empathy, arguably promotes the well-being of non-human animals, as it plays a role in maintaining our respect, care, and compassion for other species.

Aside from the philosophical debate, anthropomorphised animals are deeply rooted in the human culture. From Native American beliefs that in the past animals and people could talk to each other to ancient Biblical references of a speaking serpent in the Garden of Eden, talking animals have populated the imagination of generations for thousands of years. Even today the cinema and TV storytelling continue to reinforce this popular trait of human culture. Anthropomorphic animals and creatures have been used in many ways throughout recent times, from pure entertainment, as in Walt Disney Studios' classic animations, Pixar's animation *Wall-E* (Figure 8.1.E) or Lucasfilm's movie *Star Wars* (Figure 8.1.F), to political critique as in George Orwell's (1945) allegory *Animal Farm* to environmental campaigns as with the wildfire prevention education enacted

since 1944 by *Smokey Bear* (Figure 8.1.D). In 2010 the top box offices among all theater movies were *Toy Story 3* and *Alice in Wonderland* (Box Office Mojo, 2011), both with a cast of anthropomorphic characters.

The virtual character used in this research exploits this latter cultural inheritance. The animal was used to draw the public's attention as a way to overcome the dull and lifeless presence of an automated machine. As it replaced a human interviewer, it is arguably a zoomorphic human rather than an anthropomorphic animal. Nevertheless, it is a cultural manifestation made for and by humans. This Author considers that given (1) the cultural abundance of animal anthropomorphism; (2) the positive moral orientation ascribed to its virtual existence in survey research; and (3) the nature-oriented type of public that visits PAs, the use of an anthropomorphic animal as a virtual host will likely not depreciate actual animals nor represent any type of threat to them. Whether or not such a host leads visitors away from the intrinsic value of such species would be an interesting topic to include in a CAKI survey.

Despite the importance of the ethical debate, it is worth highlighting that, by design, CAKI's methodology does not limit the virtual host function to animals. Human models, robotic beings or any charismatic creature could be given the virtual interviewing role (Figure 8.1) and tuned to address specific audiences and the type of survey. The specific influence each type of virtual interviewer might have on sampling and data quality, however, remains to be determined. Park rangers, for example, are an ethically neutral type of virtual host and likely to address well the widest audience (Figure 8.1.A, B). Another approach can utilize non-charismatic animals or animals of distal phylogeny

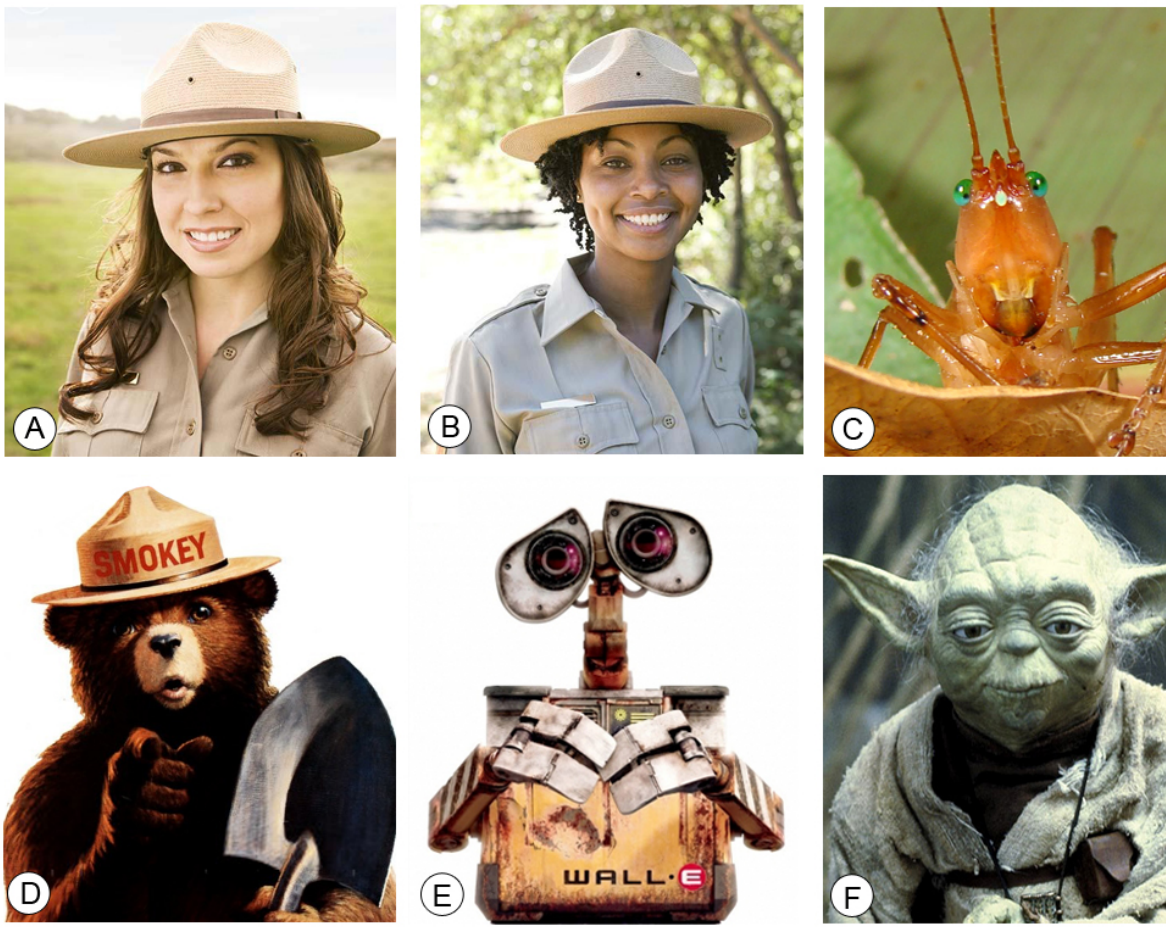


Figure 8.1: Cast of candidates considered for future utilization as virtual characters in CAKI surveys (themselves[1] or types alike). The represented sample encompasses a diversity of characteristics such as species, ethnics, gender, age, professions, charismatic appeal, and the realism/fantasy dualism. Depictions illustrate real park rangers (A, B)[2] capable of addressing the widest audiences; an uncommon arthropod species (C)[3] belonging to the native fauna of Iguaçu; *Smokey Bear*, a cartoon-like animal character (D)[4] that strongly relates to protected areas; *Wall-E*, a robotic character (E)[5] with strong public empathy and specialized in cleanup works; and *Yoda*, a sympathetic movie star fantasy character (F)[6] identified with wisdom and seriousness, among an almost unlimited repertoire of possibilities.

(Figure 8.1.C) to explore the differential importance and empathy levels people attribute to them in relation to more evolved or charismatic animals or even virtual humans.

[1] Developments based on copyrighted images and characters demand prior licensing with the copyright owners; [2] Author: Sam Diephuis/Copyright: Blend Images; [3] Author: Dr. Francisco A. G. Mello, UNESP, Botucatu; [4] Source: www.smokeybear.com; [5] Copyright: Pixar Animation Studios; [6] Copyright: Lucasfilm.

8.3.2 Anonymity and privacy concerns with multidimensional survey measurements. The understanding of people's perceptions, experiences, feelings and values could be improved by using a variety of psycho-sociological and physiological data along with the traditional cognitive questionnaire data. The former includes information regarding the respondent's emotional states that can be gathered through facial images from video and photos that are automatically recorded and stored in the interviewing terminal. The latter includes information related to physiological changes associated with affective states, which also can be subtly recorded through built-in machine sensors. These measurements include skin temperature and conductivity, pupil dilatation, and heartbeat variation, among others.

Measurement of such body-borne information that implies collection of data personally identified with a particular individual tends to void a common assumption of traditional survey methods which states that the questionnaire's answers remain completely anonymous. Although this assumption is true for most on-site surveys, with mail surveys and invitation-based web surveys it is clear that researchers know who the respondents are and when the survey is not returned on time, a reminder postcard is sent. The anonymity in this case can be seen as a soft agreement between the interviewer and the interviewee in which the later will not use the answers in any personally identifiable manner.

In the development of CAKI methodology it was fully acknowledged that taking pictures or filming the survey subjects raises privacy concerns that go beyond relating answers to a name and an address and means that researchers are watching or "spying on" respondents which may go beyond what is ethical accepted for survey research.

Irrespective of the nature of the identifiable information, CAKI's developmental guidelines included a prescription that respecting respondent's privacy is an important condition for its ethical feasibility and could be addressed in part by two different approaches: the social contract and the technological shielding.

Technological shielding means that all data from identifiable respondent is immediately subjected to strong encryption upon acquisition. This feature allows for safe storage and transportation of such data (physically and electronically) and their unencrypting is only granted by means of a security passkey. The passkey can be given to select survey analysts who can be personally accountable to guarantee data secrecy.

The computer base of CAKI allows for technological solutions to privacy concerns that go way beyond what has been already developed. With further developments of facial recognition algorithms that can be incorporated in the survey software suite (KISS), the actual respondents' images will not be even recorded. A tridimensional depiction of a respondent's faces (mesh) can be immediately created by the system with all affective information translated to vectors and codes that make it truly anonymous (Figure 8.2).

CAKI's social contract approach to assure privacy protection refers to providing the respondent adequate information as to the type of data that would be collected, and allowing them to answer or skip specific questions. What can be considered "adequate" information, however, is not an absolute value. CAKI survey systems are one link in an almost endless chain of pervasive computing networks, as it is envisaged that in the 21st century a vast numbers of networked computers will permeate our environment, heralding new ways of interaction and new applications. They are being woven into the

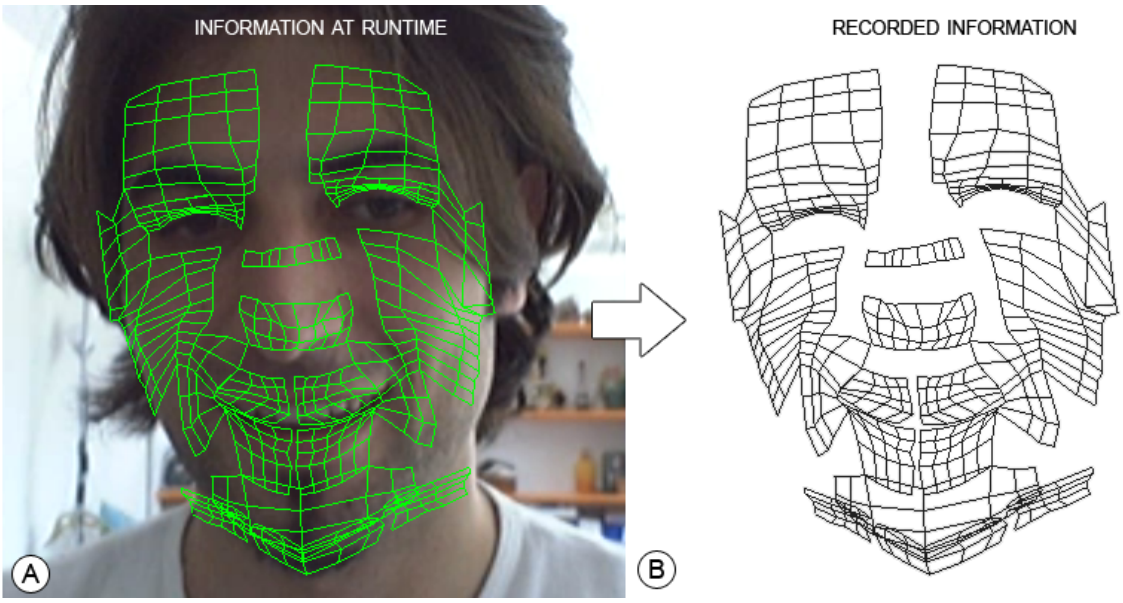


Figure 8.2: Facial expression recognition imagery: (A) an example of how the computer sees it in real-time while processing emotional states (Valenti, Sebe, & Gevers, 2007) and (B) how it can be recorded in the dataset.

fabric of human society (Abawajy, 2009). These pervasive computing environments can form a perceivable reality with ubiquitous surveillance systems. The ethics of video surveillance are considered by some becontinuously modified through social practice and agreement. What is considered acceptable or intrusive in video privacy is a result of cultural attitudes (Danielson, 2002) and steadily changes over time. The information generated in CAKI surveys is not, in principle, any more intrusive than that generated by many other systems that are already in effect and has the potential to be more ethically responsible than many of them.

As for the non-identifiable data, it follows the same trend that leads society to naturalize the interaction with unseen computers and sensors installed used for a good cause. To help contain the 2009 outbreak of influenza H1N1 virus (Swine Flu), automated temperature measurements were carried out at the main world airports. Similarly, with CAKI systems, the objective of such measurements is ostensibly to better

understand the interactions between humans and the natural environments, leading to improved management practices. While CAKI was not developed to be used in any way that is not socially and individually beneficial, as with on other survey methods, it must be recognized that the potential for abuse exists. The credibility of a CAKI survey has to be established by the institutions involved in the study.

In summary, the ethics of collecting personal information must address (1) the responsible handling of the data and its destination (sensitive data safety); (2) the assurance that such information will not be made publicly available in any way that allow individuals to be identified (effective anonymity); and (3) an adequate level of respondents' awareness/agreement about relevant survey methods (social contract). It is worthy to note that privacy matters are governed by laws in many countries, with rules and procedures that encompass all three factors above.

8.4 OTHER RECOMMENDATIONS FOR FUTURE RESEARCH

Multidimensional Survey Measurements – When appropriate, future research could record affective manifestations of the interviewee (e.g. facial expressions and skin temperature and conductance response), as well as environmental noise, water and air pollution, local weather, crowding or density, among others, using physical sensors attached to the survey terminal. By using Adaptive Multidimensional Survey Measurements, which combines environmental and affective conditions with dynamically configurable questionnaires (Figure 8.3), it is possible to plan and implement a good number of experiments, which do not seem feasible without the adoption of the CAKI framework.

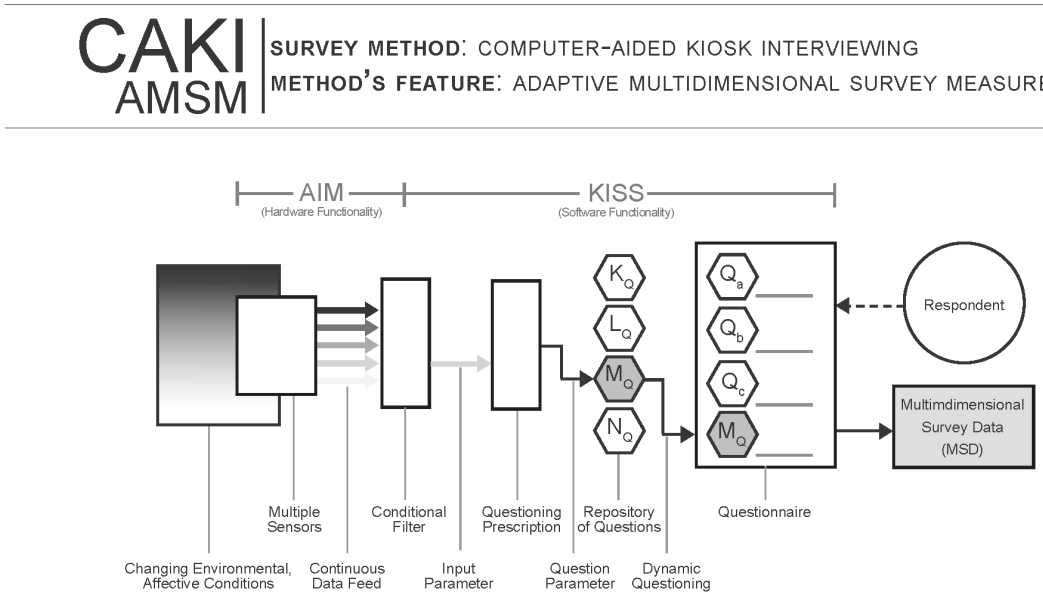


Figure 8.3: Schematic depiction of the Adaptive Multidimensional Survey Measurements rationale

Front-user interface – Future studies could incorporate a front-user interface that translates numerical survey data into easily understandable and useful information for managers. Manfredo, Vaske, & Teel (2003) contend that if a goal of human dimensions research is to provide input for natural resource decision making, it is imperative that researchers communicate to managers about the practical implications of their findings. These authors refer to a front-user functionality that is illustrated with the Potential for Conflict Index (PCI). Based on a publicly-available web site, the PCI was developed to facilitate understanding and applicability of human dimensions findings to managerial concerns (Vaske, 2011). Upon supplying the system with numerical survey data it calculates and graphs PCIs. The output graphs have an attractive layout that streamlines the communication to its intended audiences. CAKI systems could be integrated to systems like the PCI platform. A dedicated front user interface is a necessary

development for CAKI before it can be truly considered a platform for low-effort visitor data generation that assists PA planners and managers in their decision-making processes.

Multiple positioning of the survey terminal – The CAKY system should be tested at multiple suitable locations indoors, in the visitor centers or outdoors, at a trailhead. Sites that are less spectacular than the Iguaçu Falls Rim should be utilized and comparison of the results could help determine if such sites create a biased response.

Multiple virtual interviewers in the survey terminal – To test the system with other types of virtual interviewers, beyond the anthropomorphic animal utilized originally. The study should include an animated yet virtual park ranger for example. Using multiple types of interviewers or no interviewer at all can aid in prospecting potential method's strengths and bias.

Visitor's perceptions of policy or management – To gain further support of managers, future tests should test the automated system with a survey that focuses on visitor perceptions of changes in policy or management along with basic visitor and trip characteristics.

Utility of partial responses – Partially answered questionnaires corresponded to 26% of the total sample. Despite the continuous efforts to keep non-response and desistence low, it is expected that a non-negligible number of questionnaires will always be incomplete. This data could still be useful if it carries reliable information. A study should test utility and reliability of partial answers in the eyes of both managers and other researchers.

Interactions between local people and hi-tech survey system – Much needed would be a test of the system where visitors are mostly local people.

Boost system appeal with enhanced multimedia – A key functionality that sets CAKI apart from normal kiosk system is its active strategy to pique and keep visitors interested in interacting with the system. Future studies can explore the use of game-like questioning (answered with a joystick), movie clips as vignette resources, 360^{o} panoramic pictures; or use of virtual characters that interactively follow the whole interviewing process.

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APPENDICES

1 - Comprehensive Depiction of the Questionnaire

2 - Multidimensional Survey Measurements - Extended Developments

3 - Kiosk Interviewing Software Suite - Survey Module Algorithm

4 - Blueprint for the System's Casing

5 - Sampling Data

6 – Descriptive Statistics for the Entire Sample

7 - Kiosk Interviewing Software Suite – CD-ROM

APPENDIX 1

Comprehensive Depiction of the Questionnaire

Questions' Subject Matter

1. Participation in recreation activities currently offered to park visitors
2. Visitor's overall satisfaction in visiting Iguaçu National Park
3. Fulfillment of visitor's expectations in visiting of Iguaçu National Park
4. Visitor's possibility in visiting Iguaçu National Park again in the future
5. Recommending a trip to the park to visitor's relatives, friends or acquaintances
6. Participation in tourism activities currently offered to visitors in the region of Foz do Iguaçu
7. Visitor's overall satisfaction with the visiting of Foz do Iguaçu, the gateway to visit the Park.
8. Demographics: visitor's origin
9. Demographics: visitor's age
10. Demographics: visitor's gender
11. Visitor's feelings regarding the simplicity, or complexity, in operating the electronic terminal
12. Visitor's assessment regarding the time actually spent in answering the electronic survey

1.1. Question and survey identification

Question ID: 111	Template type: TQE	Campaign: First Launch

1.2. Question's subject matter

Participation in recreation activities currently offered to park visitors

1.3. Question's main text

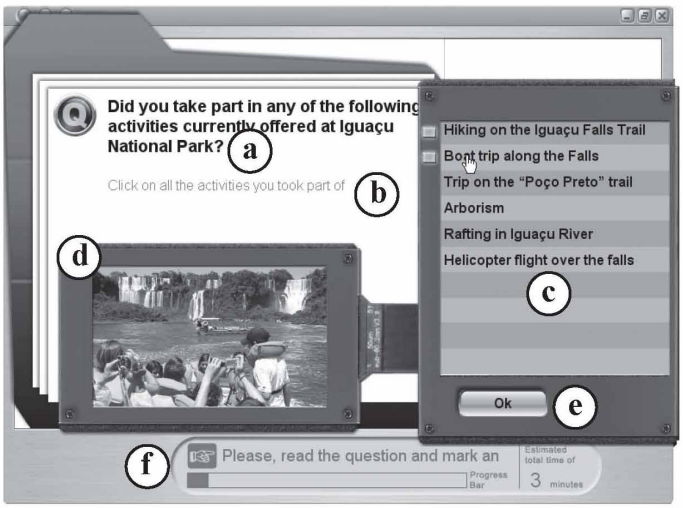
Language	Wording
English	Did you take part in any of the following activities currently offered at Iguaçu National Park?
Spanish	Usted hizo parte de algunas de las siguientes actividades ofrecidas actualmente en el Parque del Iguazú?
Portuguese	Você tomou parte em alguma das seguintes atividades oferecidas atualmente no Parque Nacional do Iguaçu?

1.4. Question reinforcement with leads to understand and answer correctly

Language	Wording
English	Click on all the activities you took part of.
Spanish	Da clic en todos los paseos que usted participo.
Portuguese	Clique em todos os passeios que você participou.

1.5. Main communication and interaction items from the human-machine interface (HMI)

a. Question main text
b. Reinforcement text
c. Textual answer alternatives
d. Non-verbal answer depiction
e. Confirm button
f. Advancement and time panel



Actual screen is color and 19-inch diagonal.

1.6. Answer alternatives

Lang.	Wording	Value	Non-verbal depiction
Eng. Spa. Por.	Hiking on the Iguaçu Falls Trail Caminada Sendero de las Cataratas Caminhada na Trilha das Cataratas	1	
Eng. Spa. Por.	Boat trip along the Falls Paseo de barco en las Cataratas Passeio de barco nas Cataratas	1	
Eng. Spa. Por.	Trip on the “Poço Preto” trail Paseo en el Sendero Pozo Negro Passeio na Trilha do Poço Preto	1	
Eng. Spa. Por.	Arborism Alborismo Arvorismo	1	
Eng. Spa. Por.	Rafting in Iguaçu River Rafting en el Río Iguazú Rafting no Rio Iguaçu	1	
Eng. Spa. Por.	Helicopter trip over the falls Vuelo de Helicóptero (Cataratas) Vôo de helicóptero nas Cataratas	1	

1.7. Variables

Short name	Long name	Type / Unit
DIDFALLSTRAIL	Did Activity Iguaçu Falls Trail	Boolean
DIDMACUCOSAF	Did Act. Boat trip along the Falls (Macuco)	Boolean
DIDPOCOPRETO	Did Act. Bike trip on the “Poço Preto” trail	Boolean
DIDARBORISM	Did Activity Arborism	Boolean
DIDRAFTDOWFALL	Did Activity Rafting in Iguaçu River	Boolean
DIDHELICOPTERTOUR	Did Actv. Helicopter flight over the falls	Boolean
TIMEIN	Instant the question is presented	Time (miliseconds)
TIMEOUT	Instant the answer is finished	Time (miliseconds)

2.1. Question and survey identification

Question ID: 112	**Template type:** TQF	**Campaign:** First Launch

2.2. Question's subject matter

Visitor's overall satisfaction in visiting Iguaçu National Park

2.3. Question's main text

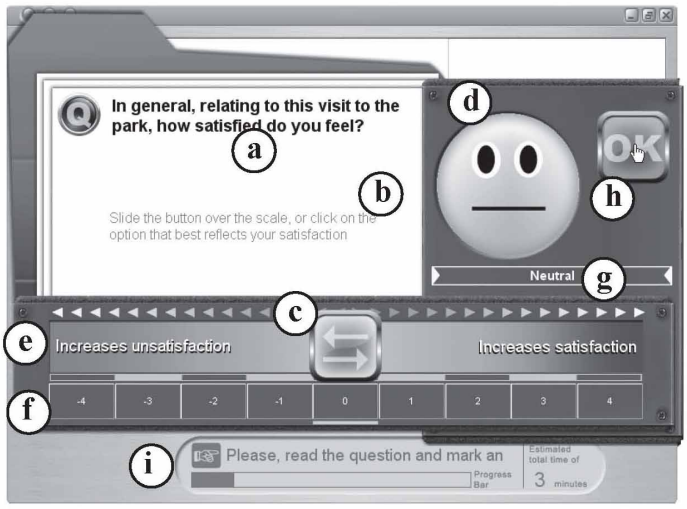
Language	Wording
English	In general, relating to this visit to the park, how satisfied do you feel?
Spanish	De un modo general, en relación a esta visita al Parque, cuanto satisfecho usted se siente?
Portuguese	De um modo geral, em relação a esta visita ao Parque, quanto satisfeito você se sente?

2.4. Question reinforcement with leads to understand and answer correctly

Language	Wording
English	Slide the button over the scale, or click on the option that best reflects your satisfaction.
Spanish	Desliz el botón sobre la escala o de clic en la opción que mejor adecue a su satisfacción.
Portuguese	Deslize o botão sobre a escala ou clique na opção que melhor reflete sua satisfação.

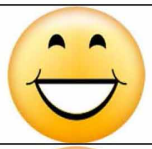
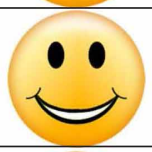
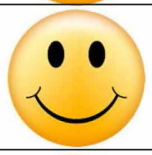
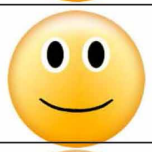
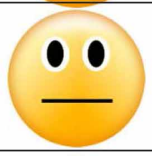
2.5. Main communication and interaction items from the human-machine interface (HMI)

a. Question main text
b. Reinforcement text
c. Likert-scale slider button
d. Non-verbal answer depiction
e. Scale with label & color gradient
f. Redundant numerical scale
g. Verbal answer statement
h. Confirm button
i. Advancement and time panel



Actual screen is color and 19-inch diagonal.

2.6. Answer alternatives

Lang.	Wording	Label (Value)	Non-verbal depiction
Eng.	Extremely satisfied	+ 4 (9)	
Spa.	Extremadamente satisfecho		
Por.	Extremamente satisfeito		
Eng.	Very satisfied	+ 3 (8)	
Spa.	Muy satisfecho		
Por.	Bastante satisfeito		
Eng.	Moderatly satisfied	+ 2 (7)	
Spa.	Moderadamente satisfecho		
Por.	Moderadamente satisfeito		
Eng.	Slightly satisfied	+ 1 (6)	
Spa.	Livianamente satisfecho		
Por.	Levemente satisfeito		
Eng.	Neutral	0 (5)	
Spa.	Ni satisfecho, ni insatisfecho		
Por.	Nem satisfeito, nem insatisfeito		
Eng.	Slightly unsatisfied	- 1 (4)	
Spa.	Livianamente insatisfecho		
Por.	Levemente insatisfeito		
Eng.	Moderately unsatisfied	- 2 (3)	
Spa.	Moderadamente insatisfecho		
Por.	Moderadamente insatisfeito		
Eng.	Very unsatisfied	- 3 (2)	
Spa.	Muy insatisfecho		
Por.	Bastante insatisfeito		
Eng.	Extremely unsatisfied	- 4 (1)	
Spa.	Extremadamente insatisfecho		
Por.	Extremamente insatisfeito		

2.7. Variables

Short name	Long name	Type / Unit
SAT_PARK	Satisfaction upon activities done in park	9-point likert-scale
TIMEIN	Instant the question is presented	Time (miliseconds)
TIMEOUT	Instant the answer is finished	Time (miliseconds)

3.1. Question and survey identification

Question ID: 113	Template type: TQH	Campaign: First Launch

3.2. Question's subject

Fulfillment of visitor's expectations in visiting Iguaçu National Park

3.3. Question's main text matter

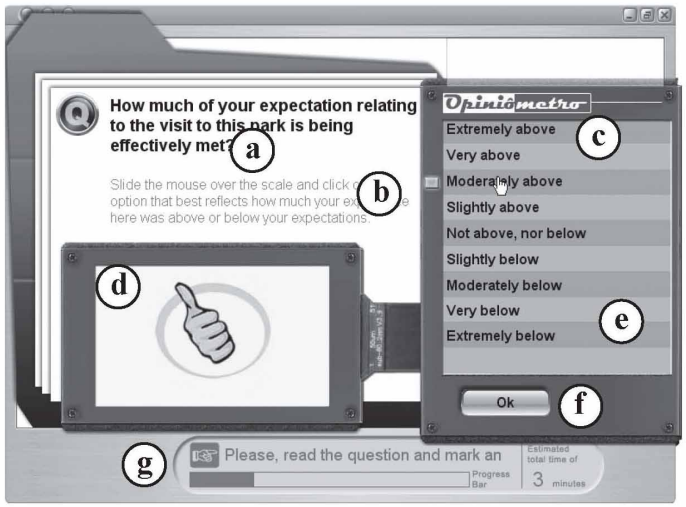
Language	Wording
English	How much of your expectation relating to the visit to this park is being effectively met?
Spanish	Cuanto a su expectativa en relación a esta visita al Parque, esta siendo efectivamente atendida?
Portuguese	Quanto da sua expectativa em relação a esta visita ao Parque está sendo efetivamente atendida?

3.4. Question reinforcement with leads to understand and answer correctly

Language	Wording
English	Slide the mouse over the scale and click on the option that best reflects how much your experience here was above or below your expectations.
Spanish	Desliz el mouse sobre la escala y de clic en la opción que mejor se adecua a lo cuanto su experiencia quedo encima o debajo de su expectativa.
Portuguese	Deslize o mouse sobre a escala e clique na opção que melhor reflete o quanto sua experiência ficou acima ou abaixo da sua expectativa.

3.5. Main communication and interaction items from the human-machine interface (HMI)

a. Question main text
b. Reinforcement text
c. Clickable Likert-scale (verbal)
d. Non-verbal answer depiction
e. Scale color patern
f. Confirm button
g. Advancement and time panel



Actual screen is color and 19-inch diagonal.

3.6. Answer alternatives

Lang.	Wording	Label (Value)	Non-verbal depiction
Eng.	Extremely above	+ 4 (9)	
Spa.	Extremadamente encima		
Por.	Extremamente acima		
Eng.	Very above	+ 3 (8)	
Spa.	Muy encima		
Por.	Bastante acima		
Eng.	Moderatly above	+ 2 (7)	
Spa.	Moderadamente encima		
Por.	Moderadamente acima		
Eng.	Slightly above	+ 1 (6)	
Spa.	Livianamente encima		
Por.	Levemente acima		
Eng.	Not above, nor below	0 (5)	
Spa.	Ni encima, ni abajo		
Por.	Nem acima, nem abaixo		
Eng.	Slightly below	- 1 (4)	
Spa.	Livianamente abajo		
Por.	Levemente abaixo		
Eng.	Moderately below	- 2 (3)	
Spa.	Moderadamente abajo		
Por.	Moderadamente abaixo		
Eng.	Very below	- 3 (2)	
Spa.	Muy abajo		
Por.	Bastante abaixo		
Eng.	Extremely below	- 4 (1)	
Spa.	Extremadamente abajo		
Por.	Extremamente abaixo		

3.7. Variables

Short name	Long name	Type / Unit
EXPECTATION	Expectaction toward activities donein park	9-point likert-scale
TIMEIN	Instant the question ispresented	Time (miliseconds)
TIMEOUT	Instant the answer is finished	Time (miliseconds)

4.1. Question and survey identification

Question ID: 114	Template type: TQH	Campaign: First Launch

4.2. Question's subject matter

Visitor's possibility of visiting Iguaçu National Park again in the future

4.3. Question's main text

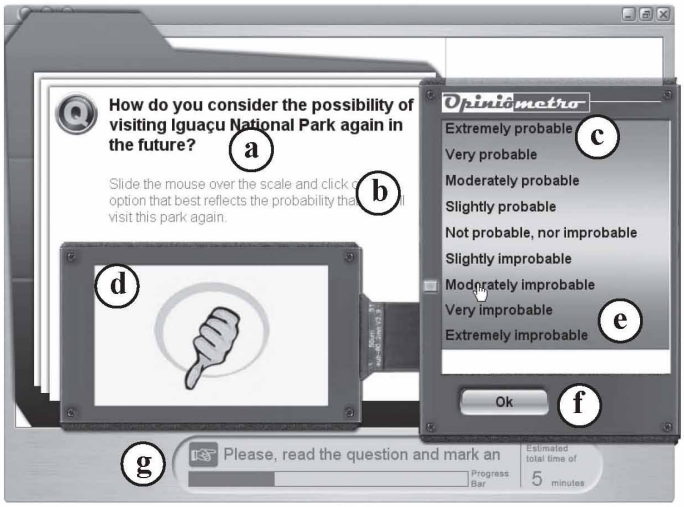
Language	Wording
English	How do you consider the possibility of visiting Iguaçu National Park again in the future?
Spanish	Como usted considera la posibilidad de volver a realizar una visita o viaje al Parque Nacional del Iguazú en el futuro?
Portuguese	Como você considera a possibilidade de voltar a realizar uma visita ou viagem ao Parque Nacional do Iguaçu no futuro?

4.4. Question reinforcement with leads to understand and answer correctly

Language	Wording
English	Slide the mouse over the scale and click on the option that best reflects the probability that you will visit this park again.
Spanish	Desliz el mouse sobre la escala y de clic en la opción que mejor se adecue a la probabilidad de que usted vuelva a visitar este Parque.
Portuguese	Deslize o mouse sobre a escala e clique na opção que melhor reflete a probabilidade de você voltar a visitar este Parque.

4.5. Main communication and interaction items from the human-machine interface (HMI)

a. Question main text
b. Reinforcement text
c. Clickable Likert-scale (verbal)
d. Non-verbal answer depiction
e. Scale with color gradients
f. Confirm button
g. Advancement and time panel



Actual screen is color and 19-inch diagonal.

4.6. Answer alternatives

Lang.	Wording	Label (Value)	Non-verbal depiction
Eng.	Extremely probable	+ 4 (9)	
Spa.	Extremadamente probable		
Por.	Extremamente provável		
Eng.	Very probable	+ 3 (8)	
Spa.	Muy probable		
Por.	Bastante provável		
Eng.	Moderatly probable	+ 2 (7)	
Spa.	Moderadamente probable		
Por.	Moderadamente provável		
Eng.	Slightly probable	+ 1 (6)	
Spa.	Livianamente probable		
Por.	Levemente provável		
Eng.	Not probable, nor improbable	0 (5)	
Spa.	Ni probable, ni improbable		
Por.	Nem provável, nem improvável		
Eng.	Slightly improbable	- 1 (4)	
Spa.	Livianamente improbable		
Por.	Levemente improvável		
Eng.	Moderately improbable	- 2 (3)	
Spa.	Moderadamente improbable		
Por.	Moderadamente improvável		
Eng.	Very improbable	- 3 (2)	
Spa.	Muy improbable		
Por.	Bastante improvável		
Eng.	Extremely improbable	- 4 (1)	
Spa.	Extremadamente improbable		
Por.	Extremamente improvável		

4.7. Variables

Short name	Long name	Type / Unit
PROBRETURN	Probability to return	9-point likert-scale
TIMEIN	Instant the question ispresented	Time (miliseconds)
TIMEOUT	Instant the answer is finished	Time (miliseconds)

5.1. Question and survey identification

Question ID: 115	Template type: TQH	Campaign: First Launch

5.2. Question's subject matter

Recommending a trip to the park to visitor's relatives, friends or acquaintances

5.3. Question's main text

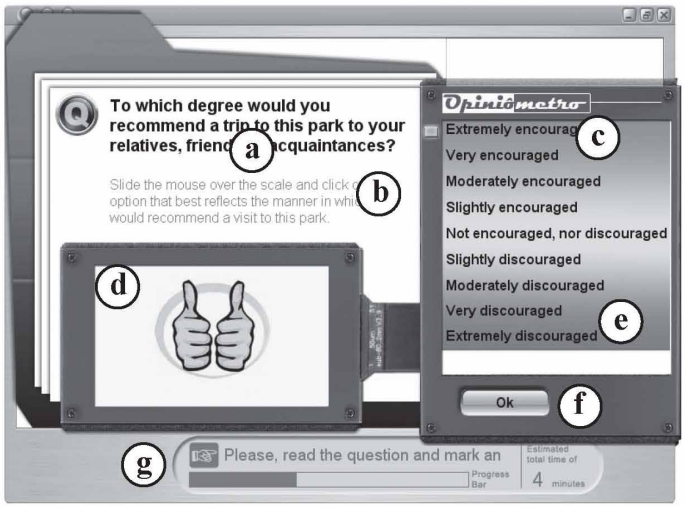
Language	Wording
English	To which degree would you recommend a trip to this park to your relatives, friends or acquaintances?
Spanish	En que medida usted recomendaría a sus parientes, amigos o conocidos para que realicen una visita o viaje a este Parque?
Portuguese	Em que medida você recomendaria aos seus parentes, amigos ou conhecidos para realizarem uma visita ou viagem a este Parque?

5.4. Question reinforcement with leads to understand and answer correctly

Language	Wording
English	Slide the mouse over the scale and click on the option that best reflects the manner in which you would recommend a visit to this park.
Spanish	Desliz el mouse sobre la escala y de clic en la opción que mejor se adecue al modo en el que recomendarías la visita al Parque.
Portuguese	Deslize o mouse sobre a escala e clique na opção que melhor reflete o modo com o qual você recomendaria a visita a este Parque.

5.5. Main communication and interaction items from the human-machine interface (HMI)

a. Question main text
b. Reinforcement text
c. Clickable Likert-scale (verbal)
d. Non-verbal answer depiction
e. Scale with color gradients
f. Confirm button
g. Advancement and time panel



Actual screen is color and 19-inch diagonal.

5.6. Answer alternatives

Lang.	Wording	Label (Value)	Non-verbal depiction
Eng.	Extremely encouraged	+ 4 (9)	
Spa.	Extremadamente recomendable		
Por.	Extremamente recomendável		
Eng.	Very encouraged	+ 3 (8)	
Spa.	Muy recomendable		
Por.	Bastante recomendável		
Eng.	Moderatly encouraged	+ 2 (7)	
Spa.	Moderadamente recomendable		
Por.	Moderadamente recomendável		
Eng.	Slightly encouraged	+ 1 (6)	
Spa.	Livianamente recomendable		
Por.	Levemente recomendável		
Eng.	Not encouraged, nor discouraged	0 (5)	
Spa.	Ni recomendable, ni no recomendable		
Por.	Nem recomendável, nem desrecomendável		
Eng.	Slightly discouraged	- 1 (4)	
Spa.	Livianamente no recomendable		
Por.	Levemente desrecomendável		
Eng.	Moderately discouraged	- 2 (3)	
Spa.	Moderadamente no recomendable		
Por.	Moderadamente desrecomendável		
Eng.	Very discouraged	- 3 (2)	
Spa.	Muy no recomendable		
Por.	Bastante desrecomendável		
Eng.	Extremely discouraged	- 4 (1)	
Spa.	Extremadamente no recomendable		
Por.	Extremamente desrecomendável		

5.7. Variables

Short name	Long name	Type / Unit
REFERRING	Referring the visit to others	9-point likert-scale
TIMEIN	Instant the question is presented	Time (miliseconds)
TIMEOUT	Instant the answer is finished	Time (miliseconds)

6.1. Question and survey identification

Question ID: 116	Template type: TQE	Campaign: First Launch

6.2. Question's subject matter

Participation in tourism activities currently offered to visitors in the region of Foz do Iguaçu

6.3. Question's main text

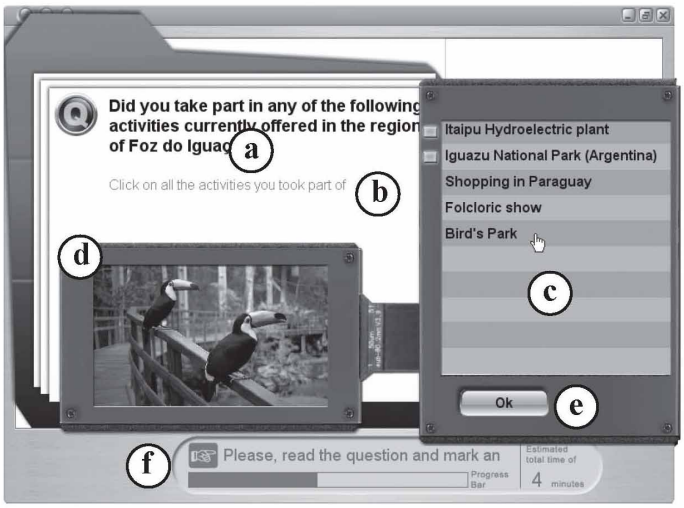
Language	Wording
English	Did you take part in any of the following activities currently offered in the region of Foz do Iguaçu?
Spanish	Usted hizo parte de alguna de las siguientes actividades ofrecidas actualmente en la región de Foz de Iguazú?
Portuguese	Você tomou parte em alguma das seguintes atividades oferecidas atualmente na região de Foz do Iguaçu?

6.4. Question reinforcement with leads to understand and answer correctly

Language	Wording
English	Click on all the activities you took part of.
Spanish	Da clic en todos los paseos que usted participo.
Portuguese	Clique em todos os passeios que você participou.

6.5. Main communication and interaction items from the human-machine interface (HMI)

a. Question main text
b. Reinforcement text
c. Textual answer alternatives
d. Non-verbal answer depiction
e. Confirm button
f. Advancement and time panel



Actual screen is color and 19-inch diagonal.

6.6. Answer alternatives

Lang.	Wording	Value	Non-verbal depiction
Eng. Spa. Por.	Itaipu Hydroelectric plant Usina Hidroeléctrica de Itaipu Usina Hidrelétrica de Itaipu	1	
Eng. Spa. Por.	Iguazu National Park (Argentina) Parque Nacional Iguazú (Argentina) Parque Nacional Iguazu (Argentina)	1	
Eng. Spa. Por.	Shopping in Paraguay Compras en Paraguay Compras no Paraguai	1	
Eng. Spa. Por.	Folcloric show Show folclórico Show folclórico	1	
Eng. Spa. Por.	Bird Park Parque del Pájaros Parque das Aves	1	

6.7. Variables

Short name	Long name	Type / Unit
DIDITAIPU	Did Activity Itaipu Hydroelectric plant	Boolean
DIDIGUAZUARG	Did Act. Iguazu National Park (Argentina)	Boolean
DIDSHOPPGUAY	Did Act. Shopping in Paraguay	Boolean
DIDFOLKSHOW	Did Activity Folcloric show	Boolean
DIDBIRDPARK	Did Activity Bird's Park	Boolean
TIMEIN	Instant the question is presented	Time (miliseconds)
TIMEOUT	Instant the answer is finished	Time (miliseconds)

7.1. Question and survey identification

Question ID: 117	Template type: TQF	Campaign: First Launch

7.2. Question's subject matter

Visitor's overall satisfaction with the visiting of Foz do Iguaçu, the gateway to visit the Park

7.3. Question's main text

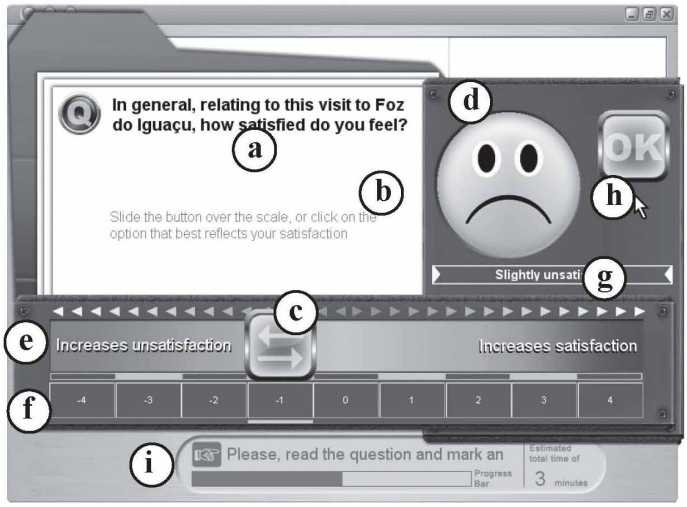
Language	Wording
English	In general, relating to this visit to Foz do Iguaçu, how satisfied do you feel?
Spanish	De un modo general, en relación a esta visita a la región de Foz de Iguazú, cuanto satisfecho usted se sintió?
Portuguese	De um modo geral, em relação a esta visita à região de Foz do Iguaçu, quanto satisfeito você se sente?

7.4. Question reinforcement with leads to understand and answer correctly

Language	Wording
English	Slide the button over the scale, or click on the option that best reflects your satisfaction.
Spanish	Desliz el botón sobre la escala o de clic en la opción que mejor adecue a su satisfacción.
Portuguese	Deslize o botão sobre a escala ou clique na opção que melhor reflete sua satisfação.

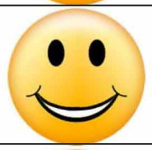
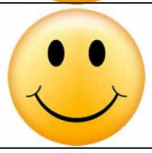
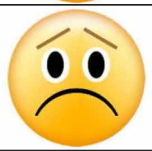
7.5. Main communication and interaction items from the human-machine interface (HMI)

a. Question main text
b. Reinforcement text
c. Likert-scale slider button
d. Non-verbal answer depiction
e. Scale with label & color gradient
f. Redundant numerical scale
g. Verbal answer statement
h. Confirm button
i. Advancement and time panel



Actual screen is color and 19-inch diagonal.

7.6. Answer alternatives

Lang.	Wording	Label (Value)	Non-verbal depiction
Eng.	Extremely satisfied	+ 4 (9)	
Spa.	Extremadamente satisfecho		
Por.	Extremamente satisfeito		
Eng.	Very satisfied	+ 3 (8)	
Spa.	Muy satisfecho		
Por.	Bastante satisfeito		
Eng.	Moderatly satisfied	+ 2 (7)	
Spa.	Moderadamente satisfecho		
Por.	Moderadamente satisfeito		
Eng.	Slightly satisfied	+ 1 (6)	
Spa.	Livianamente satisfecho		
Por.	Levemente satisfeito		
Eng.	Neutral	0 (5)	
Spa.	Ni satisfecho, ni insatisfecho		
Por.	Nem satisfeito, nem insatisfeito		
Eng.	Slightly unsatisfied	- 1 (4)	
Spa.	Livianamente insatisfecho		
Por.	Levemente insatisfeito		
Eng.	Moderately unsatisfied	- 2 (3)	
Spa.	Moderadamente insatisfecho		
Por.	Moderadamente insatisfeito		
Eng.	Very unsatisfied	- 3 (2)	
Spa.	Muy insatisfecho		
Por.	Bastante insatisfeito		
Eng.	Extremely unsatisfied	- 4 (1)	
Spa.	Extremadamente insatisfecho		
Por.	Extremamente insatisfeito		

7.7. Variables

Short name	Long name	Type / Unit
SAT_REGION	Satisfaction upon activities done in region	9-point likert-scale
TIMEIN	Instant the question is presented	Time (miliseconds)
TIMEOUT	Instant the answer is finished	Time (miliseconds)

8.1. Question and survey identification

Question ID: 118	Template type: TQH	Campaign: First Launch

8.2. Question's subject matter

Demographics: visitor's origin

8.3. Question's main text

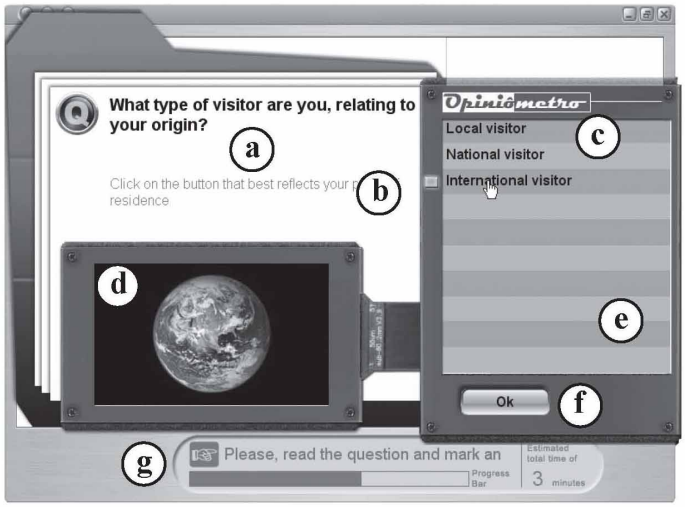
Language	Wording
English	What type of visitor are you, relating to your origin?
Spanish	Que tipo de visitante es usted en relación a su origen?
Portuguese	Que tipo de visitante é você em relação a sua origem?

8.4. Question reinforcement with leads to understand and answer correctly

Language	Wording
English	Click on the button that best reflects your place of residence.
Spanish	Clic en el botón que mejor se adecua al local de su residencia.
Portuguese	Clique no botão que melhor reflete o local de sua residência.

8.5. Main communication and interaction items from the human-machine interface (HMI)

a. Question main text
b. Reinforcement text
c. Clickable nominal alternatives
d. Non-verbal answer depiction
e. Scale color patern
f. Confirm button
g. Advancement and time panel



Actual screen is color and 19-inch diagonal.

8.6. Answer alternatives

Lang.	Wording	Value	Non-verbal depiction
Eng. Spa. Por.	Local visitor Visitante Local Visitante Local	1	
Eng. Spa. Por.	National visitor Visitante Nacional Visitante Nacional	2	
Eng. Spa. Por.	International visitor Visitante Internacional Visitante Internacional	3	

8.7. Variables

Short name	Long name	Type / Unit
ORIGIN	Visitor's origin	Categorical nominal
TIMEIN	Instant the question is presented	Time (miliseconds)
TIMEOUT	Instant the answer is finished	Time (miliseconds)

9.1. Question and survey identification

Question ID: 119	**Template type:** TQE	**Campaign:** First Launch

9.2. Question's subject matter

Demographics: visitor's age

9.3. Question's main text

Language	Wording
English	What is your age?
Spanish	Cual es tu edad?
Portuguese	Qual a sua idade?

9.4. Question reinforcement with leads to understand and answer correctly

Language	Wording
English	Type your age in the numeric keyboard displayed.
Spanish	Digite su edad en el teclado numérico al costado.
Portuguese	Digite sua idade no teclado numérico ao lado.

9.5. Main communication and interaction items from the human-machine interface (HMI)

a. Question main text

b. Reinforcement text

c. Clickable digital keypad

d. Entered numeral data

e. Confirm button

f. Advancement and time panel

Actual screen is color and 19-inch diagonal.

9.6. Variables

Short name	Long name	Type / Unit
AGE	Respondent's Age	Scale / Years
TIMEIN	Instant the question is presented	Time (miliseconds)
TIMEOUT	Instant the answer is finished	Time (miliseconds)

10.1. Question and survey identification

Question ID: 120	**Template type:** TQH	**Campaign:** First Launch

10.2. Question's subject matter

Demographics: visitor's gender

10.3. Question's main text

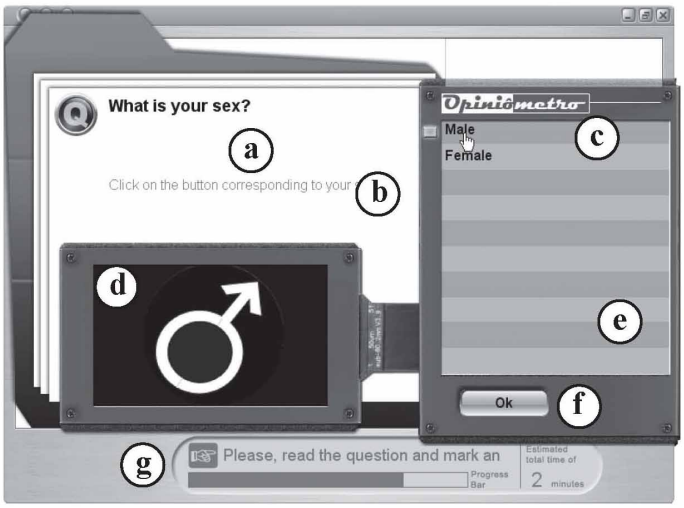
Language	Wording
English	What is your sex?
Spanish	Cual es tu sexo?
Portuguese	Qual o seu sexo?

10.4. Question reinforcement with leads to understand and answer correctly

Language	Wording
English	Click on the button corresponding to your sex.
Spanish	Clic en el botón que corresponde a tu sexo.
Portuguese	Clique no botão correspondente ao seu sexo.

10.5. Main communication and interaction items from the human-machine interface (HMI)

a. Question main text
b. Reinforcement text
c. Clickable nominal alternatives
d. Non-verbal answer depiction
e. Scale color patern
f. Confirm button
g. Advancement and time panel



Actual screen is color and 19-inch diagonal.

10.6. Answer alternatives

Lang.	Wording	Value	Non-verbal depiction
Eng.	Male	1	
Spa.	Masculino		
Por.	Masculino		
Eng.	Female	0	
Spa.	Femenino		
Por.	Feminino		

10.7. Variables

Short name	Long name	Type / Unit
GENDER	Visitor's gender	Categorical nominal
TIMEIN	Instant the question is presented	Time (miliseconds)
TIMEOUT	Instant the answer is finished	Time (miliseconds)

11.1. Question and survey identification

Question ID: 121	Template type: TQF	Campaign: First Launch

11.2. Question's subject matter

Visitor's feelings regarding the simplicity, or complexity, in operating the electronic terminal

11.3. Question's main text

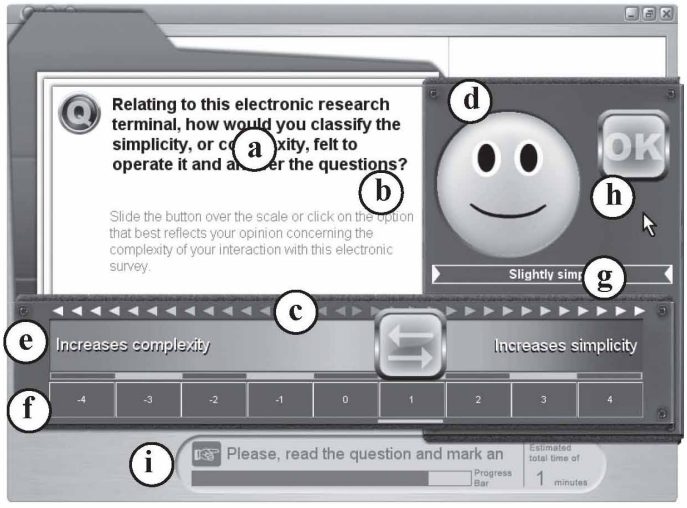
Language	Wording
English	As to this electronic research terminal, how would you classify the simplicity, or complexity, felt to operate it and answer the questions?
Spanish	Con relación a este terminal electrónico de pesquisa, como usted califica a simplicidad o complejidad sentida para operarlo y responder las cuestiones?
Portuguese	Com relação a este terminal eletrônico de pesquisa, como você classifica a simplicidade ou complexidade sentida para operá-lo e responder às questões?

11.4. Question reinforcement with leads to underst and and answer correctly

Language	Wording
English	Slide the button over the scale or click on the option that best reflects your opinion concerning the complexity of your interaction with this electronic survey
Spanish	Desliz el botón sobre la escala o de clic en la opción que mejor se adecue al modo con el cual usted ínter agio con esta encuesta electrónica.
Portuguese	Deslize o botão sobre a escala ou clique na opção que melhor reflete o modo com o qual você interagiu com esta pesquisa eletrônica.

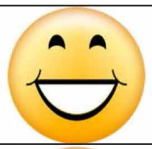
11.5. Main communication and interaction items from the human-machine interface (HMI)

a. Question main text
b. Reinforcement text
c. Likert-scale slider button
d. Non-verbal answer depiction
e. Scale with label & color gradient
f. Redundant numerical scale
g. Verbal answer statement
h. Confirm button
i. Advancement and time panel



Actual screen is color and 19-inch diagonal.

11.6. Answer alternatives

Lang.	Wording	Label (Value)	Non-verbal depiction
Eng.	Extremely simple	+ 4 (9)	
Spa.	Extremadamente sencillo		
Por.	Extremamente simples		
Eng.	Very simple	+ 3 (8)	
Spa.	Muy sencillo		
Por.	Bastante simples		
Eng.	Moderatly simple	+ 2 (7)	
Spa.	Moderadamente sencillo		
Por.	Moderadamente simples		
Eng.	Slightly simple	+ 1 (6)	
Spa.	Livianamente sencillo		
Por.	Levemente simples		
Eng.	Neutral	0 (5)	
Spa.	Ni sencillo, ni complejo		
Por.	Nem simples, nem complexo		
Eng.	Slightly complex	- 1 (4)	
Spa.	Livianamente complejo		
Por.	Levemente complexo		
Eng.	Moderately complex	- 2 (3)	
Spa.	Moderadamente complejo		
Por.	Moderadamente complexo		
Eng.	Very complex	- 3 (2)	
Spa.	Muy complejo		
Por.	Bastante complexo		
Eng.	Extremely complex	- 4 (1)	
Spa.	Extremadamente complejo		
Por.	Extremamente complexo		

11.7. Variables

Short name	Long name	Type / Unit
META_DIFFICULTY	Metasurvey about difficulty	9-point likert-scale
TIMEIN	Instant the question ispresented	Time (miliseconds)
TIMEOUT	Instant the answer is finished	Time (miliseconds)

12.1. Question and survey identification

Question ID: 122	Template type: TQA	Campaign: First Launch

12.2. Question's subject matter

Visitor's assessment regarding the time actually spent in answering the electronic survey

12.3. Question's main text

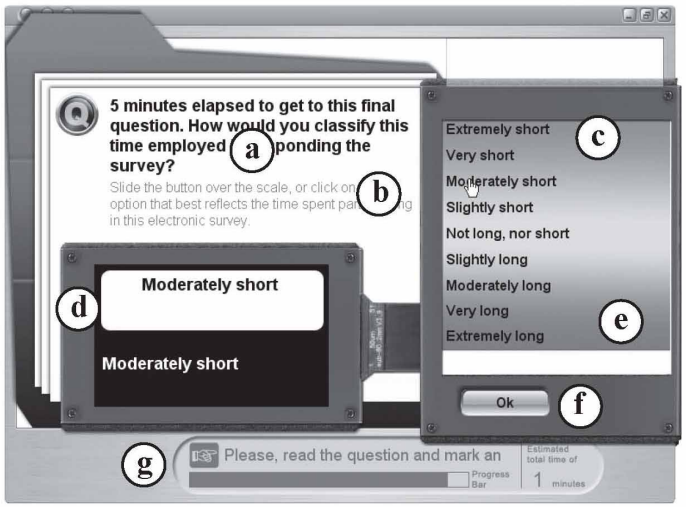
Language	Wording
English	[RealTimeVar] minutes elapsed to get to this final question. How would you classify this time employed in responding the survey?
Spanish	[RealTimeVar] minutos usted utilizo hasta esta que es la ultima cuestión. Como usted califica este tiempo empleado para esta encuesta?
Portuguese	[RealTimeVar] minutos foi o tempo utilizado para chegar a esta última questão. Como você classifica este tempo empregado para a pesquisa?

12.4. Question reinforcement with leads to understand and answer correctly

Language	Wording
English	Slide the mouse over the scale and click on the option that best reflects the time spent participating in this electronic survey.
Spanish	Desliz el mouse sobre la escala y de clic en la opción que mejor se adecua el dispendio de tiempo para participar de esta encuesta electrónica.
Portuguese	Deslize o mouse sobre a escala e clique na opção que melhor reflete o dispêndio de tempo para participar desta pesquisa eletrônica.

12.5. Main communication and interaction items from the human-machine interface (HMI)

a. Question main text
b. Reinforcement text
c. Clickable Likert-scale (verbal)
d. Chosen answer display (verbal)
e. Scale with color gradients
f. Confirm button
g. Advancement and time panel



Actual screen is color and 19-inch diagonal.

12.6. Answer alternatives

Lang.	Wording	Label (Value)
Eng.	Extremely short	+ 4 (9)
Spa.	Extremadamente corto	
Por.	Extremamente curto	
Eng.	Very short	+ 3 (8)
Spa.	Muy corto	
Por.	Bastante curto	
Eng.	Moderatly short	+ 2 (7)
Spa.	Moderadamente corto	
Por.	Moderadamente curto	
Eng.	Slightly short	+ 1 (6)
Spa.	Livianamente corto	
Por.	Levemente curto	
Eng.	Not long, nor short	0 (5)
Spa.	Ni largo, ni corto	
Por.	Nem longo, nem curto	
Eng.	Slightly long	- 1 (4)
Spa.	Livianamente largo	
Por.	Levemente longo	
Eng.	Moderately long	- 2 (3)
Spa.	Moderadamente largo	
Por.	Moderadamente longo	
Eng.	Very long	- 3 (2)
Spa.	Muy largo	
Por.	Bastante longo	
Eng.	Extremely long	- 4 (1)
Spa.	Extremadamente largo	
Por.	Extremamente longo	

12.7. Variables

Short name	Long name	Type / Unit
META_TIMESPENT	Time spent answering survey	9-point likert-scale
TIMEIN	Instant the question ispresented	Time (miliseconds)
TIMEOUT	Instant the answer is finished	Time (miliseconds)

APPENDIX 2

Multidimensional Survey Measurements

Extended Developments

Multidimensional Survey Measurements: Extended Developments

Along the implementation of the survey pilot-study in Iguaçu National Park a number of CAKI features were incorporated into KISS functionality. These capabilities were not quantitatively testes for varying reasons that include inappropriate sensors for the local conditions, hold on measurements that could possibly implicate ethical concerns before the matter be fully discussed in the appropriate level as well, budget limitation and the overall development burden to program the software, assemble the machine, test and debug the core functionalities. Nevertheless, because these functionalities can be promptly incorporated in next survey campaigns, it was considered worth to showcase them in this Dissertation appendix.

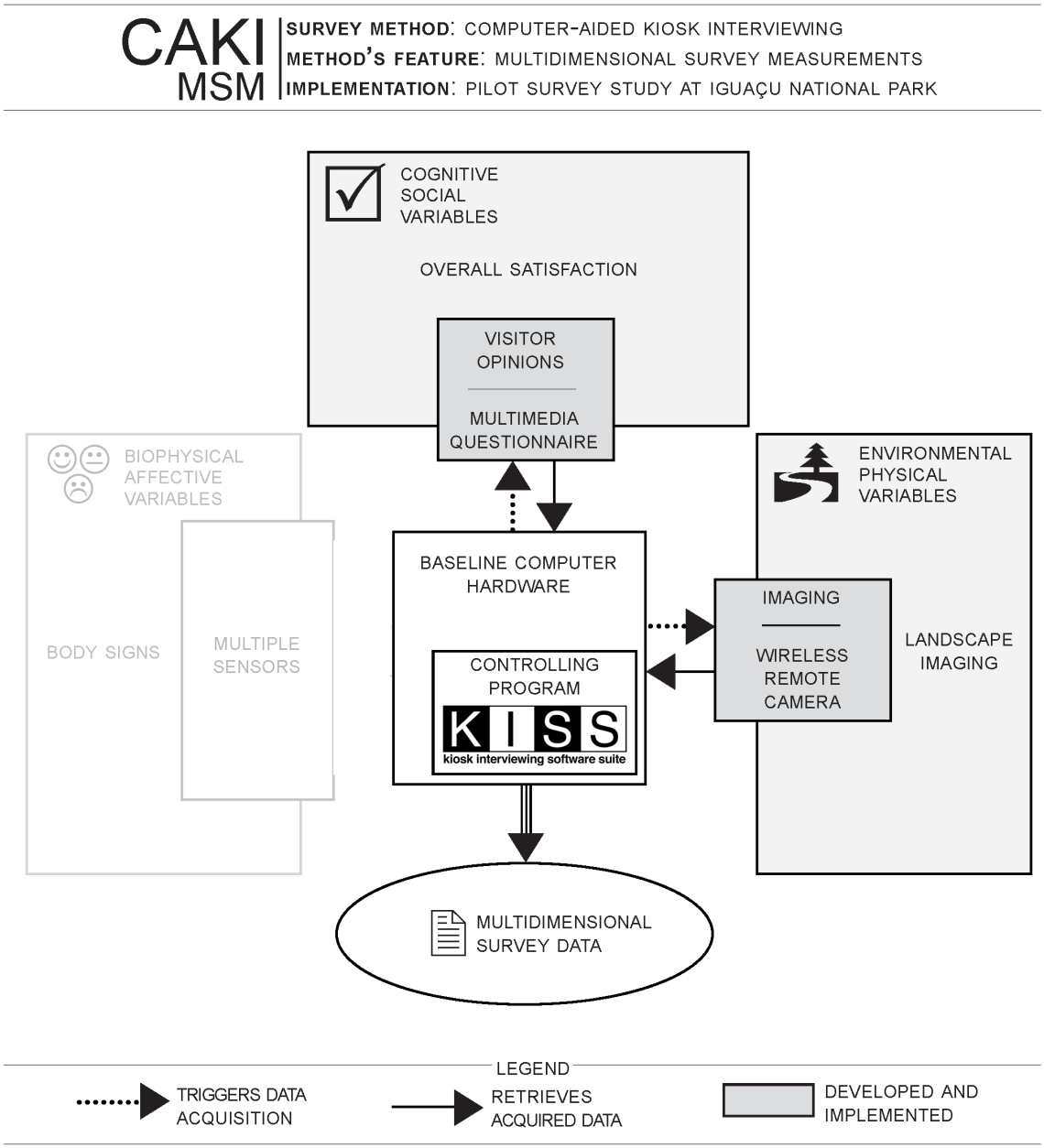


Figure A2-1: Schematic depiction of a Landscape Imaging Sensor (LIS) gauging physical environmental landscape conditions and changes in real-time. The gathered data is meshed with cognitive surveys inquiring about visitor perceptions on a range of subjects that can be affected by those conditions.

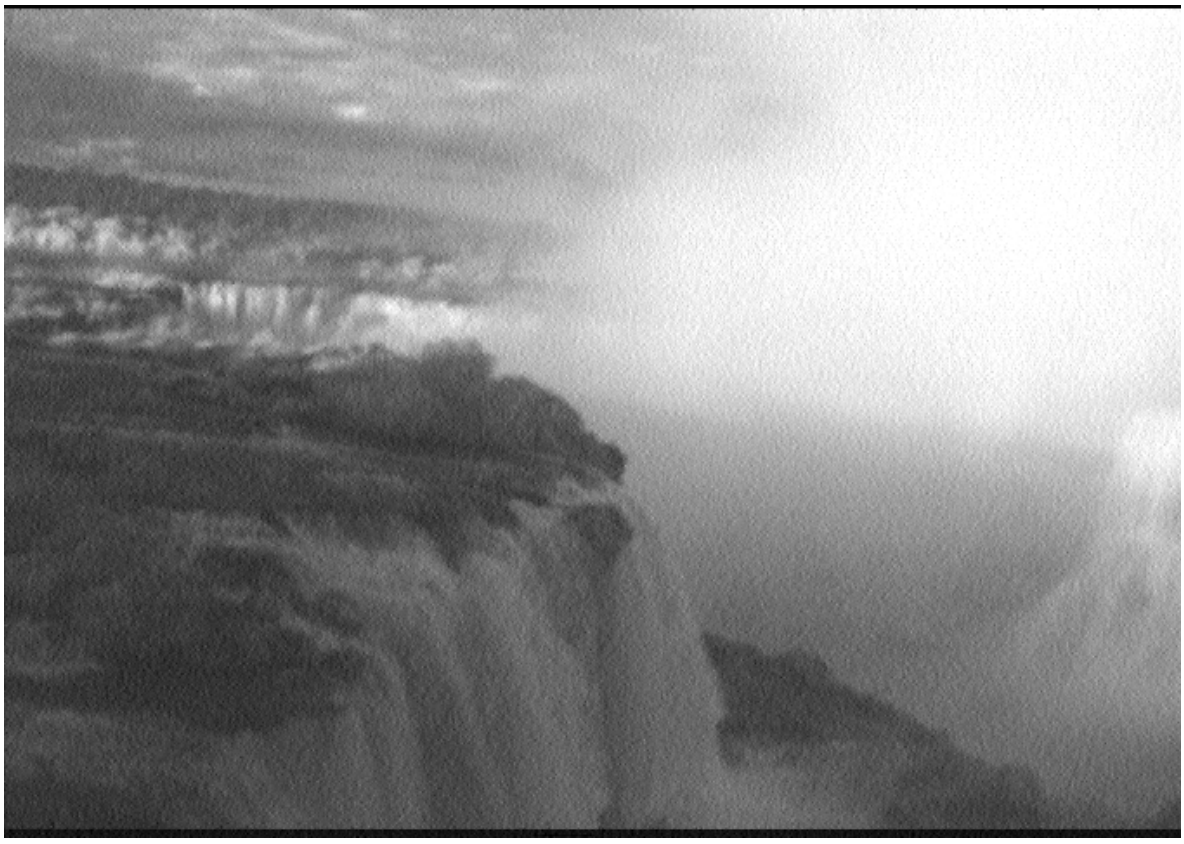


Figure A2-2: Sample data generated by the LIS showing an instant condition of the Iguaçu Falls from a remote wireless camera placed on top of the panoramic elevator tower. This image of the surrounding environment can be integrated in the survey's inquiry in real time or it can be recorded in binary form together with the social data in the respondent's survey form.

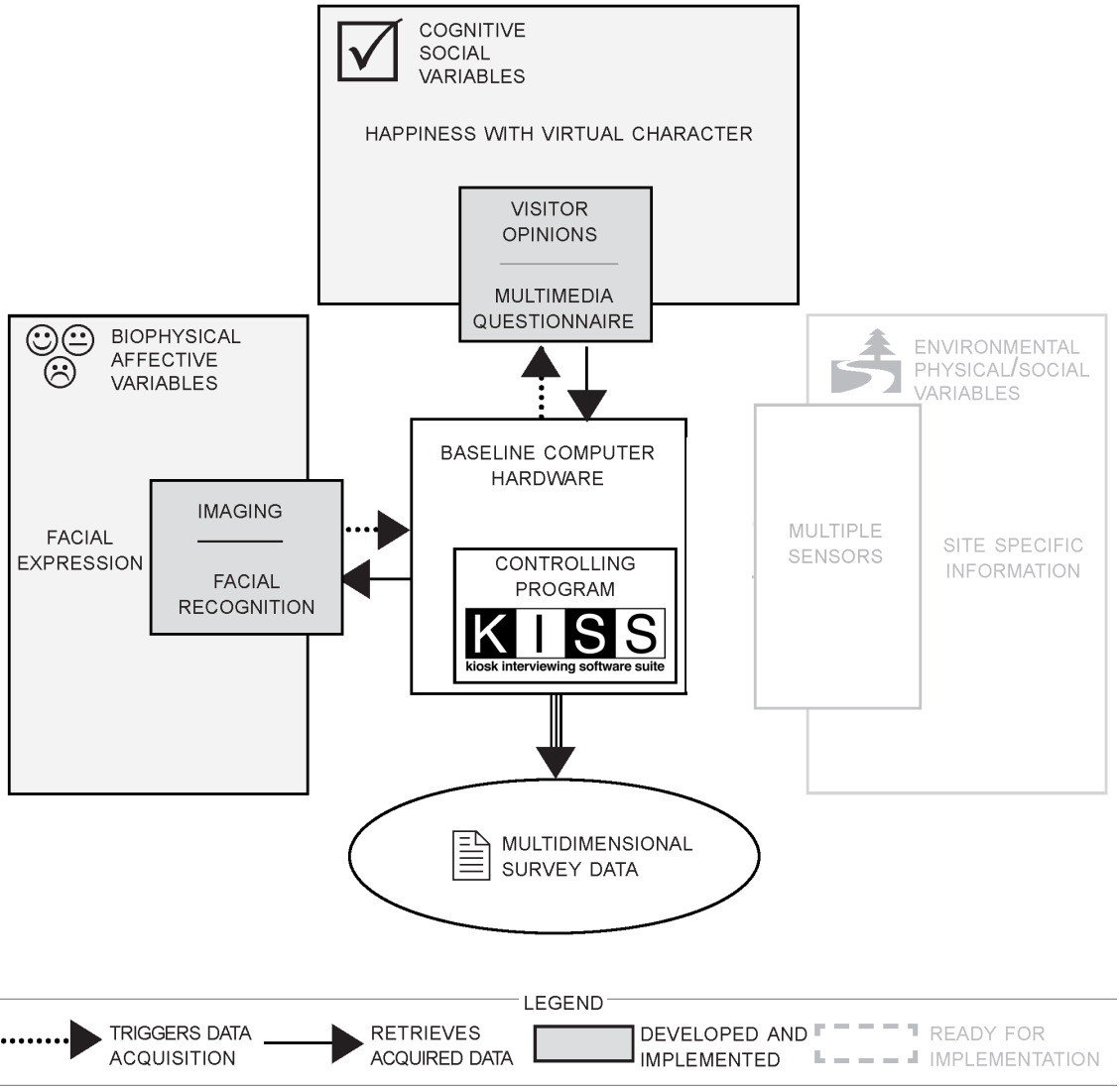


Figure A2-3: Schematic depiction of a Facial Imaging Sensor (FIS) gauging affective psychosocial conditions and changes in real-time. The gathered data is meshed with cognitive surveys inquiring about visitor perceptions on a range of subjects that can relate to those conditions.

Figure A2-4: Sample data generated by the FIS showing two instant conditions of a survey tester from a built-in CCD camera placed at the survey terminal's front bezel. This image pair captures the moment the subject chooses a language (left) and 2 seconds after the animated virtual character starting speaking (right) enacting the engagement phase of CAKI's communication strategy. The image can be integrated in the overall survey's strategy in real time or it can be recorded in binary form together with the social data in the respondent's survey form. Sensitive data is automatically encrypted upon acquiring. Data from biosensors pose ethical implications that have to be fully addressed prior to initiating comprehensive surveys that make use of it.

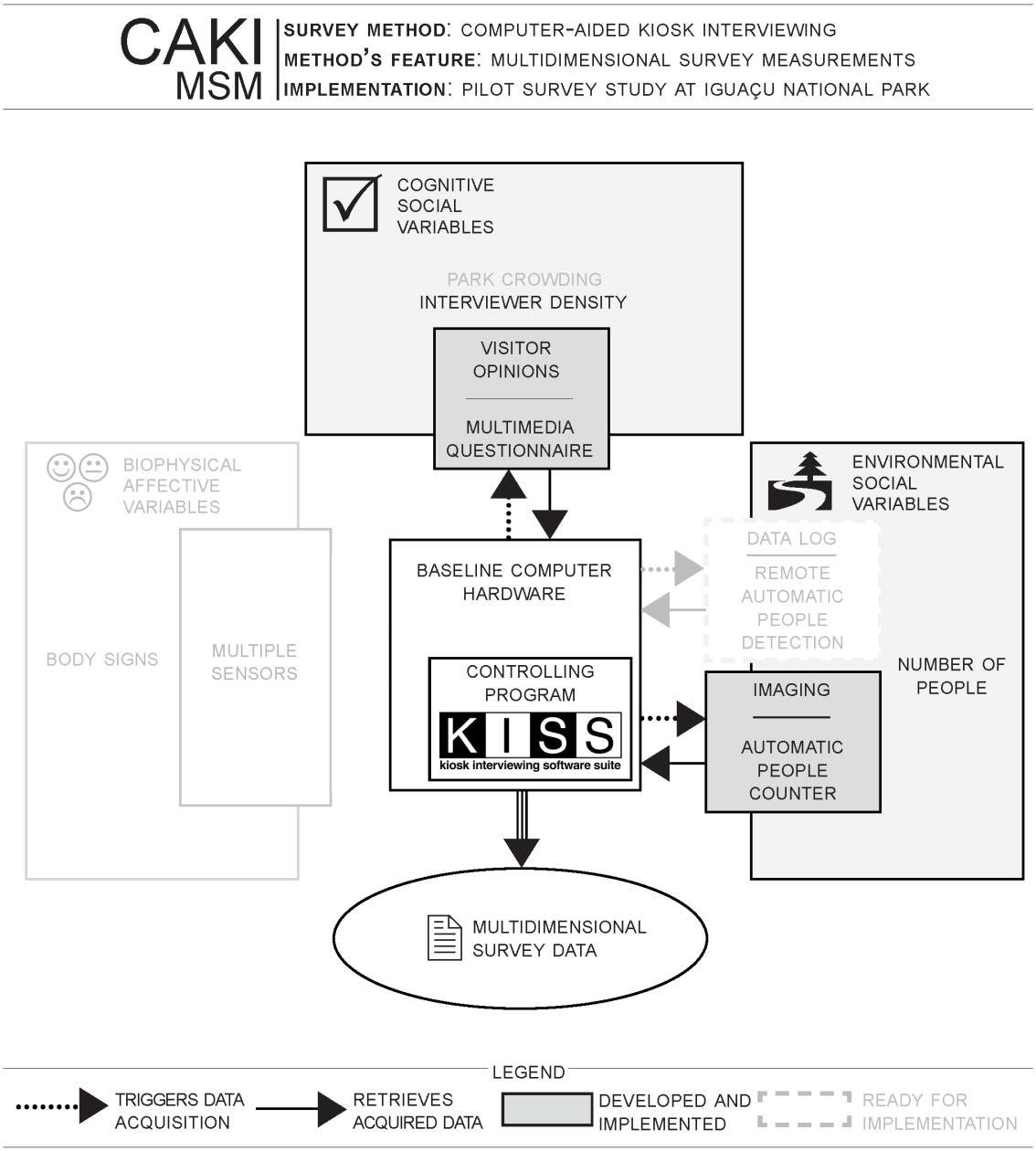


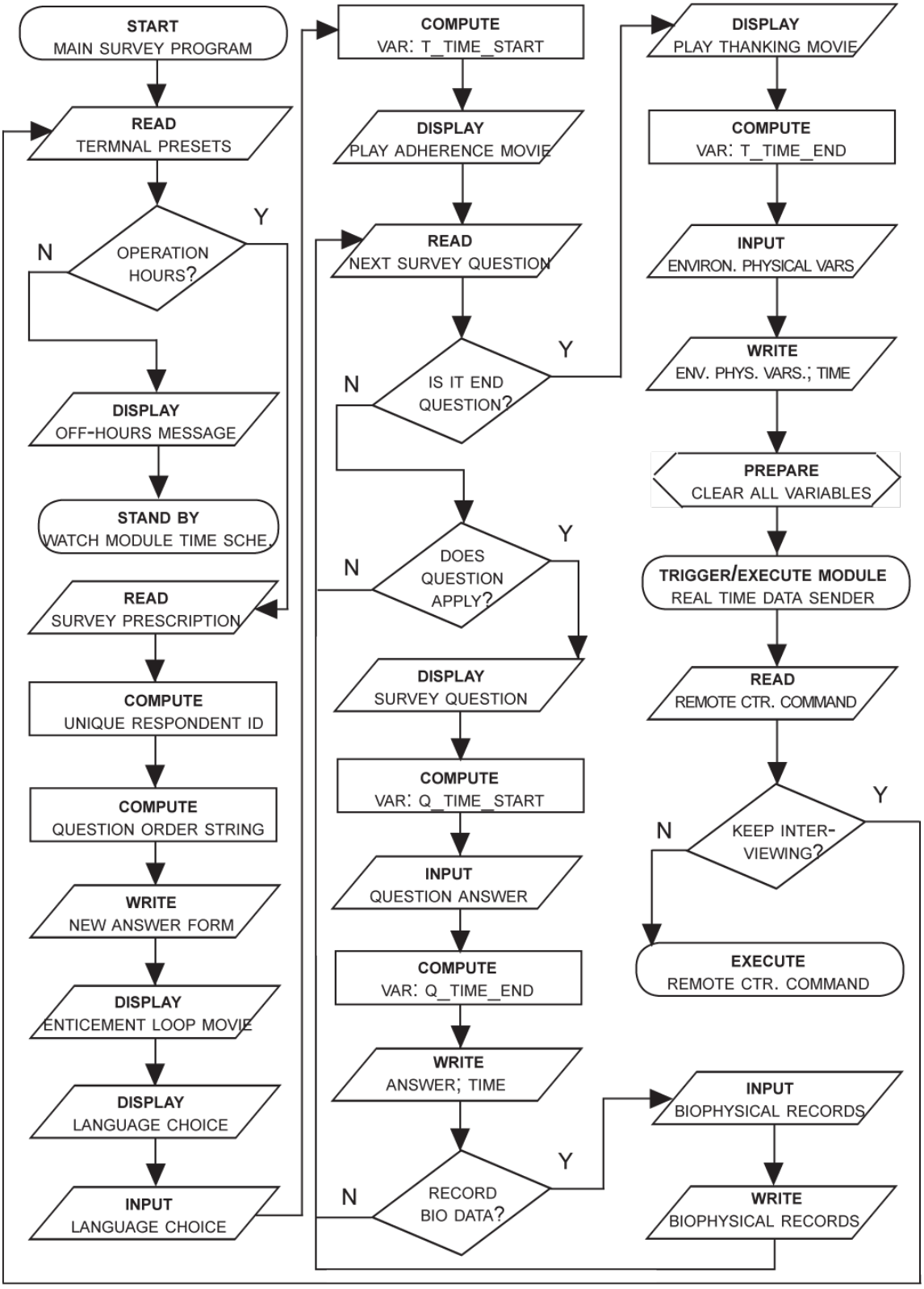
Figure A2-5: Schematic depiction of a Vicinity Imaging Sensor (VIS) gauging social environmental conditions and changes in real-time. The gathered data can be meshed with cognitive surveys inquiring about visitor perceptions on a range of subjects that can be affected by those conditions or recorded as survey application paradata and metadata.

Figure A2-6: Sample data generated by the VIS showing two instant conditions of anonymized survey takers from a built-in CCD camera placed at the survey terminal's front bezel. This image pair informs the researcher that respondent at the left answered the questionnaire alone while respondent(s) at the right may have answered questions based on pulled group opinions. This feature aids in controlling for conditions that are inherent of fully automated CAKI baseline functionality. Data from physical social sensors based on imaging pose ethical implications that have to be fully addressed prior to launch comprehensive surveys that make use of it.

APPENDIX 3

Kiosk Interviewing Software Suite

Survey Module Algorithm


START
MAIN SURVEY PROGRAM
READ
TERMNAL PRESETS
OPERATION HOURS?
Y
N
DISPLAY
OFF-HOURS MESSAGE
STAND BY
WATCH MODULE TIME SCHE.
READ
SURVEY PRESCRIPTION
COMPUTE
UNIQUE RESPONDENT ID
COMPUTE
QUESTION ORDER STRING
WRITE
NEW ANSWER FORM
DISPLAY
ENTICEMENT LOOP MOVIE
DISPLAY
LANGUAGE CHOICE
INPUT
LANGUAGE CHOICE
COMPUTE
VAR: T_TIME_START
DISPLAY
PLAY ADHERENCE MOVIE
READ
NEXT SURVEY QUESTION
IS IT END QUESTION?
Y
N
DOES QUESTION APPLY?
Y
N
DISPLAY
SURVEY QUESTION
COMPUTE
VAR: Q_TIME_START
INPUT
QUESTION ANSWER
COMPUTE
VAR: Q_TIME_END
WRITE
ANSWER; TIME
RECORD BIO DATA?
Y
N
INPUT
BIOPHYSICAL RECORDS
WRITE
BIOPHYSICAL RECORDS
DISPLAY
PLAY THANKING MOVIE
COMPUTE
VAR: T_TIME_END
INPUT
ENVIRON. PHYSICAL VARS
WRITE
ENV. PHYS. VARS.; TIME
PREPARE
CLEAR ALL VARIABLES
TRIGGER/EXECUTE MODULE
REAL TIME DATA SENDER
READ
REMOTE CTR. COMMAND
KEEP INTER-VIEWING?
Y
N
EXECUTE
REMOTE CTR. COMMAND

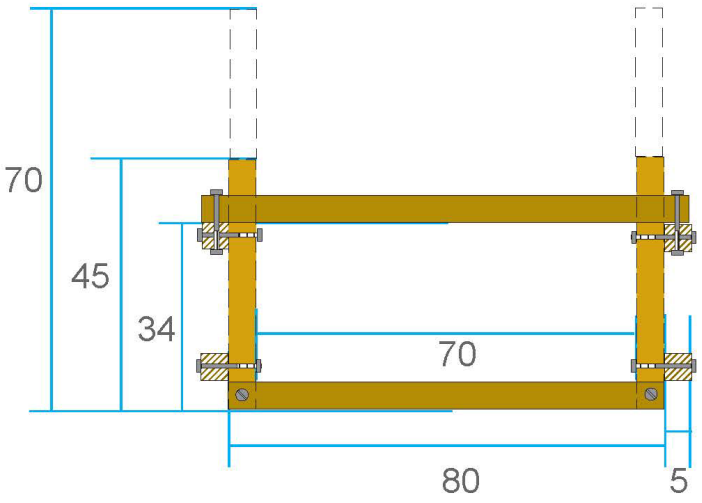
APPENDIX 4

Blueprint for the System's Casing

Blueprint for the System's Casing

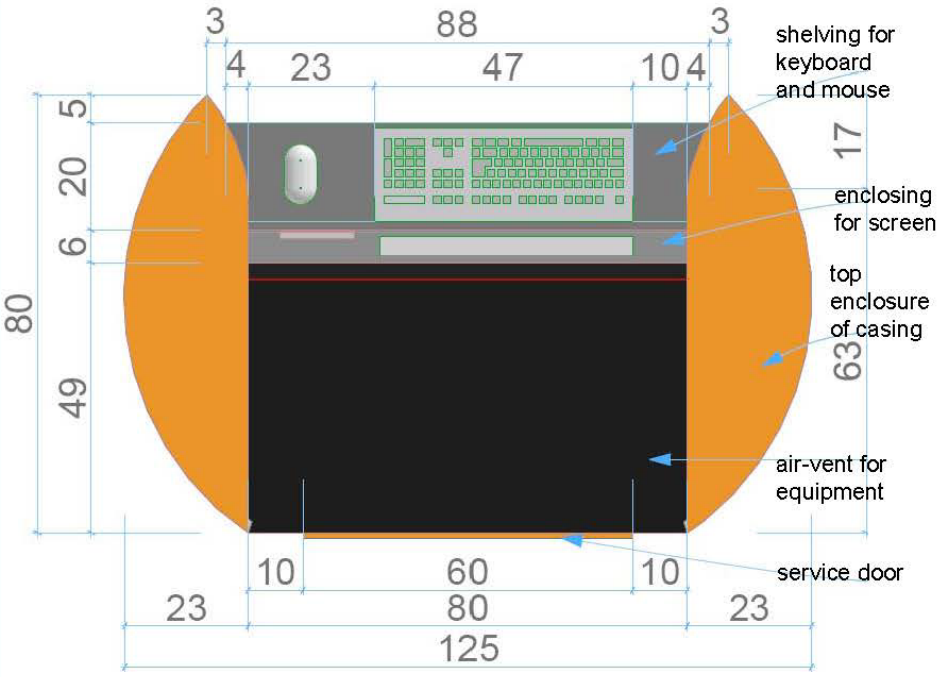
Top View of Structure

Obs: All units are in centimeters



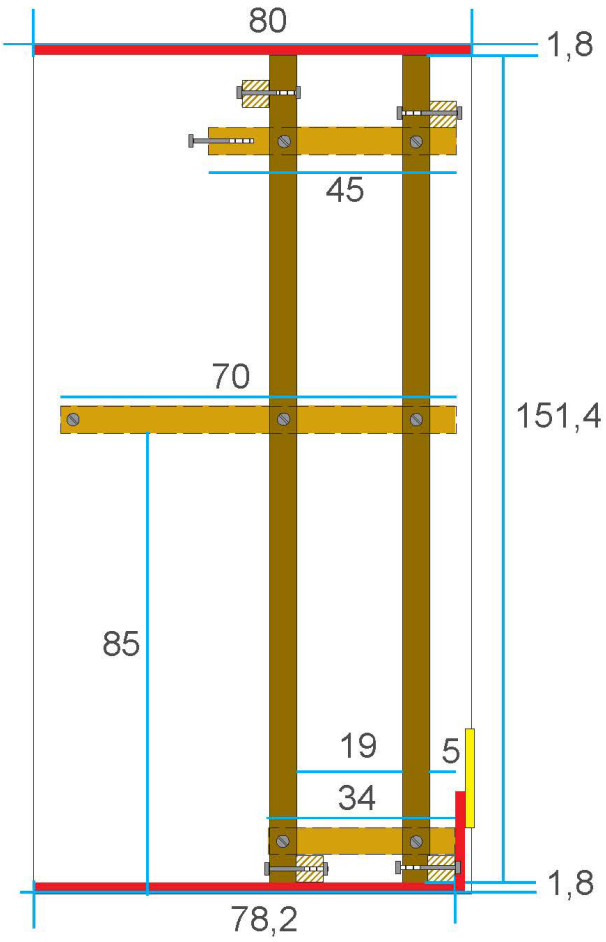
Top View of Casing

Obs: All units are in centimeters



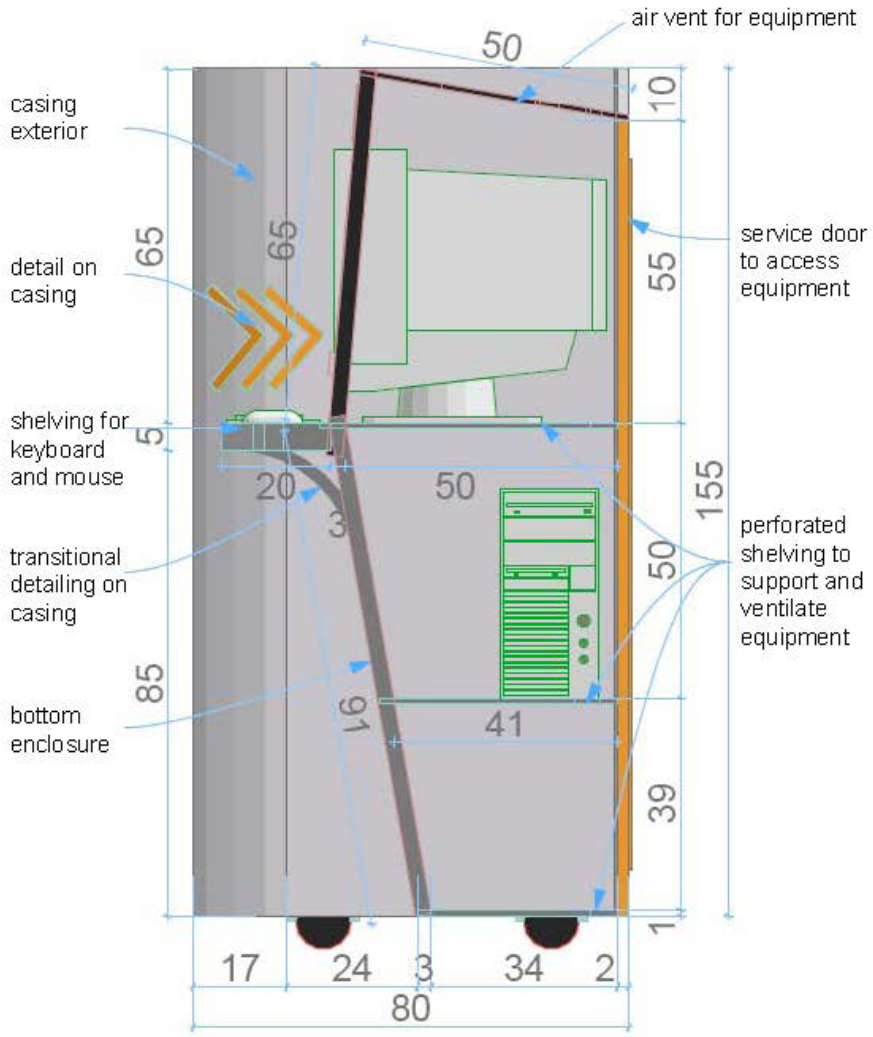
Section View of Structure

Obs: All units are in centimeters



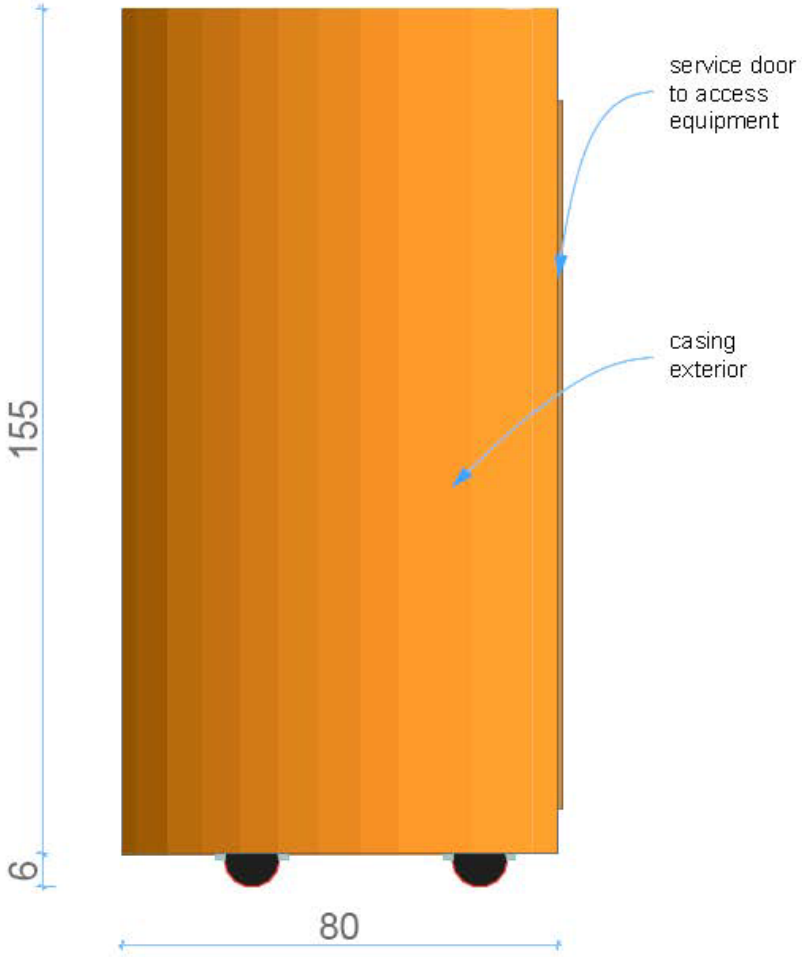
Section View of Casing

Obs: All units are in centimeters



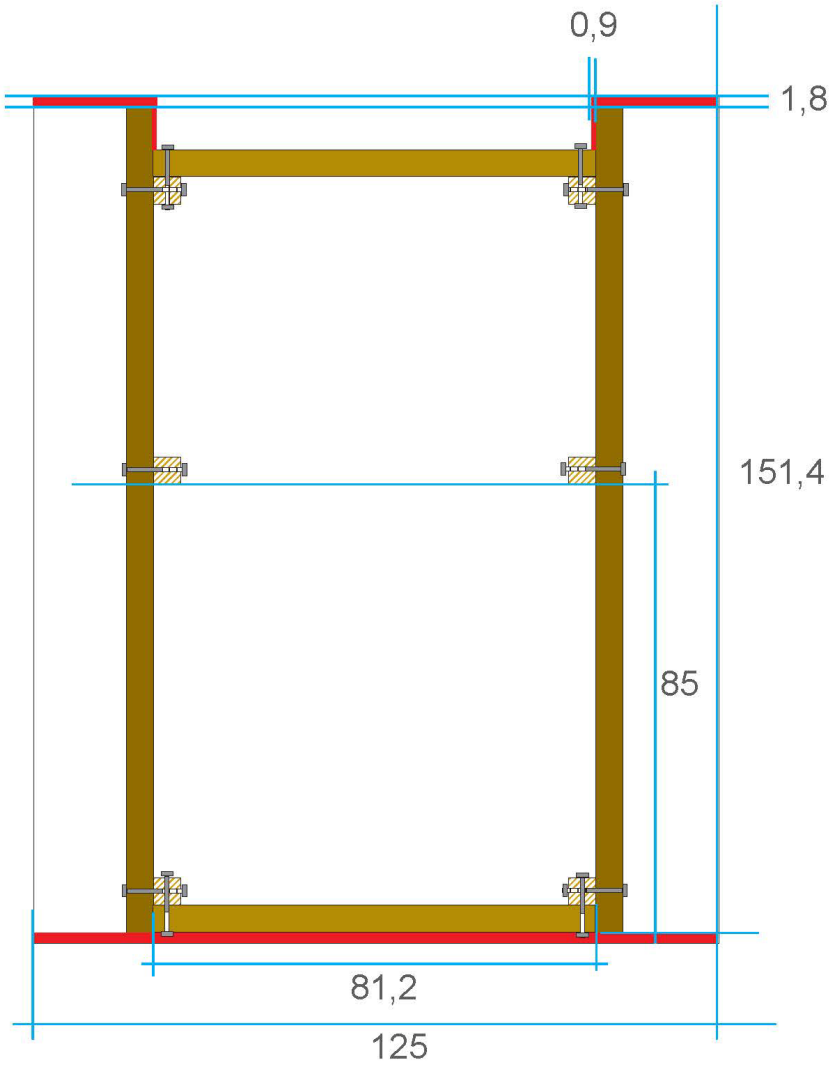
Side View of Casing

Obs: All units are in centimeters



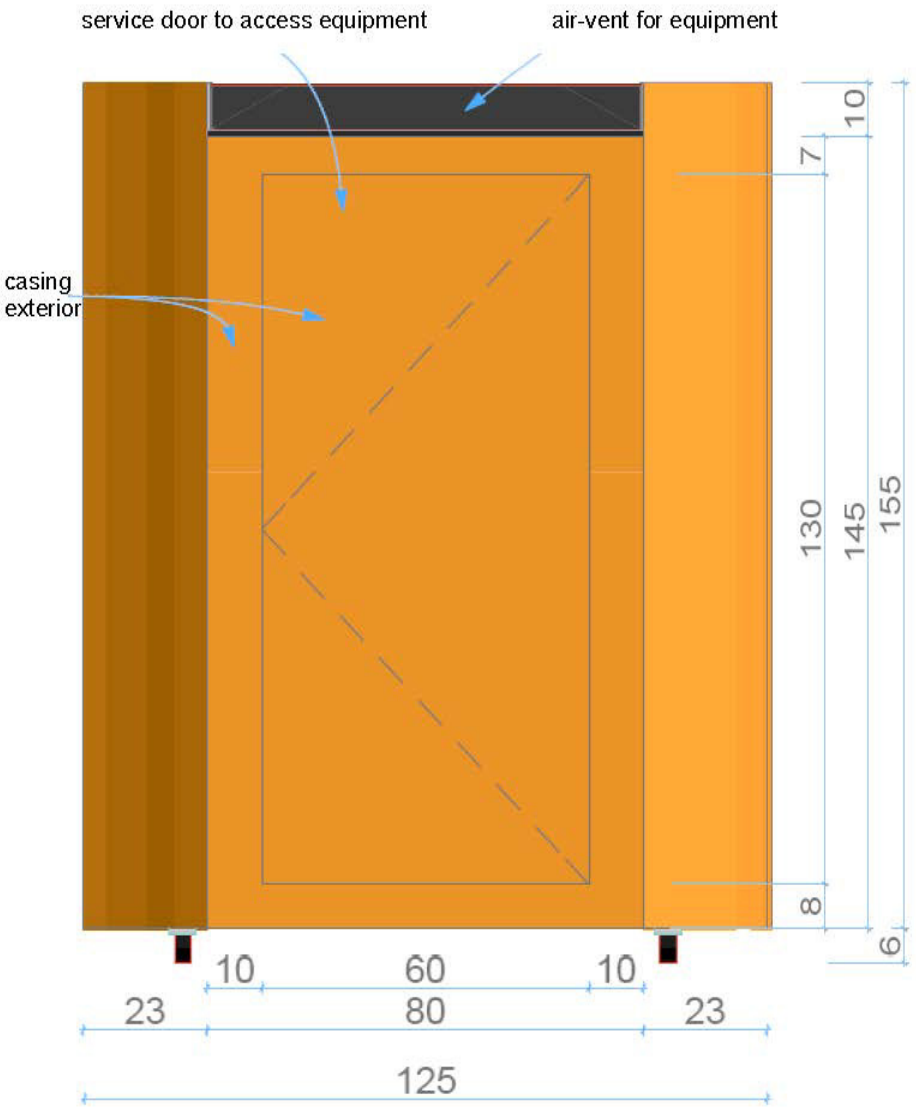
Back View of Structure

Obs: All units are in centimeters



Back View of Casing

Obs: All units are in centimeters

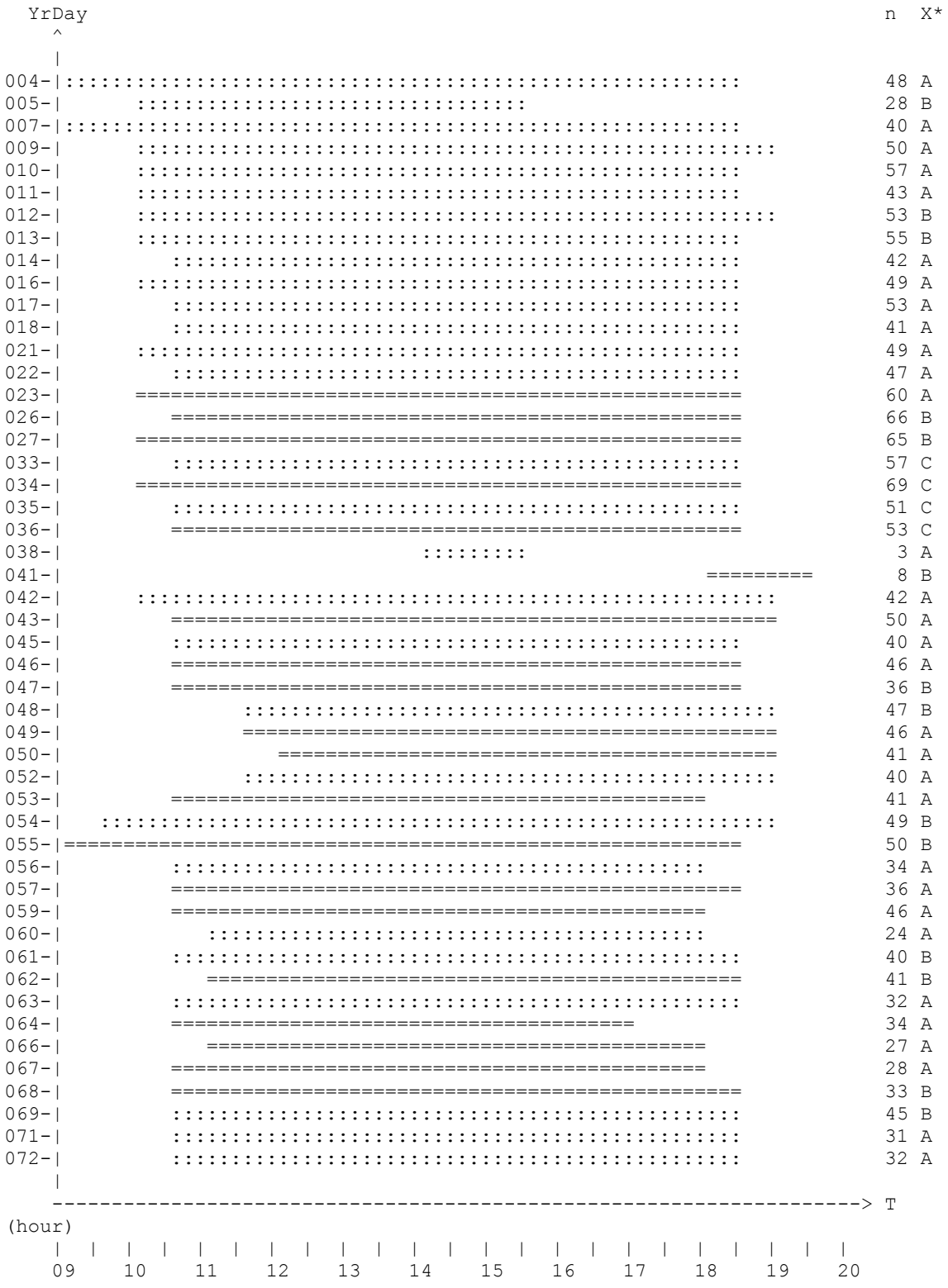


Fabrication of Casing

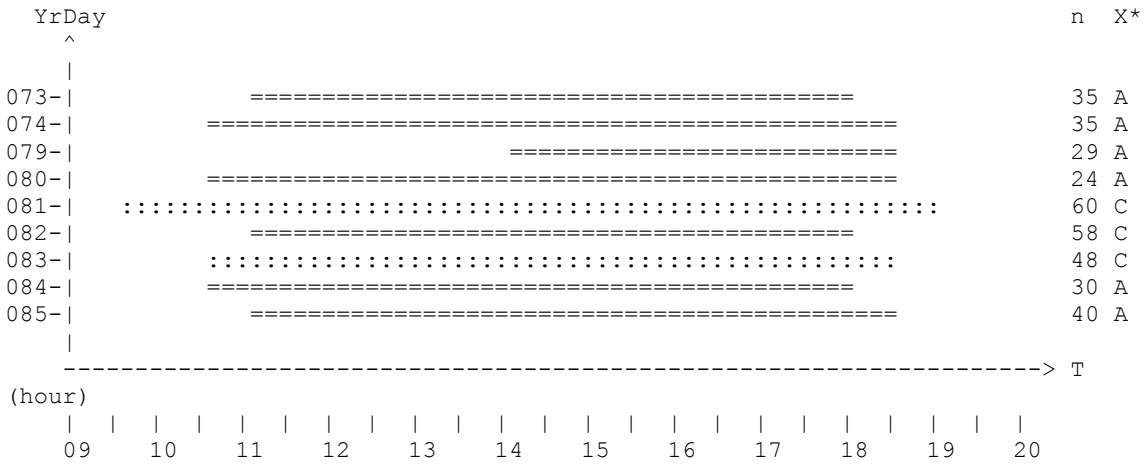
APPENDIX 5

Sampling Data

Table A5.1: Sampling Hours Matrix - Campaign: Iguaçu NP 04-Jan-2008 to 25-Mar-2008



Terminal management modes: ":::" for human-assisted and "===" for fully automated.



Terminal management modes: ":::" for human-assisted and "===" for fully automated.

* Symbol	Legend	Type of parameter
n	Day total sampling	Number of realized interviews
A	Week day - High season	Characteristics of sampling day
B	Weekend - High season	Characteristics of sampling day
C	Holiday - High season	Characteristics of sampling day
D	Week day - Low season	Characteristics of sampling day
E	Weekend - Low season	Characteristics of sampling day
F	Holiday - Low season	Characteristics of sampling day
YrDay	Day of Year	Linear year calendar (1 to 365)

Table A5.2: Sampling Results Matrix - Campaign: Iguaçu NP 04-Jan-2008 to 25-Mar-2008

YEAR|WEEK##	/DAY|X|Y| |TOT|INT| \STR|END/	/DAY|X|Y| |TOT|INT| \STR|END/	/DAY|X|Y| |TOT|INT| \STR|END/	/DAY|X|Y| |TOT|INT| \STR|END/	/DAY|X|Y| |TOT|INT| \STR|END/	/DAY|X|Y| |TOT|INT| \STR|END/	/DAY|X|Y* |TOT|INT| \STR|END/
2008|Week01	/001|-|-\ |---|---| \---|---/	/002|-|-\ |---|---| \---|---/	/003|-|-\ |---|---| \---|---/	/004|A|&\ |048|540| \030|570/	/005|B|&\ |028|300| \090|390/	/006|-|-\ |---|---| \---|---/	/007|A|&\ |040|540| \030|570/
2008|Week02	/008|-|-\ |---|---| \---|---/	/009|A|&\ |050|510| \090|600/	/010|A|&\ |057|480| \090|570/	/011|A|&\ |043|480| \090|570/	/012|B|&\ |053|510| \090|600/	/013|B|&\ |055|480| \090|570/	/014|A|&\ |042|450| \120|570/
2008|Week03	/015|-|-\ |---|---| \---|---/	/016|A|&\ |049|480| \090|570/	/017|A|&\ |053|450| \120|570/	/018|A|&\ |041|450| \120|570/	/019|-|-\ |---|---| \---|---/	/020|-|-\ |---|---| \---|---/	/021|A|&\ |049|480| \090|570/
2008|Week04	/022|A|&\ |047|450| \120|570/	/023|A|@\ |060|480| \090|570/	/024|-|-\ |---|---| \---|---/	/025|-|-\ |---|---| \---|---/	/026|B|@\ |066|450| \120|570/	/027|B|@\ |065|480| \090|570/	/028|-|-\ |---|---| \---|---/
2008|Week05	/029|-|-\ |---|---| \---|---/	/030|-|-\ |---|---| \---|---/	/031|-|-\ |---|---| \---|---/	/032|-|-\ |---|---| \---|---/	/033|C|&\ |057|450| \120|570/	/034|C|@\ |069|480| \090|570/	/035|C|&\ |051|450| \120|570/
2008|Week06	/036|C|@\ |053|450| \120|570/	/037|-|-\ |---|---| \---|---/	/038|A|&\ |003|060| \330|390/	/039|-|-\ |---|---| \---|---/	/040|-|-\ |---|---| \---|---/	/041|B|@\ |008|060| \570|630/	/042|A|&\ |042|510| \090|600/
2008|Week07	/043|A|@\ |050|480| \120|600/	/044|-|-\ |---|---| \---|---/	/045|A|&\ |040|450| \120|570/	/046|A|@\ |046|450| \120|570/	/047|B|@\ |036|450| \120|570/	/048|B|&\ |047|420| \180|600/	/049|A|@\ |046|420| \180|600/
2008|Week08	/050|A|@\ |041|390| \210|600/	/051|-|-\ |---|---| \---|---/	/052|A|&\ |040|420| \180|600/	/053|A|@\ |041|420| \120|540/	/054|B|&\ |049|540| \060|600/	/055|B|@\ |050|540| \030|570/	/056|A|&\ |034|420| \120|540/
2008|Week09	/057|A|@\ |036|450| \120|570/	/058|-|-\ |---|---| \---|---/	/059|A|@\ |046|420| \120|540/	/060|A|&\ |024|390| \150|540/	/061|B|&\ |040|450| \120|570/	/062|B|@\ |041|420| \150|570/	/063|A|&\ |032|450| \120|570/
2008|Week10	/064|A|@\ |034|360| \120|480|	/065|-|-\ |---|---| \---|---/	/066|A|@\ |027|390| \150|540|	/067|A|@\ |028|420| \120|540|	/068|B|@\ |033|450| \120|570|	/069|B|&\ |045|450| \120|570|	/070|-|-\ |---|---| \---|---/
2008|Week11	/071|A|&\ |031|450| \120|570/	/072|A|&\ |032|450| \120|570/	/073|A|@\ |035|390| \150|540/	/074|A|@\ |035|450| \120|570/	/075|-|-\ |---|---| \---|---/	/076|-|-\ |---|---| \---|---/	/077|-|-\ |---|---| \---|---/
2008|Week12	/078|-|-\ |---|---| \---|---/	/079|A|@\ |029|240| \330|570/	/080|A|@\ |024|450| \120|570/	/081|C|&\ |060|540| \060|600/	/082|C|@\ |058|390| \150|540/	/083|C|&\ |048|450| \120|570/	/084|A|@\ |030|420| \120|540/
2008|Week13	/085|A|@\ |040|420| \150|570/	/086|-|-\ |---|---| \---|---/	/087|-|-\ |---|---| \---|---/	/088|-|-\ |---|---| \---|---/	/089|-|-\ |---|---| \---|---/	/090|-|-\ |---|---| \---|---/	/091|-|-\ |---|---| \---|---/

YEAR|WEEK##	/DAY|X|Y| |TOT|INT| \STR|END/	/DAY|X|Y| |TOT|INT| \STR|END/	/DAY|X|Y| |TOT|INT| \STR|END/	/DAY|X|Y| |TOT|INT| \STR|END/	/DAY|X|Y| |TOT|INT| \STR|END/	/DAY|X|Y| |TOT|INT| \STR|END/	/DAY|X|Y* |TOT|INT| \STR|END/

* Matrix legend:

DAY = the day number in the year (1 to 365);
TOT = total applied questionnaires;
INT = interval (minutes) of the interviewing day session (max 600);

STR = 30-minute time block the interviewing session started (min 30 and max 630);
      9am to 9:30am is the first time block (30);
END = 30-minute time block the interviewing session ended (min 30 and max 630);
      7pm to 7:30pm is the last time block (630);
'X' and 'Y' are symbols for:

Symbol	Legend	Type of parameter
&	Human hosted	Terminal management mode
@	Fully automated	Terminal management mode
A	Week day - Low season	Characteristics of sampling day
B	Weekend - Low season	Characteristics of sampling day
C	Holiday - Low season	Characteristics of sampling day
D	Week day - High season	Characteristics of sampling day
E	Weekend - High season	Characteristics of sampling day
F	Holiday - High season	Characteristics of sampling day
-	Not a sampling day	Do not apply

Table A5.3: Multiple sources data collection at the day scale. Iguaçu NP 04-Jan-2008 to 25-Mar-2008

DATE*	WEEKDAY	HOLIDAY	APP_DAYYR	SAMPLED	TERMMGMT	NBRDAYVIS	RIVERFLOW	START_T	END_T	DELTA_T	SAMPL_T
1/04/2008	FRI	0	4	1	1	5745	1016	30	570	540	48
1/05/2008	SAT	0	5	1	1	6433	1365	90	390	300	28
1/07/2008	MON	0	7	1	1	4318	582	30	570	540	40
1/09/2008	WED	0	9	1	1	5139	1163	90	600	510	50
1/10/2008	THU	0	10	1	1	5469	1243	90	570	480	57
1/11/2008	FRI	0	11	1	1	3463	1371	90	570	480	43
1/12/2008	SAT	0	12	1	1	5962	1139	90	600	510	53
1/13/2008	SUN	0	13	1	1	6641	877	90	570	480	55
1/14/2008	MON	0	14	1	1	3605	695	120	570	450	42
1/16/2008	WED	0	16	1	1	5335	1494	90	570	480	49
1/17/2008	THU	0	17	1	1	4484	1290	120	570	450	53
1/18/2008	FRI	0	18	1	1	4064	1244	120	570	450	41
1/21/2008	MON	0	21	1	1	4054	661	90	570	480	49
1/22/2008	TUE	0	22	1	1	5024	1144	120	570	450	47
1/23/2008	WED	0	23	1	0	4439	1272	90	570	480	60
1/26/2008	SAT	0	26	1	0	5229	1291	120	570	450	66
1/27/2008	SUN	0	27	1	0	4481	946	90	570	480	65
2/02/2008	SAT	1	33	1	1	4336	1292	120	570	450	57
2/03/2008	SUN	1	34	1	0	9572	758	90	570	480	69
2/04/2008	MON	1	35	1	1	5064	468	120	570	450	51
2/05/2008	TUE	1	36	1	0	5573	492	120	570	450	53
2/11/2008	MON	0	42	1	1	2735	622	90	600	510	42
2/12/2008	TUE	0	43	1	0	4701	985	120	600	480	50
2/14/2008	THU	0	45	1	1	2928	1178	120	570	450	40
2/15/2008	FRI	0	46	1	0	3120	1265	120	570	450	46
2/16/2008	SAT	0	47	1	0	3635	1399	120	570	450	36
2/17/2008	SUN	0	48	1	1	4069	1322	180	600	420	47
2/18/2008	MON	0	49	1	0	2311	696	180	600	420	46
2/19/2008	TUE	0	50	1	0	3492	830	210	600	390	41
2/21/2008	THU	0	52	1	1	3132	1445	180	600	420	40
2/22/2008	FRI	0	53	1	0	2197	1275	120	540	420	41
2/23/2008	SAT	0	54	1	1	3762	1191	60	600	540	49
2/24/2008	SUN	0	55	1	0	3226	692	30	570	540	50
2/25/2008	MON	0	56	1	1	2223	544	120	540	420	34
2/26/2008	TUE	0	57	1	0	2909	816	120	570	450	36
2/28/2008	THU	0	59	1	0	2570	1278	120	540	420	46
2/29/2008	FRI	0	60	1	1	2167	1086	150	540	390	24

(continues)

Tabele A5.3: Multiple sources data collection at the day scale (continued)

DATE	WEEKDAY	HOLIDAY	APP_DAYYR	SAMPLED	TERMMGMT	NBRDAYVIS	RIVERFLOW	START_T	END_T	DELTA_T	SAMPL_T
3/01/2008	SAT	0	61	1	1	2579	1101	120	570	450	40
30/2/2008	SUN	0	62	1	0	3148	670	150	570	420	41
3/03/2008	MON	0	63	1	1	1962	450	120	570	450	32
3/04/2008	TUE	0	64	1	0	2134	751	120	480	360	34
3/06/2008	THU	0	66	1	0	1966	1007	150	540	390	27
3/07/2008	FRI	0	67	1	0	1736	1038	120	540	420	28
3/08/2008	SAT	0	68	1	0	2682	1013	120	570	450	33
3/09/2008	SUN	0	69	1	1	3280	631	120	570	450	45
3/11/2008	TUE	0	71	1	1	2163	610	120	570	450	31
3/12/2008	WED	0	72	1	1	2300	918	120	570	450	32
3/13/2008	THU	0	73	1	0	2190	843	150	540	390	35
3/14/2008	FRI	0	74	1	0	2164	707	120	570	450	35
3/19/2008	WED	0	79	1	0	2466	684	330	570	240	29
3/20/2008	THU	0	80	1	0	2926	581	120	570	450	24
3/21/2008	FRI	1	81	1	1	10466	799	60	600	540	60
3/22/2008	SAT	1	82	1	0	6241	615	150	540	390	58
3/23/2008	SUN	1	83	1	1	4109	539	120	570	450	48
3/24/2008	MON	0	84	1	0	1626	405	120	540	420	30
3/25/2008	TUE	0	85	1	0	1869	397	150	570	420	40

* Sampled days for Phases I and II of the survey pilot study;

APPENDIX 6

Descriptive statistics for the entire sample

Descriptive statistics for the entire sample

The study generated considerable data from a sample of 4,000+ visitors of Iguaçu National Park (INP) during the year of 2008. The information collected encompassed the following matters: Participation in recreational activities currently offered to Park visitors; Visitor's overall satisfaction in visiting the Park; Fulfillment of visitor's expectations in visiting the Park; Visitor's probability of visiting the Park again in the future; Chance of recommending a trip to the Park to others; Participation in tourism activities currently offered to visitors in the region of Foz do Iguaçu; Visitor's overall satisfaction with the visit to Foz do Iguaçu, which is the gateway to visit the Park; and demographics regarding visitor's origin, age, gender, and language choice. The population of Park visitors was sampled in the months of January, February, March, August, October, November and December, encompassing high and low visitation seasons. Interviews were conducted in week days, weekends, and holidays in order to yield a representative sample of the typical Park publics. A summary of these findings is presented in Tables A6.1 to A6.3.

Table A6.1: Frequencies of demographic variables included in the Iguaçu N.P. visitor survey.

Characteristic	Total Sample	N	Percentage
Age[1]	2,319		
12 and under		342	14.7
13 to 19		316	13.6
20 to 29		673	29.0
30 to 39		451	19.4
40 to 49		276	11.9
50 to 59		144	6.2
60 to 69		70	3.0
70 and over		47	2.0
Gender	2,318		
Male		1,359	58.6
Female		959	41.4
Origin	2,344		
Local		252	10.8
National		958	40.9
International		1,134	48.4
Language choice	4,047		
Portuguese		1,902	47.0
English		800	19.8
Spanish		1,345	33.2

[1] Age parameters: Average = 29.5; Median = 27; Mode = 23; Std. Deviation = 16.4; 13 answers were zero, which was interpreted as a skip pattern; 12 answers (0.5%) were between 1 and 4years, which seems non-reliable answers.

Table A6.2: Mean scores for social variables included in the Iguaçu N.P. visitor survey.

			Visitor Opinion (%)*								
	N	Mean	9	8	7	6	5	4	3	2	1
Overall Satisfaction - Park[1]	3,033	7.99	55.2	22.4	6.8	6.7	5.5	1.0	.5	.4	1.5
Expectation Effectively Met[2]	2,765	7.55	34.0	33.0	15.8	5.5	5.9	1.3	.7	1.0	2.8
Probability of Return in Future[3]	2,634	7.25	32.9	30.9	11.7	7.9	5.7	2.2	1.7	3.2	3.8
Degree of Referring to Others[4]	2,518	8.22	57.1	31.5	4.6	1.7	1.3	.6	.4	.7	2.1
Overall Satisfaction – Region[5]	2,403	7.95	47.2	28.0	11.6	7.2	3.0	1.0	.3	.2	1.5

* Cell values are percentages of answers for each level of 9-point Liket scales; Colored cells row indicates the side of the scale the answer falls in:
Green: positive side (presented to respondents as a range between +1 to +4);
Red: negative side (presented to respondents as a range between -1 to -4);
White: neutral point (neither, nor; presented to respondents as 0);

[1] Scale label: 1 = Extremely unsatisfied; 2 = Very unsatisfied;3 = Moderately unsatisfied; 4 = Slightly unsatisfied; 5 = Neutral; 6 = Slightly satisfied; 7 = Moderately satisfied; 8 = Very satisfied; 9 = Extremely satisfied; Std. Deviation = 1.60.

[2] Scale label: 1 = Extremely below; 2 = Very below; 3 = Moderately below; 4 = Slightly below; 5 = Not above nor below; 6 = Slightly above; 7 = Moderately above; 8 = Very above; 9 = Extremely above; Std. Deviation = 1.78.

[3] Scale label: 1 = Extremely improbable; 2 = Very improbable; 3 = Moderately improbable; 4 = Slightly improbable; 5 = Not probable nor improbable; 6 = Slightly probable; 7 = Moderately probable; 8 = Very probable; 9 = Extremely probable; Std. Deviation = 2.12.

[4] Scale label: 1 = Extremely discouraged; 2 = Very discouraged; 3 = Moderately discouraged; 4 = Slightly discouraged; 5 = Not encouraged nor discouraged; 6 = Slightly encouraged; 7 = Moderately encouraged; 8 = Very encouraged; 9 = Extremely encouraged; Std. Deviation = 1.49.

[5] Scale label: 1 = Extremely unsatisfied; 2 = Very unsatisfied;3 = Moderately unsatisfied; 4 = Slightly unsatisfied; 5 = Neutral; 6 = Slightly satisfied; 7 = Moderately satisfied; 8 = Very satisfied; 9 = Extremely satisfied; Std. Deviation = 1.47.

Table A6.3: Visitor participation in activities currently offered in the Iguaçu N.P. and the region.

Participation in Activity	Total Sample[1]	N	Percentage
Within Iguaçu National Park	2,506		
Falls' Trail		2,167	79.8
Macuco Safari		665	24.1
Poço Preto Trail		265	9.8
Arborism		240	8.8
Rafting Down the Falls		237	8.7
Helicopter Tour		389	14.3
In the Foz do Iguaçu's region	2,252		
Itaipu Power Plant Dam		743	34.7
Parque Nacional Iguazú (Argentina)		1,043	48.7
Shopping in Paraguay		1,069	50.0
Folkloric Show		358	16.7
Bird Park		847	39.6

[1] Respondents that answered or passed through these questions.

APPENDIX 7

Kiosk Interviewing Software Suite

CD-ROM

Disk Image

Download the software's updated information and the CD image from the links below:

Information: http://dl.dropbox.com/u/17722217/CAKI_Demo_CD.txt

CD Image file: http://dl.dropbox.com/u/17722217/CAKI_Demo_CD.iso

Burn the disk image (.iso) on a blank CD-R/RW or mount it on a virtual CD-ROM drive.

Installation

Insert the CD into your CD-ROM drive. After a few seconds, the Install Wizard will appear. This program will guide you through the remaining process via on screen prompts. In the event the Install Wizard does not appear when you insert the CD: Double-click on the MY COMPUTER icon, then double-click on the CD-ROM icon, and lastly double-click on the INSTALL.EXE file to bring up the Install Wizard.

System Requirements

PC computer with Microsoft Windows XP operating system.

Developer

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