

Luiz Agner, Patricia Tavares, Simone Bacellar Leal Ferreira

Computer assisted data collection: Ethnographic observation to support usability evaluation and design

Keywords: Usability, ethnography, data collection, statistics, Continuous PNAD, census

The impact of computer aided interviews on data quality has been systematically evaluated by statistical institutes in various countries. This article aims to illustrate the importance of field observation in the evaluation of computer assisted data collection. The proposed method shown herein was for application within the context of the Brazilian Institute of Geography and Statistics (known in Brazil as IBGE), which performs the national census. This method (Scenario and Task Based Interviews - STBI) was designed to be implemented with the participation of interviewers who use personal digital assistants to perform statistical data collection for demographic research. The authors analyzed the usability of the application developed to support Continuous National Household Sample Survey (Continuous PNAD). The proposed method represented a mixture of four evaluation approaches. This article emphasizes the description of the section of the method that concerns the application of ethnographic observations and results.

1 Introduction

Due to the advancement of information technology, people and organizations increasingly need quality-built systems. Considering that it is through interfaces that people communicate with systems in order to perform their tasks, they must increasingly be designed with a strong focus on usability (Leal Ferreira & Nunes, 2008).

There are different usability evaluation methods: there are those without the presence of users - inspection or analytical methods - and those that involve users, called observation methods or tests with users. These can be made in the context of use or in a monitored environment such as usability labs (Dias, 2007).

This article will present an evaluation method, called Scenario and Task Based Interviews (STBI), which was developed and applied to assess the usability of software developed to support interviewers during Continuous National Household Sample Survey (Continuous PNAD). This survey is conducted by the Brazilian Institute of Geography and Statistics (IBGE), the statistical institute of the Brazilian central government. IBGE is the institute that performs the Census and other important official demographic and economic data collections.

This work is also part of a master's degree research (Tavares, 2011), which addressed the usability of an electronic questionnaire in mobile devices used to automate statistical data collection during household demographic interviews. Our goal was to contribute to the improvement of the data collection process, aiming to make it more comfortable, accurate and reliable.

This research identified human-computer interface design problems in the Continuous National Household Sample Survey (Continuous PNAD), which would generate biases and errors in the results or would impact the integrity of data. The present research has contributed to Brazilian society by improving the process of data collection, since identified problems, which could occur at the moment of capturing data due to human factors. This kind of statistical research is paid for by Brazilian taxpayers, who in return expect quality data that truly represents the reality of the country.

This paper proposes a method that represents a mixture of four approaches to evaluation: ethnographic observations, usability testing using a portable lab, semi-structured interviews and heuristic inspection. Special emphasis is given to the exploratory part of the method that concerns the application of ethnographic observation, and its results.

2 Continuous PNAD survey

Continuous National Household Sample Survey (Continuous PNAD) is a nationwide household survey, which was officially implemented in 2011, with a quarterly disclosure and covers all Brazil, including the rural areas.

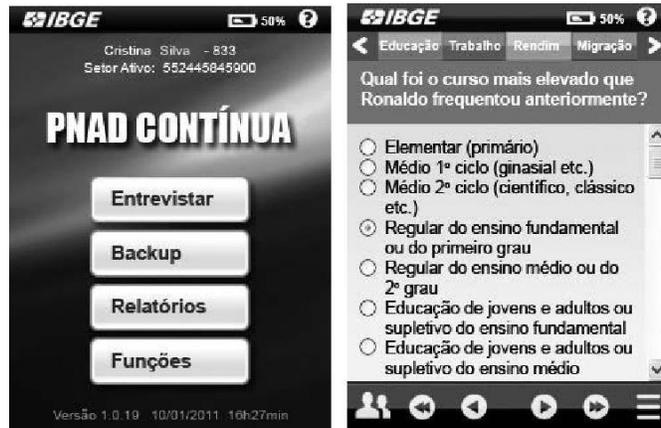
It is a combination of two household surveys – the Monthly Employment Survey (PME), which analyzes the country's labor market, conducted in six metropolitan areas and published every month, and the National Survey by Household Sampling (PNAD), a social audit conducted and published annually (IBGE, 2011).

Continuous PNAD management systems include a system for data collection supported by personal digital assistants (PDA). IBGE tested the Continuous PNAD methodology from October to December 2009 in the states of Pará, Pernambuco, Rio de Janeiro, São Paulo, Rio Grande do Sul and the Federal District, continuing tests in Rio de Janeiro during 2010.

Continuous PNAD is part of the Integrated Household Surveys and consists of a sample of approximately 179,000 households, spread across 3,328 municipalities throughout Brazil.

Besides gathering information on labor and income, the survey investigates additional topics throughout the year, such as: youth and adult education, migration, vocational education, child labor, fertility, social mobility, marriage, health, food security, information technology and communication, income transfers and use of time (IBGE, 2011).

An electronic questionnaire has been created to support data collection and management. Our study examined how easy it was to use an application, which had been developed for mobile devices. The aim was to generate design recommendations in order to make the interface more efficient and appropriate for users (Figure 1).



[figure 1] Some sketches for the new graphic user interface of the Continuous PNAD questionnaire.

3 Technology and data collection

According to Greene (2001), the introduction of technology can transform the context of an interview for collecting statistical data, and contribute to the feeling that this is an important event for the informant. In some cases, curiosity regarding the technology can attract more people to observe or participate in the interviews. It may also often help to “break the ice”, making it easier to talk with other members of the family or community. Only in certain isolated situations, can technology cause fear or anxiety.

Data collection methods assisted by computers are known by the terms CADC (Computer-Assisted Data Collection) or the European term CADAC, CASIC (Computer-Assisted Survey Information Collection), and CAI (Computer-Assisted Interviewing). Traditional paper and pencil methods are often referred to as PAPI (Paper-And-Pencil Interviewing).

One technique known as CAPI (Computer Assisted Personal Interviewing) is characterized by a personal interview conducted by an interviewer using a computer to support the process and is directed to an informant. It generally uses a mobile device: a laptop (notebook, netbook) or a handheld computer (smartphone or PDA). It can be also called MCAPI (Mobile Computer-Assisted Personal Interviewing).

The first personal interviews supported by computers were tested in Europe by Statistics Sweden in 1982, and in 1984 by Statistics Netherlands, using laptops which were slow and low on memory. The first home research using the CAPI method to collect all its data was the Dutch Labor Force Survey, performed by Statistics Netherlands in 1987 and in the same year the Nationwide Food Consumption Survey, by the US Department of Agriculture, partly used the CAPI method to support the data collection process (Couper & Nicholls, 1998).

In computer-supported personal interviews there are three elements of interaction: two humans (the interviewer and informant) and a computer with software for data collection. The quality of the final product is influenced by good interaction between interviewer and informant and good interaction between interviewer and computer. The environment of use is

also a variable that may influence the process.

During the interview, the interviewer handles the computer. His/her task is to manage two interactions simultaneously (both with the computer and the informant), and keep his/ her attention on the informant's answers as well as remaining focused on the task of entering data into the computer correctly. Therefore, the interviewer is considered the most important element, since he/she is the main connection to the data source.

This type of work attracts people who like to travel, talk, earn an extra salary or enjoy a flexible schedule. However, it is sometimes necessary to visit unpleasant households and/or dangerous areas, access unreceptive informants, withstand unfavorable weather conditions or walk for many hours.

The main feature of an interview supported by computers is that questions are structured in the correct order, following an algorithm available in the interactive program on the computer screen. The software has the intelligence to reconfigure the order and type of questions, based on previous answers and any information it already possesses on the respondent. Responses are directly entered on the computer by the interviewer or interviewee. The CADC is well accepted by interviewees and interviewers as an alternative to paper questionnaires. It permits improved quality of data, especially when complex questionnaires are used. In general, respondents react positively to the use of a computer during an interview because they attribute a greater degree of professionalism to the survey. Social interaction with the interviewer is described as comfortable (Leeuw, Hox & Snijkers, 1995).

The goal of the software is to facilitate work rather than make it more difficult. Any usability problem can cause anxiety, fear or dissatisfaction to the interviewer or informant, and may generate a lack of credibility or even refusal to continue the interview. On the other hand, good usability enhances the process by facilitating interaction between interviewer and informant (Tavares, 2011).

4 STBI method

The present study employed an innovative research method and has adapted techniques of usability testing for the specific context. As adjustment was a significant issue, it was decided to rename the method because it has become differentiated from what could be referred to as a usability test. It was called Scenario and Task Based Interview (STBI) and has been described in a number of other papers (Agner, 2010; Agner et al., 2011a, 2011b, 2011c; Tavares et al., 2010a, 2010b) presenting results as well as specific characteristics, which differ from traditional tests.

An STBI study is basically an applied qualitative research and was performed in six steps: (a) Literature and document research, (b) Ethnographic observation, (c) Sample selection, (d) Scenario and task based lab sessions, (e) Analysis, and (f) Communication of results. These steps will be described briefly throughout the following topics. This article emphasizes the description of part of the method that concerns the application of ethnographic observation and its results.

Literature and document research

Initially, the team studied and selected several tools and software that support professional interface evaluation, such as video recorders, applications that synchronize PDA with a notebook, Continuous PNAD questionnaire guides and manuals, as well as videos dealing with the best ways to approach an informant.

Ethnographic observation

The authors scheduled a field work follow-up, during which questionnaire application could be observed in real use. Our intention was to identify problems and understand the difficulties and advantages of collecting data using the PDA. In order to understand how users conducted the field work, authors followed three teams of interviewers in household approaches during the Continuous PNAD test phase.

First, the authors participated in a field visit to Alto Leblon, an upper middle class residential neighborhood. Then the authors followed a work team throughout various districts in the suburbs of Rio de Janeiro, after which a visit to the IBGE data collection agency in Copacabana was made to interview its employees. After this, a field visit was undertaken in Tanguá, a rural area located within the State of Rio de Janeiro, a district with transport difficulties and no cell phone service.

Further to this, authors followed a 2010 Census interviewer using a similar device in both a middle class area and a slum in the city of Belo Horizonte (Figure 2). Ethnographic observations were recorded through written notes, video and photos, presenting the views of interviewers about their experience using the electronic questionnaire.



[figure 2] Record of ethnographic observation: a Census interviewer walks through a slum at Belo Horizonte.

Ethnography can be described as the observation of people in their cultural context. A

culture is made up of certain values, practices, relationships and identifications. Thus, a workplace may be described as a culture, filled with work standards, business practices (both formal and informal), and relationships between coworkers and between workers and managers (Burke & Kirk, 2001).

Ethnography is a category of research in Human Computer Interaction. Ethnographic study is a powerful means of identifying the true nature of the work. It is very common for users to perform their tasks differently from what was prescribed. Ethnographic techniques can discover valuable and unusual facts that would never be identified by in-house methods. According to Burke and Kirk (2001) “the goal of ethnography for systems designers, on the other hand, is the improvement of a system in use in the culture by finding the problems in the way it is currently used. This involves observing users’ interactions with the system as well as the effects the system has on the culture of the workplace”.

Cooper, Reimann and Cronin (2007) state that contextual studies developed in the process of interaction design should bring the spirit of ethnographic research and apply it on a micro level.

Most of the data originating from an ethnographic study is elicited through personal observation, interviews or audio recordings and videos. Their results are qualitative information such as statements, impressions, opinions and descriptions of the environment or location. The ethnographic observations made during the follow-up of the teams were registered with images, audio interviews, video, notes and reports - presenting the user’s views on the interaction with the mobile device in the field.

Sample selection

To analyse the target audience of Continuous PNAD workers, an online questionnaire was developed and included in the Continuous PNAD management system. Users were informed of the benefits that would be obtained with the usability research. Results were aggregated and analysed, yielding a total of 57 responses, where 29 users (51%) agreed to participate. The general profile was predominantly male (70%) aged between 18 and 29 years (66%) with incomplete schooling (44%) or complete schooling (39%), with a wide experience of PDA (33%) or moderately wide (33%). This overview was used as the basis for selecting a sample of six users to participate in the next stage of evaluation: the scenario and task based lab sessions.

Scenario and task based lab sessions

After field work observations a number of laboratory sessions were performed. The term Scenario and Task Based Interview (STBI) was coined to avoid creating anxiety in the participants and to avoid any suggestion that they were being tested. In addition to this, participants are accustomed to the term “interview” because of their own work in Continuous PNAD.

Comprehension of informant approach situations represented a valuable aid for building scenarios of use (common situations that occur in fieldwork, written with familiar language to the user). Meetings with the application development team were held to consolidate scenarios/ tasks addressing the main field situations as presented in Table 1. A fictitious database was also provided to help perform the tasks.

The type of usability lab used to support lab sessions was a minimalist portable setup (Rubin & Chrisnell, 2007). There was no specific room dedicated to testing: the equipment and software were taken to different locations in a notebook. This configuration is considered by Rubin and Chrisnell (2007) as the most suitable for organizations that are beginning to test because it presents the best cost-benefit, dispensing with physical surroundings. Another added advantage is that it is easier to recruit participants.

During lab sessions, users were provided with the option of stopping the tasks and freely registering their storytelling, comments, criticisms or suggestions. Hence, the method differs from traditional usability testing which is focused on the measurement of performance. It is essentially a method of evaluation that generates insights and qualitative data.

[table 1] Examples of scenarios and tasks presented to the users during STBI lab sessions.

Scenario	Tasks
1. You are conducting a Continuous PNAD interview, using your PDA. You opened a domicile and were informed that there was a family with 3 persons living there.	1. Register a family made up of 3 persons and confirm the information in your PDA.
2. As you continue to interview, you discover that there is one more person to be registered in this household.	2. Please establish the relationship between the persons in the family and include the grandmother, according to the data provided.
3. On the same day, you continued to collect data and opened up another domicile, with 5 people forming two families.	3. Register two families formed by these 5 people, who live at the same address according to the information provided.
4. Now you will continue an interview begun the preceding month, and so, you will need to open the file that is in the backup area of your PDA.	4. Save a backup of the current data and restore the backup of the previous interview.
5. In the middle of the interview, you notice that it will be necessary to make corrections to the previously recorded revenue information.	5. Change the income data of the residents according to the figures provided.
6. You had to stop the interview at the request of the informant. You will have to call and reschedule another day to finish the survey.	6. Write down the informant's phone number and in the appropriate field type a reminder to call her the following Thursday, between 8:00 am and noon.

Analysis

The STBI study adopted a top-down analysis: six user sessions produced 48 videos which were carefully reviewed by researchers who conducted an heuristic inspection to identify all the problems and related suggestions given by the users.

After registering all the problems and suggestions, researchers used a top-down data grouping strategy beginning with Nielsen's ten heuristic categories (Nielsen, 2005) which describe general usability principles. The top-down approach began from this well-known

range of established principles because they would provide consistency to the analysis and to the interpretation of data (Agner, 2007).

In this article, few details will be provided regarding the lab sessions and analysis in order to focus on the description of the ethnographic observation phase and results.

5 Some research results

Ethnographic observation results

The authors were able to confirm that the PDA needs to withstand harsh environmental conditions (heat, cold, humidity, drought, and light) depending on the locality. It is a fact that mobility imposes physical, visual and cognitive limitations to users (Burzagli *et al.*, 2007).

Added to these factors is the difficult access to certain households (high-risk areas, distant places) and upper middle class condominiums where more and more restrictions to interviewers are imposed due to security concerns. To register these circumstances and facts, the authors wrote ethnographic reports indicating the main events (Tavares, Agner & Leal Ferreira, 2010a). The color contrast of the screen in the sunlight was the most often cited usability problem: researchers photographed the device under the incidence of sunlight to emphasize the severity of the problem (Figure 3).

It was also observed that the ethnographic study is a powerful means of identifying the true nature of the work. It was very common for users to perform their tasks in a different manner from that prescribed. In the case of computer-aided data collection, ethnography can be useful to illustrate whether users pose their questions using popular language, different from that proposed by the official questionnaire guide. Or, again, it may be noticed whether users attempt to bypass the regular application operation in order to avoid slowing down, crashing or other technical issues that impact usability.



[figure 3] Field use observation: in the sunlight, legibility of the device screen was considerably impaired.

The following text is a selected part of an ethnographic observation report made during the

Continuous PNAD testing phase, as previously explained. The text is an example and represents an overview of the observation experience in the rural sector of Rio de Janeiro. All names have been changed to protect privacy.

Example of Observation Report (1)

After several field visits to urban areas in Rio de Janeiro, we decided to perform ethnographic observation in a rural area. Carlos and I met Gláucio, a research coordinator. He proposed that we visited Tanguá, where data are collected in areas with very rural characteristics, although it was formally considered an urban sector.

Accompanied by Ubiratan, a very talkative interviewer, we drove to this region by car. On the way, Ubiratan complained that cars were not usually available to go to these distant sectors. The coordinator Gláucio emphasized that priority for the use of vehicles was being given to the Population Census, another survey that was also in progress at that time.

During the trip, we realized that all urban characteristics, such as paved roads, curbs, signs and buildings were gradually disappearing and giving rise to characteristics of a rural region.

As we entered an unpaved street, we observed the growing number of ranches along the path. At various points, we passed through grazing cattle and many orange trees. Ubiratan commented that this was a typical landscape of the region as it was a major producer of oranges. Although it was winter, the sun was very strong and the sky blue. We noted as we drove through several very large puddles that if it had been raining, we would not have reached our destination without a four-wheel drive vehicle.

About half an hour later, with great difficulty and after going round in circles through a series of unpaved pathways and alleys, in the midst of dense crops and pastures, Ubiratan spotted one of the selected households. We parked our vehicle in the shade in front of a very simple house, with peeling paint and plaster. A dog started barking but stopped soon after (Figure 4). A flowering shrub stood outside the house and a cage with a bird was hanging on the front porch.



[figure 4] Record of ethnographic observation: Continuous PNAD interviewer focuses on a selected household

in Tanguá, a sector with rural characteristics in Rio de Janeiro.

A resident and his wife came to the door. Ubiratan identified himself and asked permission to interview him on behalf of the IBGE. The citizen was slightly wary, but did not reject this approach. He was a quiet man, wearing scruffy shorts, slippers and no shirt (Figure 5). He was clearly very muscular and suntanned, and seemed to be in his forties. He later revealed he was a farmer.

Ubiratan looked for some shade on the porch, sitting on the wall, accompanied by the house owner. After requesting and drinking a glass of water, he turned on his mobile device, and began to use it silently. The informant was patient and at the same time seemed curious, as he waited for the questions. The interview began at around 12:15.

Ubiratan used simple words and managed to gain the trust of the informant in order to obtain the data he needed. The informant became a little embarrassed to say how much he earned per month. He said he was an agriculturist, but sometimes he received no money because he lost the whole crop. He replied politely to all questions, but did not understand why Ubiratan wondered if he would like to work more hours a week.



[figure 5] Record of ethnographic observation: Continuous PNAD interviewer (left) uses a mobile device to collect data at the selected household.

Ubiratan spent some time explaining the purpose of this question to the man, but he was still unable to understand. Gláucio, the coordinator, also tried to explain, but the man and also his wife remained in doubt. Why would you want to work harder than you already do?

When asked questions about his wife, the farmer asked for her help. She said she had returned to her high school studies at night and went to school by bicycle. She worked as a domestic servant and earned about U\$ 175 per month. Ubiratan did not ask who the head of household was, therefore we do

not know whether he indicated the farmer or his wife as the head. While the interview was taking place, Carlos and I took photos and wrote our observations on a piece of paper.

These were clearly very simple people, but they were polite and made no grammar mistakes. A second middle-aged man who was not identified and their daughter, a ten-year-old child, joined the group on the balcony, showing curiosity about the interview. In the backyard, chickens and ducks circulated and a cock crowed. It seemed to us that the family usually grew all their own food.

The interview lasted for about 45 minutes. We said goodbye, took some pictures in front of the house and left. In the car, responding to a question from Carlos, Ubiratan said that the latest changes made to the PDA screen design, suggested by our previous usability studies, had improved interaction and that the new virtual keyboard had made things much better. However, he complained about some other technical problems.

The text below is also part of an ethnographic observation undertaken during the Continuous PNAD. The names of all involved have been changed to maintain privacy. The report represents an overview of our observation experience in Leblon, Rio de Janeiro.

Example of Observation Report (2)

On a sunny autumn afternoon, we started following the work of a Continuous PNAD interviewer, in the neighborhood of Alto Leblon in the southern part of the city of Rio de Janeiro. There were four people in the field work: Manuela (who works for the Information Technology Direction and is part of the application development team), Roberto, the research supervisor responsible for the area, Reinaldo, the interviewer selected to accompany us, and myself. Alto Leblon is an upper-class residential area, with large apartments and luxury penthouses.

After about ten unsuccessful attempts to open households to apply the survey, we finally managed to visit a residence. Reinaldo waited for us at the gate and we went up in the elevator to one of the penthouse apartments, where we were greeted by Marlene, accompanied by her house maid. Reinaldo introduced me and Manuela as his supervisors, and asked if we could both monitor the interview. We obtained the approval of the owner of the house, though she did register some surprise about the number of people entering.

Upon entering, Marlene invited us to a large balcony, tastefully decorated with potted plants, where there were two couches, chairs and a coffee table. Reinaldo sat in the place indicated by the interviewee, but

was soon forced to move due to the light that was shining on his PDA screen, impairing its operation.

The interview began at 11:25 am and ended around 12:25. During the observation of the interview and the use of hand-held device by Reinaldo, Manuela and I noted down the following occurrences:

- ■ *Most of the questions were informal. The interviewer has adapted the questions presented by the PDA into colloquial language. This strategy helped to create a relaxed interview, and the conversation flowed normally.*
- ■ *Reinaldo began the survey with a question about the last course that Marlene had finished. She said she had completed her master's degree. With this answer, Reinaldo deduced a number of other answers, for example, that she could read and write. He did not ask this question. After the interview, we asked him why he had adapted some of the questions and had not followed the proposed sequence. He knew that the Coordination staff required him to follow the strict sequence of the questionnaire, but he argued that if he did it would be tiring and boring for the informant.*
- ■ *The interviewee went on to talk in an informal tone with the interviewer, giving more details than he had strictly asked. The interviewee went on to describe the story of her life. This created the need for a good deal of interpretation by the interviewer. On the other hand, out of personal curiosity, Reinaldo asked some additional questions not included on the Continuous PNAD questionnaire.*
- ■ *Reinaldo had to backtrack on the questions because the informant said she was an architect, but later she corrected herself saying that she also had extra income from property. Reinaldo took considerable time to operate the mobile device between questions on the questionnaire. During these intervals, he clicked several times on the touch-screen device with his pen. Marlene demonstrated an element of boredom as she waited for each question.*
- ■ *The interviewer had difficulty in classifying international retirement in a predetermined category of response. This revealed that the interviewer needed a certain general culture to interpret some answers properly. Demonstrating experience, the interviewer made financial calculations in his head, and helped the informant to answer the questions about her income.*
- ■ *The interviewee telephoned her husband, Oswaldo, three times to confirm his details and income. The last time, she handed the phone directly to the interviewer. After talking to Oswaldo and receiving his information, Reinaldo took a long time to find the question and insert the missing information into the PDA.*
- ■ *When he finished, Reinaldo reported that the interview had fallen within the normal time limit (one hour for a family of three). He also*

informed us that he usually performed about three interviews every day.

Session lab results

Usability problems detected in semi-controlled lab test sessions were analysed and grouped together according to Nielsen's heuristic categories (Nielsen, 2005).

Violated heuristics were identified as the following (figures show the percentage of occurrences): Match between system and the real world (13%); User control and freedom (11%); Visibility of system status (10%); Consistency and standards (8%); Flexibility and efficiency of use (6%); Aesthetic and minimalist design (6%); Error prevention (3%); Recognition rather than recall (3%); and Help users to recognize, diagnose, and recover from errors (2%). In addition to these well-known usability principles, the analysis and organisation of results indicated that extra categories needed to be created so as to permit a better classification of our findings.

Thus, 4 specific categories were added to the previous list in order to provide a better description of our usability issues and emphasize a number of important findings. The extra categories, appropriate for our case study, are as follows: Response time (11%); Explicitness, grammar and spelling (2%); Bugs and crashes (19%); and Concept usability (6%). Concept usability concerns the concepts used in the research and whether they were suitably understood by the interviewers and interviewees.

It is important to note that these issues were detected during the early testing phase and were given careful consideration for subsequent correction by the software development team.

6 Conclusions

The impact of computer-aided interviewing on data quality has been systematically evaluated by statistical institutes in diverse countries. This paper has presented a method for usability evaluation designed for application with interviewers who used PDA (personal digital assistants) during the experimental phase of the Continuous National Household Sample Survey in Brazil. The proposed method represented a mixture of four evaluation approaches: field observation, usability testing with a portable lab, semi-structured interviews and heuristic inspection. The article has afforded special emphasis to describing the section of the method that concerns the application of ethnographic observation and its results.

The STBI method essentially contained two major steps: observing users in a real context and performing common tasks while users were interviewed

and interacting with the interface on a notebook lab. As previously seen, the exploratory stage of this study included field observation procedures inspired by the techniques of ethnographic research incorporated into human-computer interaction research. The experience has illustrated that field observation may be considered a very important phase for interface design because it reveals the true nature of the work and avoids misunderstandings or idealization.

Typical Continuous PNAD interviewers collect economic and demographic data when they visit millions of households across the country to interview families who have been selected as part of a statistical sample. These kinds of household interviews may be conducted under very adverse conditions such as bright sun, rain, or in hazardous areas. Frequently, it is necessary to walk for thirty or forty minutes in the heat to collect data in a rural area, far from the nearest bus stop, with no cell phone signal, nor street name signs.

Frequently, it became evident that users conduct their work in a different manner from that prescribed. For example, they tend to formulate questions using popular colloquial words, instead of reading the official version. They also reverse the order of questions as posed by the software, with the intention of reducing the length of the interview. They may also do all they can to make it less tedious and more natural for the informant. While interviewers are aware they are required to follow the digital sequence of the questionnaire they argue that - if they do this - it would be tiring and stressful for the informant.

The authors also observed that the color contrast of the device's screen in the sunlight was one of the most cited problems: we had the opportunity to check the severity of this condition, which seriously impacted the readability of the questions. A central issue of data collection aided by mobile devices is ambient light conditions, which can generate extra reflections on the PDA screen, impairing the readability of the electronic questionnaire. The lettering of the PDA screen can be small or so poorly designed that the interviewer is unable to read the questions or answers. This implies that the interviewer will memorize the questions and any memory lapses may lead to problems regarding data reliability, plus the additional problem of verification or post-correction.

Furthermore, long questions have caused a significant negative impact on the usability of the equipment, as it has such a small viewing screen. Texts are harder to read on computers than on paper and even harder on mobile devices (Leeuw, Hox & Snijkers, 1995).

We are in agreement with Martin et al. (2007) by arguing that, in some cases, questions need to be modified in the transition from paper to computer in order to be successfully communicated by the interviewer and

perfectly understood by the interviewee. As interviewers do not read long lists of response categories, they often choose one or two response options to read to the respondent, instead of reading the entire question as worded - even though they know this is mandatory.

Moreover, interviewers have the spontaneous behavior of closing windows with messages, without reading the specific alerts that the questionnaire sends out. They claim that they had already memorized the messages and become bored with the repetition of screens with information and extra clicks to close the windows.

We noted that interviewers demonstrated difficulties in interpreting specific survey concepts. For example: there was confusion regarding the concepts of "other relative" and "person aggregated to the family". Also, when registering two or more families living in the same household, there was confusion between the concept of "main responsible person at home" and "main responsible person in the family". These facts indicated problems of concept usability.

It was also observed that specific questions caused delays in the process: questions on color or race usually generate doubts. In the question about whether the informant would or would not like to work harder, respondents were unable to understand and the interviewer would consequently spend extra time explaining. In the questions concerning income, the informant often became inhibited.

Evidence from the field studies reinforced a number of conclusions reached during the lab sessions. This has allowed us to affirm that both techniques have a great potential when applied in a complementary manner, as shown. The STBI method was considered satisfactory, since it involved observing real users and low-cost usability testing. Ethnographic reports with visual and audio records of fieldwork added life and a sense of urgency to usability recommendations, and so the problems detected during the survey testing phase were carefully considered for subsequent correction by the development team.

There were a number of usability issues in the context and its verification contributed to the proposition of simple solutions. The results of this work may translate into future positive impacts on life, at work, with regard to the interviewer's comfort and productivity. One of the products generated by this research has been a list of usability recommendations for household surveys supported by personal digital assistants (PDA). With these recommendations, it is our intention to make the work of interviewers more effective, speed up data entry, assist in reading the questions for a better understanding, maximize the quality and integrity of data collected and reduce training costs.

During the phase of reporting the results, apart from scientific papers, the conclusions of this study have been presented at seminars for software

development teams, and have aimed to spread and institutionalize the methodology of usability at the Institute in order to provide a contribution for more efficient, comfortable and reliable procedures for data collection.

Acknowledgement

The authors acknowledge the support of the IBGE Executive Director, Directory of Research and the IBGE teams at the Rio de Janeiro unit and IBGE/DI/CODES, without whom this research would not have been possible. The opinions expressed in this article are the sole responsibility of the authors and do not necessarily express the views of the IBGE.

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About the authors

Luiz Agner | Dsc. in Design at PUC-Rio (2007), visual designer, researcher and professor. He authored the book "Ergodesign and Information Architecture - Working with the User" (Quartet, 2009). He integrates professional staff of The Brazilian Institute of Geography and Statistics (IBGE), where he has worked in the evaluation of usability of computer assisted data collection. His research interests also include: interaction design, usability testing, gestural interfaces and cyberculture.

Patricia Tavares | Msc. in Information Systems from Universidade Federal do Estado do Rio de Janeiro (UNIRIO). She graduated in Data Processing Technology, Postgraduate in Analysis, Design and Management Systems (PUC-Rio). She is a Systems Analyst at The Brazilian Institute of Geography and Statistics (IBGE). Areas of interest include: usability, CAPI (computer-assisted personal interview) and human-computer interaction.

Simone Bacellar Leal Ferreira | Dsc., is Professor of Information Systems courses (masters and undergraduate) Department of Applied Informatics, Universidade Federal do Estado do Rio de Janeiro (UNIRIO). Author of the book "e-Usability", published and released in September 2008 by Editora LTC. Areas of interest include: usability, accessibility, human-computer interaction, and information systems.