Life360: Usability of Mobile Devices for Time Use Surveys

Jennie W. Lai[1], Lorelle Vanno[2], Michael W. Link[3], PhD, Jennie Pearson[4], Hala
Makowska[5], Karen Benezra[6], and Mark Green[7]
[1-3] The Nielsen Company, 501 Brooker Creek Blvd., Oldsmar, FL 34677
[4] University of Nebraska-Lincoln, Lincoln, NE 68588
[5-7] The Nielsen Company, 770 Broadway, New York, NY 10003-9595

Abstract
Mobile technology offers researchers a new set of tools for collecting information on how people spend
their time, in addition to where they are and whom they are with during their daily activities. There has
been limited research conducted on survey designs for mobile devices. Even less research has focused on
the usability of self-administered surveys on mobile devices over extended data collection periods. We
used the functionality of a smartphone to capture information on people's attitudes, surroundings,
interactions, and behaviors to gain a richer appreciation for the different lifestyles and personalities that
characterize a particular population. A sample of adults was provided with a specially equipped
smartphone that allowed for the self-administration of a brief survey at periodic intervals throughout the
day (approximately 8 to 12 three minute surveys per day). Information was collected about the
respondent's current location, the activities in which they were engaged, the people they were with, and
their mood at the time (i.e., happy / depressed / energetic / etc.). Respondents offered images and words to
catalog their daily experiences. The additional smartphone functions provided richer data beyond typical
survey responses, but also presented some challenges for respondents to comply throughout the survey
period. To improve our understanding in this area, a series of cognitive interviews was conducted with
individuals who used the smartphone to evaluate the usability of the data collection tool in terms of ease
of use and compliance issues. We provide an overview of the project, highlight the key findings of
usability issues including operational difficulties, and provide recommendations to improve the technical
features of the smart phone to gain greater compliance from respondents.

Key Words: smartphone, digital ethnography, mobile survey, Internet survey

1.0 Introduction

In the digital age of Facebook, MySpace, Twitter, etc., the general public, in particular the younger cohort
has become more prone to sharing their day-in-the-life activities with friends, family or whoever may be
interested. By leveraging this trend in information sharing and some of the advances in
telecommunications, survey researchers are now in a position to make observations of their subject of
interest remotely and wirelessly. The increasing popularity of smartphones which feature advanced
capabilities of Internet access, email communication, built-in camera and video, etc. can be transformed
to a versatile electronic data collection tool that can store rich data far beyond the traditional paper-and-
pencil questionnaire.
Traditional ethnographic fieldwork coupled with in-person interviews allows the researcher to make their
own first-hand observations on their subject of interest. As typically undertaken, ethnography is a
qualitative research method based on participant-observation in the field which allows the researchers to
directly observe and participate in the communities they are studying. This traditional approach can often

be challenging to maintain objectivity for the researcher throughout the entire data collection period given the field work is time consuming, emotionally draining and physically dangerous at times. The digital age presents a unique opportunity to conduct the ethnographic fieldwork by leveraging the ubiquitous nature of mobile, video and Internet-based technologies in place of the researcher. This may allow greater transparency in studying the subjects in their natural setting and minimize the potential for interviewer bias.

This electronic approach of gathering details of attitudes, preferences and behaviors of the targeted communities can be adopted for a variety of research studies such as consumer behavior, political interests, and media consumption. "Digital ethnography" can provide valuable insight on emerging trends when fully utilizing the capability of the mobile device as a data collection tool. The Life360 project conducted by The Nielsen Company adopted the digital ethnography approach to measure attitudes, preferences and behaviors of the targeted segment using mobile phone surveys, photography, Internet-based journals, and Web surveys. Given the nascent stage of this type of electronic measurement, there is a great deal that can still be learned on mobile device usability and survey design. Therefore, a series of cognitive interviews were conducted with exited panelists from the Life360 project to identify potential areas of improvement on data quality and compliance of the task. The purpose of this research paper will focus on the usability aspect of self-administered surveys on mobile devices and potential improvements to the technical features to gain greater compliance for a long-term panel.

2.0 Background

The early research studies on the electronic measurement of behaviors originated from clinical scientists seeking a more reliable way of measuring patient intensity and frequency of pain as well as quality of life using an electronic portable device. In fact, researchers found few differences in responses of surveys using electronic portable devices when compared to self-administered paper questionnaires (Marceau, et al., 2007; Caro et al., 2001). These participants also preferred surveys on electronic devices over paper questionnaires for such clinical studies. These findings would also apply to mobile surveys given the similarity in functions with the electronic portable devices.

Many of these early research studies would program their surveys at regularly scheduled intervals which could lead to anticipation bias by the respondents. Peters et al. (2000) used an Experience Sampling Method (Lee and Waite, 2005; Delespaul, 1995) to randomize survey administration and reduce potential bias for these frequently administered surveys. Their research indicates that electronic diaries can be more accurate than other survey modes that rely on patient memory for recall; and provides further evidence for greater reliability and validity of continuous measurement throughout the survey period.

The digital ethnography approach utilizing a mobile device can also be well-suited for time use studies which measure how people choose to spend 24 hours of each day. Paper questionnaires and telephone interviews have been the most typical survey methodology to record the daily activities of respondents for time use surveys. Some examples of varying methods to measure time use include the US Department of Agriculture's paper questionnaire to record the daily activities of homemakers (Stinson, 1999) and others have used telephone methodology (Canadian General Social Survey, 2005; American Time Use Survey, 2007). The aforementioned paper questionnaires by the USDA used a rather complicated format of time grids for respondents to indicate when they began and ended their activity, write down the activity they perform, etc. This could be a burdensome task in addition to the risk of retrospective bias since there is always the likelihood of respondents erroneously recalling their activities. The telephone surveys also rely upon retrospective accounts of how the respondents spent their day or even week which is much less precise than data collected at the moment of activity. Although few time use surveys have utilized a portable electronic device or smartphone for data collection, it is relatively certain that electronic tools can help minimize the retrospective bias of time use surveys using paper or telephone methodology.

While there are clear advantages in employing electronic measurement for data collection, there is limited research to date on the best practices of design or usability of mobile devices for long-term panels. Some argue that the same heuristics to questionnaire design for other survey modes (Tourangeau, Couper, and Conrad, 2004) can also be applied to surveys on mobile devices (Peytchev and Hill, 2008). Peytchev and Hill concluded the cognitive processing of findings from survey research in other modes uphold in mobile device surveys with some differences in responses that are attributed to the small size of the screen and keyboard. Moreover, Palmblad and Tiplady (2004) proposed a set of guidelines for designing surveys on portable electronic devices such as avoiding the need to scroll or use drop-down menus to view the response options; or using larger "tap" areas on a screen to reduce the amount of time it takes for respondents to make a selection. These findings are based on their clinical research on electronic diaries to measure quality of life or pain assessment.

These early research findings on electronic measurement of behaviors, time use studies, and survey design on mobile devices helped to build a foundation of the digital ethnography approach for Nielsen Life360. It uses a mobile device as the key instrument to collect data on details pertaining to attitudes, preferences and behaviors on a specific population of interest. The data, text and pictures collected are then used to develop composite "profiles" that offer unique insights into various population segments. A random sample of these exited panelists was followed up through cognitive interviews in order to gain greater understanding of their survey experience using the mobile device and identify potential areas of improvement on survey design and usability.

3.0 The Life360 Approach

The goal of Life360 is to capture what is happening in people's lives to depict everyday environments, lifestyles and personalities by collecting "in-the-moment" surveys from the population of interest. There are several data collection techniques used to piece together a whole picture of day-in-the-life activities of respondents during the survey period. The central component is the administration of recurring timed surveys via a smartphone. The specially equipped smartphone would prompt the respondents to complete a short survey on an hourly basis in addition to capturing an image using the built-in camera as a pictorial description of their surroundings and activities in real-time. The timed survey is relatively brief, about 2-4 minutes in duration, with open and closed-ended questions specific to respondents' current location (Where are you? Home, Family/Friends' house, Workplace away from home, etc.), activities they are engaged in (What are you doing? Spending time with family, Shopping, Reading, etc.), people they are spending time with (Who are you with? Family, Friends, Coworkers, etc.), and their current mood (What is your mood? Happy/Depressed, Energetic/Tired, Calm/Irritated, etc.).

These respondents also complete an Internet-based pre-survey at the start of the field period to provide basic demographic information as well as some baseline behavioral and attitudinal data; and a post-survey to capture greater details of behaviors and attitudes throughout the survey period, or monitor any change. The respondents were also asked to complete an online e-journal to record their thoughts about their day in an open-format on the Internet like a blog or paper journal. Each of these components makes up a full picture of the life of a respondent during the survey period.

4.0 Results

In 2008, The Nielsen Company recruited a group of respondents that previously participated in the Nielsen Online Megapanel, an online meter panel measuring Internet usage at home, work or school, for Life360. The goal of the study was to learn about their consumption, management and habits related to television/video content, music, Web surfing, gaming, etc. over the course of a 10-day data collection period. These respondents were given a smartphone that was locked with only survey administration capability and asked to complete a brief survey and take photos to illustrate their activities every hour

during the course of their day. Additionally, they were also asked to complete a pre-survey and post-survey via the Internet; and keep an e-journal throughout the survey period. Prior to the start of the survey period, these respondents were mailed the smartphone along with a welcome kit that included a quick start guide outlining the basic functions of the smartphone. These respondents were also provided with a Web-based link to view a video demonstration on how to use the smartphone and invited to a one-hour training over the telephone to walk through the smartphone survey administration functionalities.

A random sample of these respondents was recruited for a cognitive interview upon exiting the Life360 panel. A total of eleven respondents participated in the cognitive interviews with specific recruitment procedures to ensure they were representative in terms of demographic characteristics of gender, age, household income, geographic location, etc. (see Table 1). These one-hour long cognitive interviews were conducted over the telephone with reference materials emailed to respondents in advance, and in return they received a $25 cash contingent incentive for their participation.

Table 1. Cognitive Interview Respondent Demographics

Gender	Age	Area you live	Household Income	Region
Female	35-54	City	$25,001 - $50,000	North East
Female	25-34	Suburb	$200,001 - $250,000	North East
Male	35-54	City	$25,001 - $50,000	North East
Female	55+	Suburb	< $25,000	North East
Male	55+	Suburb	$25,001 - $50,000	North East
Male	55+	Suburb	$75,001 - $100,000	South East
Female	55+	City	$75,001 - $100,000	Mid West
Female	18-24	City	$25,001 - $50,000	South East
Female	25-34	City	$50,001 - $75,000	Mid West
Male	18-24	Suburb	< $25,000	Mid East
Male	35-54	Rural	$75,001 - $100,000	Mid West

The cognitive interviews were conducted with the objective to understand the thought process of the question wording, questionnaire layout, and usability issues encountered during the survey period in addition to the other areas of the survey task such as the e-journal. For the purpose of this research paper, the following sections will focus on the findings from the cognitive interviews in the key areas of (1) technical features of the mobile device, (2) interface design and usability evaluation of the survey questionnaire and (3) compliance with tasks throughout the survey period.

4.1 Technical Features of Mobile Device

The respondents were asked to recall their interaction with the smartphone during the survey period specific to the technical features starting from when they were prompted to complete the survey. The volume of the alarm reminder for the survey presented a challenge to respondents who were bringing the smartphone to their workplace. The alarm function of the smartphone was limited to two levels of volume, high or silent. If the phone was silent, the respondents would often miss the reminders especially when they snooze – there was a 10 minute pause to the next reminder. It was apparent that a vibrate option and volume control would be useful to accommodate the surrounding the respondents were in during the survey period.

Additionally, these respondents were asked at the end of their hourly survey to take a photo of what they were focused on prior to the start of the survey. There was some difficulty when using the built-in camera of the smartphone to take photos because of a lack of proper lighting, or focus of the camera, or the

movement of people, etc. would often impact the quality of the digital photos. All of the respondents experienced the need to retake photos that were out of focus or too dark, which would lengthen the time of the survey. However, these instances dramatically lessened after the respondents adjusted to the learning curve of taking a photo with the smartphone.

There was also an occasional glitch discovered during the survey period when the smartphone would freeze after taking photos for some respondents. This was related to a scripting error which caused the smartphone to freeze during the upload process. There was an immediate fix in place upon discovery of the glitch reported by the panelists before the start of the survey period. An instructional video was then developed to illustrate how to download the software patch to resolve the scripting error in addition to customer service support team available via telephone to answer any questions.

4.2 Interface Design & Usability Evaluation

There were a few questions in the survey that required the respondents to scroll to the next page to see a complete listing of response options due to the limited screen size of the smartphone (see Figure 1). Most of the respondents were aware of the scroll down arrow located at the bottom right of the screen, but were "annoyed" to have to scroll to see a complete listing. After taking a dozen of these surveys, the respondents would become familiar with the order of the response options they would typically select for each question. The source of their frustration stemmed from the fact that a pop-up reminder would require them to scroll before they could go to the next question. For some respondents, they knew the response options on the next page would not be applicable so the extra step of having to scroll was considered to be burdensome for every survey. For example, one respondent shared: "Difficult? No. Annoying? Yes. Most of my answers are on the first screen, seems there should be a way to program it after a few times. Every hour it got to be annoying."

**Figure 1. Example of Question Format**[1]
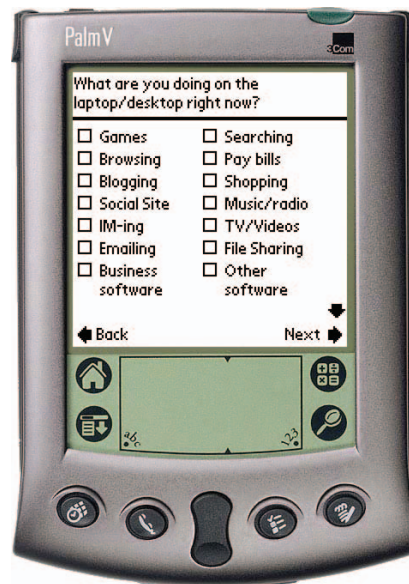
Given the limited real estate of the smartphone screen, the radio buttons for the response options allowed only a small area for respondents to select their responses. Even though each smartphone was accompanied with a stylus for respondents to use if they preferred not to use their fingers to select on the

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[1] Figure 1 illustration of question format simulated in Palm Pilot for clarity of screenshot only. The actual mobile device used for survey administration is illustrated in Figure 2.

touchscreen, a number of respondents still had trouble with the precision of selecting their response (see Figure 2). For example, one respondent noted: "Had to get used to it because I'm not used to using a stylus… tried to use the touchscreen with my fingers but keyboard was too small. My fingers are tiny but I still couldn't do it."

Figure 2. Example of Smartphone with Stylus
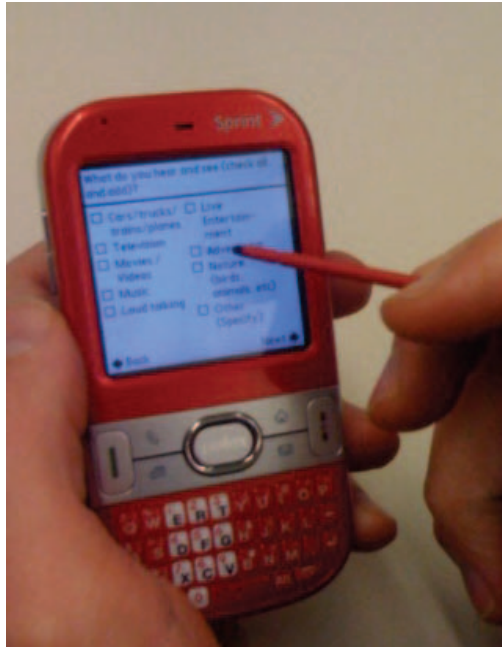
The challenge of using a touchscreen for survey administration is the precision required to select the intended area for the response option which can increase the burden of the task over an extended period of time. The need to increase the surface area, e.g., outline the entire text area of the response option and allow the respondent to select anywhere within the designated area, should especially be considered for survey on a mobile device.

For questions requiring a more specific response, an open-ended format for the "Other – please specify" response option is available. The smartphone allows the respondent to type in their response using the keyboard, which can be difficult given the small size of the keys. For the smartphone used for this study, each character is allotted its own key which mirrors a regular size keyboard used for a desktop or laptop computer (unlike other models which combine two or more characters on the same key). Even so, over half of the respondents interviewed expressed difficulty in typing in an open-ended response using the small keyboard on the smartphone. One respondent made the following comment on the open-ended format used for the question "Where are you?": "… the (response) options there were usually where I was. When I had to use 'other' I had to type in and that was annoying. Would type the restaurant name, address, city, etc."

It has been considered for future surveys that this question can potentially be eliminated if geo-positioning system GPS functionality is installed on the device so the location could be detected electronically. However, for other questions that cannot take advantage of the smartphone capability, researchers should take into consideration the frequency (i.e., how often "Other" will be selected) and amount of information needed (i.e., how much information needs to be typed) from the respondents.

4.3 Compliance of Task
The two key motivators that kept the respondents complying with the task of completing these hourly surveys were the contingent incentive offered and their curiosity/interest in the research project. Also, since all of these respondents have already established a relationship with Nielsen through another research initiative, they were generally less skeptical in participating and more willing to comply with the task as well.

Most of these respondents stated the strongest motivator was the amount of contingent incentive offered for the task. The incentive plan was based on pay for performance, in other words, the respondents would earn $100 for completing the mobile diary portion of the survey, but could earn up to $150 at the end of the survey period upon completion of all tasks. In fact, when asked for suggestions on other types of incentive payment, over half of these respondents said they would have liked to keep the smartphone since they became familiar with its functionalities. They also expressed interest in participating for a longer period of time if they were offered the smartphone with an unlimited data and voice plan.

Ultimately, these respondents also participated and complied in sharing such detailed information about their life over the survey period because they were interested and/or curious about the research project. One respondent echoed similar responses of others on their willingness to participate: "At first I was uneasy with all the detailed information, I thought, why do they want so much? But as I went through it, I learned so much about how I spent my time throughout the day. It opened my eyes on how I spent my time, doing so much laundry when I should be spending time with my kids."

Most respondents were also engaged with the journaling aspect of the task, which allowed them to gain better understanding of how they use their time each day. Others were interested in the technology of the smartphone and wanted the opportunity to interact with it.

5.0 Conclusions

The digital age can offer survey researchers the alternative of collecting data electronically through a variety of technology platforms such as a computer, mobile phone, electronic portable device, etc. which can exponentially improve the expediency of turnaround time for survey return and efficiency of data processing. Moreover, electronic measurement would particularly be ideal for a survey administered over an extended period to allow researchers to monitor the progress of respondents' participation in real time. The use of a mobile device such as a smartphone for survey purposes is appealing given it has similar capabilities of a PC but is more versatile in terms of size, portability and mode of communication (e.g., telephone, email, Internet access, data transmission, etc.).

For the Life360 project, the smartphone played a dual role as the ethnographer immersed in the targeted segment of the digital media users and a multi-functional data collection tool in capturing survey data and photos. The continual breakthroughs in technology will only advance and expand the capabilities of mobile devices to collect even more precise data such as a GPS or other software applications that can be customized for the specific survey needs, including barcode readers to track purchases. However, the enhancement to these functionalities may also introduce an even greater level of complexity to the survey task and overburden the respondents with learning to use the device, which can exacerbate fatigue in participating.

The cognitive interviews revealed a learning curve for the respondents at the start of the survey period, such as data input or selection but most of the respondents would adjust to the usability of the device after the first few days. It was also clear that simple improvements on the technical features such as allowing for better adjustment on volume control for the reminder alarm could potentially increase the compliance of the task. This type of improvement has already made a significant difference for study participation in

longer-term panels. Finally, a user-friendly survey design with limited use of scrolling by collapsing response options to broader categories or data entry to collect open-ended responses on the mobile device can improve overall data quality for the duration of the survey period.

There are limitations to these findings that should be considered for further research. While the qualitative nature of these findings offered unique insight to the interface design and usability of the mobile survey specific research on questionnaire format/administration such as: (1) text font / style / size / effect based on the dimension of the smartphone specifically used for the survey, (2) response order effect of the same survey administered multiple times on a daily basis over an extended period, (3) anticipation bias over the frequency of these surveys administered daily, etc., could help to gain greater compliance for longer-term panels. Nonetheless, the concept of digital ethnography in leveraging the mobile device as the "participant-observer" along with the capability to customize the hardware and applications to meet the needs of specific research studies opens doors to capture an enhanced level of details that is unattainable through the traditional survey approaches.

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