Exploring User Motivations for Eyes-free Interaction on Mobile Devices

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ABSTRACT

While there is increasing interest in creating eyes-free interaction technologies, a solid analysis of why users need or desire eyes-free interaction has yet to be presented. To gain a better understanding of such user motivations, we conducted an exploratory study with four focus groups, and suggest a classification of motivations for eyes-free interaction under four categories (*environmental, social, device features, and personal*). Exploring and analyzing these categories, we present early insights pointing to design implications for future eyes-free interactions.

Author Keywords

Eyes-free; user motivation; mobile devices.

ACM Classification Keywords

H.5.m [Information Interfaces and Presentation (e.g., HCI)]: Miscellaneous;

INTRODUCTION

Interaction with and through mobile devices tends to rely primarily on users' visual attention. However, visual attention is a limited resource and is often heavily taxed by contextual factors in mobile environments. Researchers and designers have recently tried out alternative modalities such as acoustic and haptic to assist interaction with mobile devices and minimize the reliance on visual attention, also known as eyes-free interaction [1, 2, 4, 8, 9].

When designing such interactive systems, an important principle, as argued by Alan Cooper [3], is to satisfy the needs and desires of the user. It emphasizes that we perform tasks in order to achieve specific goals. Applying this principle to the design of effective eyes-free interaction requires an understanding of user motivations in order to provide the best way to support eyes-free interaction. While many innovative systems with eyes-free interaction capabilities have been introduced [1, 2, 4, 9], there is a lack of systematic investigation into the fundamental user motivations that drive the need and desire for eyes-free interaction.

CHI'12, May 5–10, 2012, Austin, Texas, USA.

In this paper, we present a user-centered exploration of user motivations in choosing eyes-free technologies for mobile interaction. To assure a wide range of user feedback, we held four focus groups with twenty-two participants in total and identified ten typical user motivations for eyes-free interaction, classified into four categories (environmental, social, device features, and personal) as defined by the intersection of two dimensions (contextual vs. independent; physical vs. human).

We present contributions intended to increase understanding of eyes-free interaction in the following two aspects: 1) From a user's perspective, we systematically examine motivations for eyes-free interaction on mobile devices, and further describe a categorization for them; 2) By exploring the characteristics of these motivations, we establish high level design implications for satisfying users' needs and goals.

METHOD

In order to collect user motivations for eyes-free interaction in an open-ended fashion, we chose to use focus groups, which are particularly suitable for early exploration in identifying new problems and assessing users' needs [5].

Participants

Twenty-two participants (indexed P1-P22; 13 male and 9 female) from a diverse background (14 students from different disciplines: computer science (8), biology (3) and Chinese studies (3), 8 working professionals from different industries: banking (1), telecommunications (4), education (2), and IT (1)) were recruited for our focus groups. Average age was 26.7 years (SD=7.40). All participants had more than 5 years of experience in using mobile devices. Each focus group had 5 or 6 participants.

Procedure

Four focus groups were conducted. Each of them lasted approximately 90 minutes with the following five steps. 1) The moderator introduced the purpose of this research. (~5 mins); 2) The moderator introduced the concept of "eyes-free" with the demonstration using two tasks: volume change in HTC G2 and text typing in Dopod C750 (~5 mins); 3) Participants performed a self-introduction and discussed their first impression of eyes-free interaction (~15 mins); 4) In the main discussion participants freely

discussed three themes: a) situations where visual interaction is not suitable, b) experience of using eyes-free interaction and c) expectations of eyes-free technologies (~1 hour); 5) Summary and debriefing (~10 mins).

Analysis

Each focus group was filmed; the recordings were transcribed and coded based on the Grounded Theory [7] by the two experimenters. The following measures were taken to minimize the influence of less logical statements that often occur in focus groups towards the validity of motivation categorization: 1) Participants were encouraged and guided by the moderator to reflect on and verbalize the underlying logical meaning behind their statements; 2) During the coding phase, less logical statements that were not backed up by other statements were not used as evidence.

A CATEGORIZATION OF MOTIVATIONS

Via clustering and merging, ten motivations for using eyes-free interaction in mobile context (identified as M1 to M10) emerged from the focus groups. We identified the properties of each motivation and found that they were related to specific settings and originated in either the physical or human realm. Based on this observation, the ten motivations were categorized along two orthogonal dimensions as shown in Table 1.

	Physical	Human
Contextual	***Environmental*** **M1**: Enable operations under extreme lighting conditions (e.g. [2]) **M2**: Improve safety in task-switching (e.g. [2])	***Social*** **M3**: Foster social respect (e.g. [1]) **M4**: Avoid interruption to social activities (e.g. [1]) **M5**: Protect private information (e.g. [4])
Independent	***Device Features*** **M6**: Enable operation with no/small screen (e.g. [9]) **M7**: Enable multitasking on same device (e.g. [4])	***Personal*** **M8**: Entertainment **M9**: Serve desire for self-expression **M10**: Lower perceived effort

Table 1. Categorization of user motivations for using eyes-free interaction: based on two dimensions (contextual vs. independent; physical vs. human) we sorted all motivations into four categories (environmental, social, device features, and personal).

The first dimension is the context dependency, which can be either contextual or independent. The second dimension is the realm, which can be either physical or human. Crossing these two dimensions results in four categories: environmental, social, device features, and personal. Now, we present, examine, exemplify, and discuss the ten motivations (M1 to M10) by category.

Environmental (contextual + physical)

In many environments interaction with mobile devices is interfered with or prevented by the characteristics of that environment.

As participants indicated, extreme lighting conditions are a major source of interference to visual perception (M1) [2], which can be either too bright or too dark. In the former situation, participants complained that overly bright situations, such as direct sunlight, often make the screen unreadable, *"It's hard for me to read the text while walking in bright light. So I have to try to find a place without so much light."* (P3) In the latter situation, one participant mentioned her experience when working in a dark room for film development: *"I often needed to answer calls or wanted to switch the music, but I was developing photographs in a dark room where the light from the screen was not allowed."* (P5)

Another motivation frequently mentioned is improving safety in contexts where switching visual attention between the device and the physical environment poses safety concerns (M2) [2]. For example, it is hazardous to switch visual attention between a mobile device and the road while driving. Nonetheless, such simultaneous usage is often unavoidable: *"Everyone knows it's dangerous to use mobile phones while driving, but I just want to use it. I think it's a part of my life."* (P8)

Social (contextual + human)

As indicated by Palen et al. [6], using mobile devices has become a part of social norms. However, in some situations overtly using a mobile device is socially inappropriate (M3 and M4), while some other situations raised privacy concerns (M5).

In some social settings, openly interacting with mobile devices is unanticipated and sometimes unacceptable. For instance, while talking with others, frequently playing with mobile phones is impolite and may leave a bad impression on the other party. Nonetheless, sometimes attending to the mobile device is necessary (e.g. an urgent message). In that case, users can be motivated to use eyes-free interaction to reduce the perceived interference between mobile interaction and the surrounding social activities to maintain social respect (M3) to others [1], *"When I was doing a presentation, a phone call came and I felt the vibration. I couldn't take it out because it was impolite. So I just reached into the pocket and pressed the end button."* (P10)

In other situations, users may voluntarily desire to pay more attention to the surrounding social activity, such as when attending a lecture. In that case, avoiding the interruption to the social activities (M4) can motivate users to adopt eyes-free interaction [1]. For example, one participant described such a situation where eyes-free interaction can facilitate quick responses – *"I often text messages in class. But in math class, sometimes I had to copy the formulas written by*

the teacher so that I couldn't pay attention to the received messages. So sometimes I missed some appointments." (P3)

Besides maintaining social relationships, users may also be motivated to use eyes-free interaction for protecting privacy. More specifically, interaction relying on visual feedback has the danger of leaking private information to others in social contexts (M5) [4]. Eyes-free interaction is expected to reduce this risk by hiding the user input (e.g. the operation of pressing buttons) and/or the device output (e.g. displayed visual information). As one participant indicated, *"I am always worried that my password could be seen by others when I am in a queue."* (P11)

Device Features (independent + physical)

Sometimes, users would like to use eyes-free interaction with their mobile devices due to the physical constraint of the devices themselves. In order to overcome inconveniences (M6 and M7) caused by device constraints, users are motivated to adopt eyes-free interaction.

Participants mentioned two types of inconveniences related to eyes-free interaction on mobile devices. On one hand, devices designed with small or even no screens (M6) make interaction using visual feedback difficult and/or irrelevant [9]. For example, *"There is no screen on my iPod shuffle. But I can operate it very well just with the audio feedback."* (P2) On the other hand, interruptions can happen while performing multiple tasks on the same mobile device (M7) [4], which can motivate users to use eyes-free interaction to reduce the interruption: *"When talking with my customers on the phone, I have to frequently check my schedule in my phone to make appointments. So I have to frequently suspend the phone conversation to look at the screen. It's very inconvenient."* (P20)

Personal (independent + human)

In addition to achieving practical goals, eyes-free interaction is also motivated by personal factors. In this category, the motivations (M8, M9, and M10) are more intrinsic to the users themselves and not necessarily dependent on devices or contexts.

Some participants indicated that they would like to use eyes-free interaction just because they thought it was fun to use (M8). The joy is generated from the unusual experience and the resulting sense of accomplishment. As one participant said, *"I can experience very different things when I am using eyes-free interaction. I think I am very good if I can succeed."* (P17)

Several participants also indicated that their desires for self-expression (M9) made them take the initiative to use eyes-free interaction. One participant said, *"It's cool to show my friends that I can use my phone without using my eyes. I think they envied me and I felt proud."* (P10)

Interestingly, participants mentioned that sometimes they used eyes-free interaction even when it was possible to visually focus on the mobile devices. An underlying reason may be that some users perceived the cognitive/physical effort for eyes-free interaction (M10) to be lower than for visual interaction. For example, one participant mentioned, *"When I enter the library, I need to switch my phone to silent mode. But it's troublesome to take the phone out. So I like to do it in my pocket without looking at the phone."* (P4)

DISCUSSION

Although our investigation has covered a variety of different motivations, this is meant to be a list of representative motivations instead of an exhaustive one. We expect the categorization suggested will help to identify more user motivations in the future. Still, we believe this list provides a solid initial basis for discussion of design insights for the diversity of motivations, the concurrency and shifting of motivations, and related design implications.

Diversity of Motivations

Our results have shown that there is a diversity of motivations for eyes-free interaction, ranging from environmental constraints to personal intentions. Designing a single eyes-free solution to cover all those motivations is challenging and perhaps undesired, but it is essential for designers to be aware of this diversity. Much research has focused on eyes-free interaction widgets, which are more or less designed as a general technique (e.g. earPod [9]). However, in order for such inventions to be widely adopted by users, mechanisms to adapt and customize them to various user motivations may be key.

By exploring the diversity of motivations, we also surprisingly find that personal intentions may play an important role in motivating eyes-free interaction. On one hand, this reveals future potential innovations such as the design of eyes-free systems for entertainment. On the other hand, perhaps more significantly, it highlights the role of enjoyment when designing eyes-free interaction.

Concurrency and Shifting of Motivations

It is important for designers to understand how multiple motivations can play a joint role. That is, frequently a small number of motivations are not independent and may all be in effect concurrently during an activity.

In our study, concurrency of motivations is observed in two aspects. First, as a kind of basic demand, it is quite common for users to mix M10 together with other motivations. For example, participants who reported to be in outdoor environments with bright sunlight also complained that the small screen influenced their operations and that they expected eyes-free interaction to require less effort.

"Sometimes when I am walking (M2) in bright daylight (M1), I have to search for someone's contact information in my phone. I have to make too much effort (M10) to recognize the text in the small screen (M6)." (P19)

Second, if the user is in a specific context, different motivations related to the contextual dimension often complement one another. For example, in social activities, the need to avoid interrupting social activities often complements the need to foster social respect.

"My friend was supposed to present at a seminar. But he was late and his professor asked me about his whereabouts, I wanted to send a message to get my friend to contact his supervisor immediately. But I had to focus on the chat with the professor (M4) and I didn't want to be rude (M3)." (P8)

Besides the concurrency of motivations for the same user and device, there are cases when the user, while attempting to complete a task, is exposed to different situations consecutively, each of them requiring eyes-free interaction but with different motivations, which we call "shifting". For example, as one participant mentioned, *"When I am driving, typing text may be dangerous (M2). But after I arrive at the destination and talk with others, typing text could be impolite (M3)."* (P14) In both situations, the task was the same (typing text), and both had the need for eyes-free interaction, but the motivations were different (M2 vs. M3).

Design Implications

Based on the observations and analysis of user motivations, we highlight three groups of implications for the design of eyes-free interactions in mobile usage.

Make the interaction method adaptive to changing motivations: As discussed above, the user may want to use eyes-free interaction with different motivations at different times. In this case, a single interaction method may not satisfy different motivations unless dynamic adaptation occurs. We notice that motivations often vary together with changes in the contextual settings. So designers could leverage context-aware technologies to facilitate such adaptive interaction methods. For example, by detecting the change in contextual settings, non-visual reminders could change from vibrations in a meeting room (e.g. M3 and M4) to audio cues while driving a car (e.g. M2).

Seamlessly integrate with social activities: During social activities, eyes-free interaction demands more social responsibility (e.g. M3, M4, and M5). So designers need to think about the social impact of interaction methods they design for eyes-free interaction. Ideally, eyes-free interaction should be subtle and socially acceptable. One possible solution is embedding eyes-free interaction into commonplace objects and socially acceptable behaviors such as rotating a finger ring [1].

Minimize cognitive/physical workload: Although eyes-free interaction reduces reliance on visual attention, it is still possible to cause a high cognitive/physical workload due to the uses of cognitive/physical resources from other modalities [8]. Thus, designers need to carefully design the interaction method so that users can finish the eyes-free interaction with a minimal cognitive/physical cost. Beyond the desire for perceived convenience (e.g. M10), it is also relevant to more critical issues such as safety (e.g. M2).

CONCLUSION

We adopted a user-centered approach to explore motivations for eyes-free interaction on mobile devices via focus groups. Based on context dependency (*contextual or independent*) and realm (*physical or human*) we developed a four-category classification of motivations. We analyzed user motivations and sorted them into the four categories. We then discussed issues of diversity, concurrency and shifting of motivations, followed by design implications for eyes-free interactions in mobile device usage.

Our work provides a different view of eyes-free interaction from the user's perspective and helps to reveal insights and relationships among motivations. By enhancing the understanding of the motivations behind eyes-free interactions, we hope that better eyes-free interfaces can be created in the future.

ACKNOWLEDGMENTS

This project is funded by the National Research Foundation (NRF) and managed through the multi-agency Interactive & Digital Media Programme Office (IDMPO) hosted by the Media Development Authority of Singapore (MDA) under Centre of Social Media Innovations for Communities (COSMIC). We thank Erik Tobin, anonymous reviewers, and all members in the NUS HCI lab for their help.

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