

# Understanding the Impact of Abstracted Audio Preview of SMS

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## ABSTRACT

Despite the availability of other mobile messaging applications, SMS has kept its position as a heavily used communication technology. However, there are many situations in which it is inconvenient or inappropriate to check a message's content immediately. In this paper, we introduce the concept of audio previews of SMS. Based on a real-time analysis of the content of a message, we provide auditory cues in addition to the notification tone upon receiving an SMS. We report on a field trial with 20 participants and show that the use of audio-enhanced SMS affects the reading and writing behavior of users. Our work is motivated by the results of an online survey among 347 SMS users of whose we analyzed 3400 text messages.

## Author Keywords

Emoticon, SMS, mobile phone, user studies, auditory UI.

## ACM Classification Keywords

H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

## General Terms

Human Factors

## INTRODUCTION

The short message service (SMS), also referred to as text messaging, has become a form of mass communication since it provides a convenient way of exchanging textual information on-the-go. However, there are many situations, e.g., when users are engaged in other activities, where it is difficult or inappropriate to check the content of an incoming message immediately, even if the user is made aware of a message arrival by the notification tone. We believe that if a user is made aware of the type of received message by using an abstracted audio preview similar to a notification tone, this may lead to a change in the reading behavior. For example, users might want to answer a text message con-

taining a question immediately, whereas in other cases they may check messages after finishing the current activity.

The main goal of this work was to find out how providing abstract audio previews of SMS messages can influence the SMS reading and writing behavior of users. The first hypothesis is that users will adapt when to read/check the SMS content depending on the provided audio preview. The second hypothesis is that users will increase the usage of emoticons and phrases that create meaningful audio previews after they have used the system for a while. To investigate this a system was implemented which intercepts incoming SMS messages on the phone and creates for each message a preview tone, representing some simple and abstracted indication on the content of the SMS.

The contribution of this paper is twofold. First, we present the results from an online survey among 347 participants, analyzing 3400 messages with regards to the usage of emoticons, keywords, and punctuations marks. Based on the survey's result, we implemented a mobile application, which analyzes incoming SMS content in real-time and plays an audio preview of the content that represents the type of the message. Second, we report on the results of a field trial with 20 users. We show how the use of audio preview affects their behavior while writing and checking text messages, and present the results on learnability and usability of the abstracted audio preview.

## RELATED WORK

Non-verbal clues are important aspects of interpersonal communication. The absence of such clues, as well as contextual information, in SMS communication might often raise difficulties in understanding the received messages correctly. In computer mediated text-based communication means for explicitly expressing emotions and feelings by abbreviations and symbols have been developed [3]. Emoticons widely add emotional expression to text-based communication. Walther and D'Addario investigated the affect of emoticons on message interpretation and conclude that the emoticons have an impact but their contribution is outweighed by the textual content [9]. These findings motivated our research and led us to look at emoticons as well as the textual content.

In the mobile domain sharing emotions is an important issue and researchers look at how to enhance communication

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via text messages. SenseMS [1] is designed to augment text messaging with contextual information and human embodiment and aims by these means to provide richer messages. Persson et al. [7] developed ExMS, a message system allowing users to concatenate and annotate avatar animations and send them to peers. Another similar type of application, Comeks, enables people to create comic strips as MMS, thus empowering a more expressive communication [8]. In that system, the interplay between text and animation allows users to create expressive messages. In contrast to this research we focus on the use of text messages only and audio as output.

Our approach is inspired by the idea of sonification of contents and provision of audio cues. Providing audio cues for blind visualizing of messages has been investigated in instant messaging communication. QnA estimates the type of an instant message, e.g., whether it is a question or not, and changes the notification mechanism accordingly [2]. The results indicate that modifying the way of notification can create a benefit for the user. In our work we were especially interested if the same is true in the context of mobile communication using SMS. Hubbub [5] is a sound-enhanced mobile instant messenger aiming at increasing background awareness by providing audio clues.

The focus of our research is to enable an abstract preview of incoming messages' content in mobile phones and investigate how sonification can influence the user experience in the mobile context.

### ONLINE SURVEY OF USERS' SMS BEHAVIOR

Several studies exist as to where, when, and for which reasons text messaging is used, e.g., [6] and [10]. Users are facing several limitations when writing short messages. Firstly, space is scarce, limiting the amount of information that could be transmitted. Secondly, SMS lacks expressiveness and support for non-verbal communication. Those issues led to the evolution of a distinct language for text messaging [4], characterized by the use of abbreviations, acronyms, and emoticons. Such elements seem to be suitable for defining the type of a message. To inform our work we conducted a survey to get quantitative information on emoticons used in SMS.

#### Setup

We conducted an online survey where we assessed the users' behavior with regards to writing and receiving SMS. The web survey was an open call announced via mailing lists and social networks (such as facebook and myspace), not targeted any specific group, ran over three weeks in spring 2009 and was available in English, Finnish, German, and Spanish. In total there were 347 participants, 53.9% males and 46.1% females, with the average age of 29.83 years (SD 8.2). Participants came from 21 different countries, mainly Germany, Finland, and the United States. They had various backgrounds, being, e.g., high school or college students, or employees with different academic and vocational backgrounds. The completion of the survey took approximately 10 minutes for each participant.

The survey was divided into three main parts: first, we assessed general data on the users' SMS behavior (number of SMS, communication partners). Second, we were interested in the users' behavior when receiving SMS (in which situations they checked the messages immediately, in which they did not). Third, we asked them to analyze their last 10 received SMS and provide the following data: the first word of each SMS, the number and type of emoticons included in the messages, and the number of question marks.

### Results

The majority of the participants wrote and received on average more than 10 SMS weekly (60.4% senders, 65.6% receivers). Their predominant communication partners were friends, family members, partners, and colleagues.

#### SMS checking behavior

We were especially interested in situations in which the users checked or did not check the message immediately after they were notified of an incoming message by the tone (multiple selection was possible). We discovered that 87.0% checked their SMS immediately if being at home, 79.9% in public transport, and still 65.3% in the office. However, more than two thirds of the participants did not check on SMS immediately while driving or doing sports.

#### SMS analysis

We analyzed the text messages for the use of keywords, emoticons, and punctuation marks in order to find out whether the type of message could be easily determined. Overall, 90.9% of all participants used emoticons in their SMS. Table 1 shows the most popular emoticons.

| :-) or :) | ;-) or ;) | :( or :( | others |
|-----------|-----------|----------|--------|
| 85.03%    | 65.25%    | 62.71%   | 31.41% |

Table 1: Percentage of users using specific emoticons

For the question marks, on average 25.4% of the analyzed SMS (approx. 3400 messages) contained at least one question mark. From analyzing the first word of each SMS the most frequently used ones were greeting phrases such as *hi*, *hey*, *hei*, or *hello* (573 appearances), further keywords included *ok* (197), and *yes/no* (135/108).

#### Limitations of the survey

The set of SMS that were assessed was fairly large - nevertheless the survey does not claim to be representative due to the fact that users were openly recruited online (self selection). This may have drawn in people who are more au fait with digital technologies than the average user, and may not be a perfectly matching sample compared to the participants of the user study conducted later.

### DESIGN SPACE FOR AUDIO PREVIEW AND CONCEPT

Our above-described survey revealed that there are situations in which users prefer not to check incoming messages immediately. Further the survey showed that the scarce space and lack for expressiveness of short messages led to a widespread use of emoticons and abbreviations. Since emoticons are universal in many languages, we decided to sonificate them in incoming messages. So if a message in-

cludes certain emoticons or keywords, we map them to specific notification tones. Our hypothesis is that this kind of content presentation may change the users' behavior in writing and checking SMS.

Our approach consists of the following steps: (1) The content of incoming messages is scanned for key strings, emoticons, and punctuations. (2) Based on the expected meaning of the spotted key strings we select a specific tone indicating the assumed type of a message. (3) After the standard notification sound the selected tone is played to inform the user on the potential content of the message. We discriminate between the following types of messages:

- happy messages
- sad messages
- questions
- answers and responses

A similar concept is popular for incoming calls on mobile phones when it comes to identifying the caller. Users may assign different ringtones to individual contacts.

### IMPLEMENTATION

We implemented a Python-based application capable of detecting certain sets of characters from incoming messages and playing a corresponding tone in case of finding a positive match. The standalone application works on Symbian S60 mobile phones. After the installation and launch, the program runs as a background process without having any impact on the other phone's functionalities. The application has a callback feature, which is activated whenever a short message arrives. The callback feature analyzes the content of the incoming message and plays a corresponding tone after the normal SMS tone. The tones are played based on the current profile settings of the phone, e.g., if the silent mode is activated the audible notifications are not played.

The application used for the study detects five different character sets (based on the survey's result): three kind of emoticons (:-) or :), ;-) or ;) , :-( or :( ), question marks, and *ok* as a keyword (not case-sensitive). It was a conscious design decision to limit the number of different preview sounds to a small set to avoid the complexity of learning them and minimize the effort for the user. A professional composer created a tone for each message type representing the characteristics and emotions included. If a message includes more than one key string the application detects just the first key string and plays the related tone. In addition, the application includes a GUI, which shows the detected characters and creates a log file. We did not implement a comprehensive content logging function since this would have had a major impact on the users' privacy. We did not replace but append tones with the original SMS notification tone. The created tones did not exceeding three seconds.

### USER STUDY

To evaluate how the abstracted audio preview was experienced and how it changed the text messaging behavior we conducted a field trial with 20 users including seven cou-

ples—10 males and 10 females with an average age of 28 years. Participants could either use their own mobile phone if it was compatible with the application or we provided a Nokia 6210 Navigator for the duration of the study. During the four weeks' test period, the participants used their own SIM cards and received 20 Euros as compensation. Since the application was running in the background users were not required to interact with the application during the trial. During the study we provided a hotline and contacted the participants regularly asking if they faced any problems.

The study consisted of four parts: (1) in the preliminary interview, we gathered demographics, asked about the participants' current SMS behavior, gave a short briefing about the study and explained how the application worked. (2) Approximately after one week's usage, the participants were asked to fill in a web survey, which unveiled the initial impression about the audio preview and if it already had changed the messaging behavior. In addition, the users were asked to complete a System Usability Scale (SUS) questionnaire. (3) One week before the final interview a second web survey was conducted which asked participants for suggestions of how to enhance the audio preview application. (4) In the final interview we repeated the questions from the first web survey, in order to compare the initial impact to the long term one. Additionally, open-ended questions asked for cases where, when, and how the audio preview had changed their SMS behavior. Besides, we did a recognition test, playing the tones to the users and asking them which character set they thought the sounds correspond to in order to evaluate the learnability.

### *Limitations of the user study*

In the study we did not include a control group to collect comparative data as we assume that SMS behavior does not change significantly in short-term with experienced mobile phone users, and thus relied on the data collected in the preliminary interview. The data collection time was limited to 4 weeks. Although one can argue that this is not long enough to record the long-term influence of new technology, this time frame seemed appropriate as we could observe interesting changes in behavior.

### RESULTS AND DISCUSSION

The results of the study indicate that the abstracted audio preview had an impact on how the participants utilize SMS. Already after a week of usage, 11 participants stated that they opened a received message faster if they heard the question-mark tone. Secondly, 8 out of 20 said that they did not need to open a message immediately if they heard the *ok* tone. In comparison with the results from the final interview there was not a statistically significant margin to these result after one-week usage. Figure 1 shows the results from the interview. During the interview some of the users mentioned that they usually did not check the incoming messages immediately if their phones were not nearby, unless they heard a tone indicating a question mark. In this case they wanted to check the message directly. If the participants had an ongoing SMS conversation and they heard a

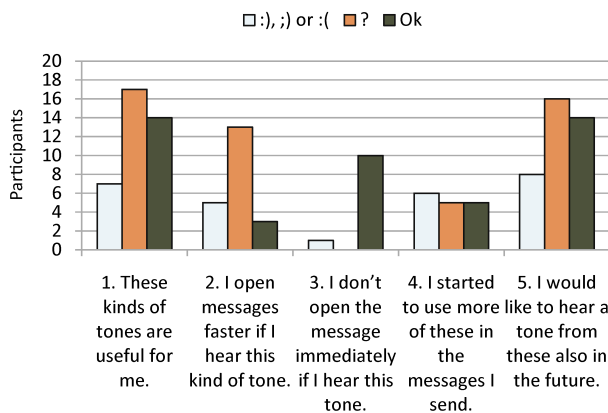
tone indicating *ok* they did not necessarily open the message, but could anticipate to what the message responded. Beside that, based on qualitative user feedback, we found out that couples tended to use more emoticons and *ok* instead of yes or similar agreement words in their SMS conversations after they started using our application as both sides were aware that their partners also use the application.

|                    | <i>ok</i> | :)   | ?    | :(  | ;) ) |
|--------------------|-----------|------|------|-----|------|
| <b>Recognition</b> | 19        | 17   | 15   | 8   | 4    |
| <b>Occurrences</b> | 11.3      | 12.2 | 22.8 | 1.6 | 1.7  |

**Table 2: Number of users which could recognize the tones compared to average occurrences of preview tones per user.**

Table 2 gives an overview of the results from the recognition test. It can be seen that the tones for *ok*, :) , and ? could be recognized best among the participants. We discovered that the degree to which users could recognize the tones, related to the number of received emoticons, keywords, or punctuations during the study (our application logged the number of received key strings). The correlation coefficient between the recognized and the number of received tones is 0.71. This result indicates that the abstracted audio can be used to preview content, but the learning of the tones is dependent on how often they are heard.

The results from the SUS indicate that the users were more comfortable with the application after a longer period of usage. The score from the initial survey was 77.12 and from the final interview 83.12. One of the enhancements suggested in the second web survey was the opportunity to define character sets and notification tones by the end user.



**Figure 1: The results from the interview indicate how the audio preview had changed the SMS behavior.**

## CONCLUSIONS

In this paper we presented the concept of audio previews for text messages. Based on an online survey we motivated not only the need for such a feature but also gathered knowledge about the usage of keywords, emoticons, punctuation marks, and SMS checking behavior. We implemented a mobile application, which intercepts incoming messages and notifies the user about the type of the incoming message using preview tones. In a field study we evaluated the impact of our application on the users' SMS read-

ing and writing behavior. We discovered that there was a significant impact when it comes to checking messages in situations where users are engaged in other activities. Question marks often led users to check messages immediately. In contrast messages including *ok* were mainly checked after finishing current activities. Additionally coupled participants used more emoticons and *ok* instead of *yes* or any similar agreement words after using the application and understanding the audio preview. In these cases both partners were using the system and knew that their partners also used the system. This supported our second hypothesis.

As future work, we plan to investigate how the personalization of the sounds and their mapping to emoticons can help to meet the users' personal preferences in audio previews.

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