

# A Note Paper on Note-Taking: Understanding Annotations of Mobile Phone Calls

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## ABSTRACT

Note-taking has been largely studied in contexts of work meetings. However, often people need to remember information exchanged in informal situations, such as during mobile phone conversations. In this paper we present a study conducted with 59 subjects who had their phone calls semi-automatically transcribed for later annotation. Analysis of the 621 calls and the subjects' annotation behavior revealed that phone recall is indeed a relevant user need. Furthermore, identifying patterns in phone calls such as numbers and names provide better indicators of annotation than variables related to the callers' profile, context of calls, or quality of service. Our findings suggest implications for the design of mobile phone annotation tools.

## Author Keywords

phone call; annotation; context; mobile information

## ACM Classification Keywords

H.5.2 Information Interfaces and Presentation: User Interfaces (D.2.2, H.1.2, I.3.6)

## INTRODUCTION

Lots of information is exchanged every day during mobile phone calls. While a consistent part of this information could be ephemeral as supporting our social needs, another part of it might be important to remember as being functional to our lives. For example, we might receive a phone call to remember to buy some groceries on our way back home, to pick kids from school because our partner is busy, or we might agree to meet a colleague at a specific time in a restaurant.

It can be speculated that most people have a good memory for remembering important details shared during phone calls, while others require taking notes in order to avoid forgetting. To date however, there is little support of applications for this latter case and it is frequently experienced by many the cumbersome situation of having hands tight and needing to take notes while on the phone. Perhaps, this is due to the lack of studies that have tackled this issue.

\*Research conducted while working for Telefonica Research.

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Many studies in the past have focused on how people take notes during work-related meetings [1, 7, 3, 8]. However, how people take notes during daily mobile phone calls it is a different and less studied topic. More specifically, we have little evidence of what is important to remember during mobile conversations and which factors, whether contextual or demographic, play a role in this process.

## RELATED WORK

In the recent years, scholars focused extensively on work-related meetings, during which participants also have the need to take annotations. Mobile phone calls can be considered as a two-people meetings but they are different from formal work-related gatherings. Typical mobile phone calls tend to be relatively short in time when compared to work meetings. Also, while in mobile phone calls parties tend to quickly share information with ad-hoc formalisms between greetings and salutations, work meetings tend to be rather structured following agendas and action points.

People normally take notes during meetings and in many other situations of daily life to record important issues and remember things that have been discussed [1]. Geyer and colleagues [3] note how: "personal notes primarily serve as a memory aid for individuals to remember important facts, actions, ideas, and decisions but are hardly useful for persons other than the author". In formal work settings, notes take a structured form and usually include action items. Often also formal minutes of the meetings are recorded to create a shared group memory and to make the meeting more efficient [3].

Despite the rise of Information Capture and Retrieval (ICR) technology for collaborative exchanges, the most common recording techniques used in meetings today are still pens, paper or notebooks, and sometimes laptops [7]. More sophisticated techniques comprise the recording of the audio and sometimes the audio-video trace of the meeting [3]. However, the drawback of these techniques is that they require a timestamped indexing of the content to alleviate retrieval of relevant information.

Notes that people take for themselves during meetings contain "personally important points and in particular details on action items that the note-taker needs to deal with later" [1]. Personal notes usually mention decisions, names, dates and actions [7]. Whittaker and colleagues [7] analyzed the content of people's notes and found that in 30% of the cases personal notes concerned comments that could supply context for action.

Whittaker et al. [6] have studied note taking as the primary

way of recording what occurred during a meeting. Subjects in their study reviewed regularly their notes after the meeting (33%). The large majority of people in their sample (70%) reported difficulty in taking notes due to various reasons, like the failure to note facts that turned out to be important later, illegible names, lack of time, and notes that lacked the right level of summarization for *a posteriori* understanding. One of the most significant problem with personal notes is that taking notes reduces the ability of people to participate in the conversation [7].

ICT systems developed in the past aimed at addressing some of these issues. Hindus & Schmandt [4] presented a system that allowed people to mark interesting portions of an ongoing telephone conversation. Degen et al. [2] modified a handheld tape recorder so that users could mark the audio while it was being recorded. Wilcox et al. [8], designed a system called Dynamite, which allowed users to attach keywords to recorded notes so to create an index of the content. Whitaker et al. [5] looked as well at how to improve voicemail by allowing users to visually inspect its content and enabling annotations.

All these findings come from studies of work meetings while little work has focused on understanding the role of annotations as support of daily mobile phone conversations. With this work we aim at shedding some light in this area by highlighting *annotation habits*, an initial overview of *how* people make these annotations, and some evidences of *problematic aspects* related to annotations made during mobile calls.

## METHODOLOGY

We designed a quantitative experiment to collect a large sample of mobile phone calls, their annotations –if any–, and contextual parameters at the time of the calls.

### Participants

A total of 59 subjects (41 male) participated actively in the user study, *i.e.* answered the pre-study questionnaire and made at least one phone call during the study. Their mean age was 31.05 years ( $s = 7.4$ ), they were all living in Spain and reported being fluent in speaking Spanish –a requirement of the study. The sample was well geographically distributed (37 unique cities) and included only subjects that had at least the basic education (primary school: 3.4%), followed by 3.4% who finished secondary school, 78% that concluded technical school or obtained a bachelor degree, and 15.2% who had either a masters or a doctorate degree. The reported annual income suggests that all social classes were represented in the sample (27%, 19%, 25%, 20%, and 9% earned up to €10K, €20K, €30K, €40K, and €40K+ a year respectively).

### Procedure

The study spanned over 50 days. It was conducted amongst participants who voluntarily registered after following advertisements in popular Web portals in Spain. We had to limit participation to people who owned and used an iPhone or Android mobile, since we only had VoIP applications available for these platforms. We invited participants via email, asking

them to fill a registration questionnaire which, besides general demographics, asked relevant questions such as calling habits and general note-taking habits during phone calls.

We offered participants free calls to mobile or fixed phone lines inside the Spanish territory. To be able to make free calls, they had to install a VoIP application on their mobile phones and configure it to connect through our servers. Participants were allowed to make calls either using the VoIP application—in which case they would contribute it to our study—or the native phone application so as to prevent us from having access to the conversation. We explicitly explained them how to switch between these two options. Whenever participants used our VoIP application, a short message was played to both the caller and the callee informing them that the call was going to be recorded and transcribed. Transcriptions were first generated automatically and later manually inspected and corrected by an expert before being presented to participants.

We developed a web application which allowed participants to interact with call data. It displayed a list of phone calls, and for every call, its transcription, date, duration, status and callee number, as well as a related questionnaire. Participants were asked to:

1. Enter the web application and confirm that they wanted to contribute the calls. Participants were allowed to delete a call within a 24 hour period if they considered it to have sensible content. They could review call data to assist the decision.
2. To select and highlight pieces of text that they considered important, or worth remembering, from the transcriptions. In case there was no important text, to explicitly declare so.
3. To answer a questionnaire related to each phone call.

### Measures

The questionnaire associated to each phone call included several questions: 1) Relationship with callee; 2) Who was with the caller at the time of the call; 3) Location of the caller at the time of the call; 4) Objective of the call; 5) Level of importance of the call; 6) Reasons for highlighting text (if applicable); 7) Whether the caller could take written notes at the time of the call; 8) How important was to take notes during the call; and 9) General questions about sound and transcription quality. Given that participants reported objectives of calls in free text, these were manually classified by two coders as either: “discuss topic”, “appointment”, “give/receive information”, “ask favor”, or “social”. Inter-rater reliability was highly acceptable ( $K = .81, p < .001$ ).

## RESULTS AND DISCUSSION

*Patterns of phone calls and annotation habits in the study were consistent to self-reported data.* During the 50 days of the study deployment, participants made 621 calls with a total duration time of 87,035 seconds ( $\bar{x} = 140.15; s = 191.991$ ). Quality of the calls was considered acceptable ( $q2 = 3$ : acceptable,  $q1 = 3$ : acceptable,  $q3 = 4$ : good). Transcriptions of the calls and annotations yielded a total of 811,453 characters ( $\bar{x} = 1,306.69; s = 1889.6$ ) and 44,744 characters ( $\bar{x} = 72.05; s = 219.59$ ) respectively. The average

number of calls per participant was 10.53 ( $s = 8.69$ ,  $min = 1$ ,  $max = 32$ ), and they annotated an average of 4.61 of their calls ( $s = 5.36$ ,  $min = 0$ ,  $max = 29$ ). Hence, about 44% of all phone calls were annotated, which is consistent with the participants' self-reported annotation habits captured by the pre-study questionnaire (34% and 46% indicated taking notes frequently using mobile phones and paper/pencil respectively). Likewise, participants called family members more often than friends, and called friends more often than work colleagues, which reveals the same order reported in the pre-study questionnaire. These findings support consistency between the participants' behavior in the study and how they perceive their behavior in real life.

### Phone Recall Needs

*Recalling information from calls is a general need and not necessarily a simple task.* While 15% of the participants reported that this need rarely occurs, almost half of the sample agreed it occurs sometimes (48%), and over one third indicated it happens frequently (37%). No one reported the absence of this need. When evaluating the easiness to recall information obtained in phone calls, 37% said it is either easy or very easy, 36% reported it is neither easy nor difficult, and the remaining 27% agreed the recall task is at least difficult. These results suggest the importance of supporting recall of phone conversations.

*Mobile phone is the primary tool to support recall.* Several tools can be used to annotate phone calls. According to our sample, mobile phones and regular paper and pencil are the most important ones—46% and 34% respectively use them frequently for this task. Note that our sample is composed only by smartphone users, hence the popularity of mobile phones as the primary annotation source. Participants reported taking *a posteriori* notes of phone conversations using text-based notepads and audio-based memo applications (25% record audio notes for phone calls at least once a week).

### Dynamics of Phone Annotation

*If the call is important, expect important notes to be taken.* As one might expect, the participants' evaluation of the importance of the calls strongly correlates to the importance of the corresponding annotations ( $\rho = .50$ ,  $p < .001$ ). This means that the higher one thinks is the importance of a call, the more likely important annotations will be made for it.

*If the call is important, callers tend to get prepared for taking notes.* While 65% of all calls happened when users had one hand holding the phone and the other hand free (usual setting when attending a phone call), this figure increased to 91% when call annotations were considered important. From this result, we raised the hypothesis that callers would make sure to have their hands free when making important calls because of the higher probability of taking notes during them. Indeed a significant association ( $\phi = .11$ ,  $p = .007$ ) was found between importance of the call (*i.e.* whether the call had at least some importance) and ability to take notes (*i.e.* whether the participant had at least one hand free to take notes). As there is no off-the-shelf solution for creating hands-free notes during a phone call, apparently people tend to change their be-

havior right before the call to ensure that at least one of their hands will be free for taking notes.

*Transcribing the entire conversation is indeed not efficient.* Only 5.5% of the characters in the transcribed calls were highlighted in the participants' annotations. This result is in agreement with previous work in the sense that providing full transcripts of conversations most likely overload users thus switching their recall problem for information retrieval [7].

*Annotations have patterns and these are better indicators of note-taking than most of the variables observed in the study, i.e. contextual, quality of service (QoS) and caller profile.* In the preliminary questionnaire, participants were asked about the kinds of information they find themselves trying to remember after a phone call. About 79% mentioned pieces of information that necessarily include numbers (*e.g.*, phone numbers, dates, prices, addresses) and 34% mentioned information related to names (*e.g.*, addresses, contacts). Therefore, we implemented three parsers to count numbers, names, and interrogative adverbs (*i.e.* why, where, how, when) in the phone call transcriptions respectively. According to Table 1, these pattern variables have significant medium correlations with the length of notes ( $\rho = .33$ ,  $\rho = .31$ ,  $\rho = .30$  respectively), and these are higher than most correlations with other variables observed in this study—call length is the only exception ( $\rho = .41$ ). In other words, the more numbers, names, and interrogative adverbs are mentioned in a call, the higher the probability to take notes and also the longer the annotations might be.

From the data shown in Table 1, we can highlight at least three interesting findings. First, none of the callers' demographic variables (*i.e.* gender, age, education and income) revealed significant correlations with the annotation variables.

The second interesting result is the fact that QoS variables are positively correlated to taking phone notes. Moreover, quality of call is positively correlated to both the note taking activity ( $\rho = .18$ ) and duration of calls ( $\rho = .20$ ). One possible explanation is that the better the quality of calls, the more time users engaged in a phone conversation, thus increasing the probability of taking notes.

And finally, contextual variables played distinct roles on the note-taking activity. Although the call place and callee information did not reveal any significant relationship with phone annotation, information about the caller's companion, the call objective, and the call length did. Phone calls next to work colleagues were positively correlated with taking notes ( $\rho = .11$ ), probably due to the nature of the call objective (information:  $\rho = .11$ ; appointment:  $\rho = .08$ ). On the other hand, phone calls with no companion were inversely related to generation of notes ( $\rho = -.09$ ). Stronger interaction effects were revealed by call length ( $\rho = .35$ ) and social calls, *i.e.* calls reported by participants as "just to chat" or "say hello" ( $\rho = -.26$ ). The former result could indicate that the lengthier the call, the higher chances of taking notes, whereas the latter result is an indication that social calls tend to have significantly fewer annotations.

In summary, the results of this study suggest that taking notes

**Table 1. Correlations/Associations between annotation-related variables (Note Taken: Yes/No; Note Length in number of characters) and other variables related to the call task.**

Variable	Source	Coefficient*	
		Note Taken	Note Length
Total numbers/call	Pattern	<b>.29</b>	<b>.33</b>
Total names/call	Pattern	<b>.28</b>	<b>.31</b>
Total adverbs/call	Pattern	<b>.25</b>	<b>.30</b>
Gender	Profile	.07	.06
Age	Profile	-.01	-.05
Education	Profile	-.02	-.01
Income	Profile	.02	.02
Recall frequency	Profile	<b>-.10</b>	-.07
Recall easiness	Profile	-.04	<b>-.12</b>
Note mobile frequency	Profile	-.02	.00
Note paper frequency	Profile	<b>-.11</b>	<b>-.18</b>
Call quality	QoS	<b>.18</b>	<b>.20</b>
Transcription quality	QoS	<b>.12</b>	<b>.08</b>
Call length (chars)	Contextual	<b>.35</b>	<b>.41</b>
Call length (seconds)	Contextual	<b>.29</b>	<b>.35</b>
Call who: mate	Contextual	.04	.04
Call who: family	Contextual	-.05	-.06
Call who: friend	Contextual	.04	.06
Call who: work	Contextual	-.03	-.04
Call with: alone	Contextual	<b>-.09</b>	<b>-.09</b>
Call with: mate	Contextual	.06	.07
Call with: family	Contextual	.05	.03
Call with: friend	Contextual	-.05	-.04
Call with: work	Contextual	<b>.11</b>	<b>.10</b>
Call from: home	Contextual	.04	.03
Call from: work	Contextual	.05	.05
Call from: commute	Contextual	-.07	-.05
Call why: discuss topic	Contextual	.04	<b>.08</b>
Call why: appointment	Contextual	<b>.08</b>	.06
Call why: info	Contextual	<b>.11</b>	.06
Call why: ask favor	Contextual	<b>.08</b>	<b>.10</b>
Call why: social	Contextual	<b>-.26</b>	<b>-.23</b>

\* Correlations between ordinal and non-normal interval variables were assessed using Spearman's Rho ( $\rho$ ). Associations between dichotomous variables were assessed using the  $\chi^2$  derived Phi coefficient ( $\phi$ ). Coefficients in bold are significant at  $p < .05$ .

during mobile phone calls is a common need, and that such need is not well satisfied by current off-the-shelf solutions. Participants of our study chose to be prepared whenever they felt that a call was important, leaving at least one hand free for taking notes. The importance of the notes taken was, unsurprisingly, correlated with the stated importance of the call. Advanced smartphones users used their devices more frequently than pen and paper for taking notes. However, the latter method was still widely used.

Another interesting finding was that participants annotated mostly information containing numbers and names, such as phone numbers, addresses, dates, or contacts. These patterns can be easily identified signaling the importance to annotate calls. Further semantical analysis might reveal more complex patterns and potentially refine our conclusions.

## IMPLICATIONS FOR DESIGN

Our study provide evidence that users tend to have at least one of their hands free during calls they consider to be important. While being on the go, this probably implies limiting user's mobility. In order to overcome this problem, we emphasize the need to assist users in creating automatic annotations during mobile phone calls. We can speculate that for the callee

this need might be even greater given that s/he cannot anticipate important incoming calls. Mobile phones shall be the most suitable devices to enable such solution as they were reported to be the primary phone annotation tools for the participants of our study—all smartphone users. The lack of viable solutions for automatic hands-free annotation of phone calls implies that currently the process must be accomplished off-line, after the call has finished, thus increasing the possibility for important pieces of information to get lost.

An important feature for a practical solution is to avoid full call transcription and rather focus on important pieces of information towards preventing the user's information overload. According to our study, these pieces of information usually appear in patterns, such as phone numbers, dates, addresses, prices, shop/to-do lists, contact names, activities, among others. The application should be able to recognize these patterns and annotate them for later recall.

Finally, the mobile application should not only look for patterns in the call, but also leverage its embedded sensors to gather relevant contextual information for the note-taking activity, such as with whom the caller is (alone vs. with work colleagues) and what is the objective of the call (social vs. non-social). By identifying call context, call QoS—via analysis of the microphone signal, and patterns in the calls, the need to annotate a phone call might be detected and potential annotations inferred.

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