To Answer or Not to Answer: That is the Question for Cell Phone Users

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CHI 2009, April 4–9, 2009, Boston, Massachusetts, USA.
ACM 978-1-60558-247-4/09/04.

Abstract
People are constantly making decisions to answer or ignore cell phone calls based on inferences derived from partial information about the incoming call. To gain an understanding of this information deficit we conducted a survey study of cell phone call handling practices. The results highlight the type and extent of information desired about incoming cell phone calls. It also shows that desired information is largely unknown and often misattributed by the receiver. Our findings can be used by designers to prioritize the presentation of additional types of call related information on cell phone displays, and in so doing, empower users to make informed call handling decisions.

Keywords

Cell Phones, Interruptions, Availability, Context

ACM Classification Keywords
H5.2. Information interfaces and presentation (e.g., HCI): User Interfaces, User Centered Design

Introduction
The increased ability to communicate and be contacted through cell phones and other technologies comes with a price in terms of inappropriate interruptions. People

frequently have to make decisions to answer or ignore calls based not only on their availability but also the perceived benefits of a call derived from inferences regarding call content and caller context. For example, a call received from a colleague after work may be perceived as important. However, the accuracy of such implicitly derived information is not always guaranteed. In our own everyday communication practices it is easy to imagine situations in which we may perceive a call to be important or pertaining to a particular subject matter only to realize later that our perception was wrong. Therefore, if we are to aid people in accurately perceiving the costs and benefits of responding to a call, we need to gain a deeper understanding of the nature of information that people currently lack and their desire for its use in call handling decisions

To address the above issues, we are examining call handling practices through a mix of qualitative and quantitative research. In this paper we present initial findings from a survey of call handling decisions made by 101 individuals.

Background

A small number of studies have looked at how and what information is used in cell phone handling practices. Some researchers have looked at the information that can be used by callers before making a call. In a diary study Guzman et. al. [2] examined what information callers used to make calls and what information receivers wished callers had considered before placing calls. They found that both callers and receivers considered the receiver's task and physical availability to be the most important factors in deciding whether to place a call. Avrahami et. al [1] studied the effectiveness of providing the caller with contextual information by measuring the degree of agreement between the receivers' desires and callers' decisions. They found that callers with information such as cell phone ringer state, location, and presence of people around the receiver, made more accurate decisions than those without this information. *CallsCalm* [8] allows receivers to display information on their local context such their role, location and social setting so callers can make an informed decision on whether to call or not. These studies provide valuable information regarding how the context of the individual receiving a phone call can be leveraged by callers.

A number of context-aware computing researchers have explored the design of phone applications that help manage responses based on caller identity. *BayesPhone* [5] allows users to pre-define cell phone callers' interruption rights based on organizational relationships, activities, and ad hoc groups such as "critical associates" and "close friends". *Taming of the Ring* [9] allows receivers to respond through pre-recoded voice messages by the touch of a button such as "hold", or "will call back soon after my meeting". While these applications provide some control to the receiver, they assume that receiver's disposition to answering an incoming call is based only on his/her mental state, activity, and social surrounding and not on factors independent of receiver's current local context such as what the call is about, or its importance/urgency.

Two prototypes allow implicit and explicit negotiation between callers and receivers regarding engaging in a call. *Quiet Calls* [7] extends the use of pre-recorded response options by enabling receivers to listen silently to the caller without vocalizing a response. *Negotiator*

[10] allows callers and receivers to negotiate an appropriate time for call but does not consider what the call may be about. While these application show the utility of negotiation for the receivers, we still lack a deep understanding of how and what information receivers use in their decision to answer or defer a call.

Milewski [6] looked at the interruption management practice of using call screening via answering machines and found that people looked for caller identity, call reasons, urgency, and emotional state from the vocal characteristics. Grandhi and Jones [4] found that people primarily make call handling decisions based on who the call is from and what the call is about more than their own local context. However it is not clear what is it exactly about the caller or the call content that people use in their decisions.

The need to consider factors beyond the receiver's local context as an equally important aspect in call handling decision making is identified by the interruption management decision framework (Figure 1) [4]. This framework treats call handling decisions (interruption management) as an individual's attempt to predict the interruption's value based on an individual's: 1) cognitive context which comprises interruptee's cognitive levels of involvement in tasks; 2) social context which comprises interruptee's local environmental factors such as place, and people around; and 3) relational context which comprises all aspects between the interruptee and the interrupter such as the nature of the relationship, what the interruption is about, the interrupter's local context, and historic interrupter-interruptee interaction patterns that define the nuances of relationships.

The framework highlights a very important distinction between the local context of the reciver and the relational context. While the local context of the receiver is fully known to the receiver and information on the relational context is to a large extent unknown. Further, it asserts that individuals will typically try to reduce uncertainty regarding the unknown relational context to derive the value of engaging in or ignoring a call. It also suggests that the presentation of richer relational context information, by reducing uncertainty, will aid in an individual's call handling decisions. This logic is presented in Figure 1[4].

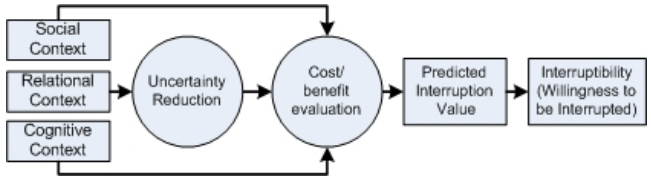

Figure 1: Interruption Management Decision Framework

Research Questions and Hypotheses

The cell phone call handling survey explores three broad questions: 1) What factors/information beyond a receiver's local context are people most uncertain about? 2) What factors most strongly influence people's cell phone call handling decisions? 3) What factors do people desire for cell phone call handling decisions?

Method

Study Procedure

In an attempt to mimic the nuanced data gathered from *in situ* collection, this survey was directed towards 3 most recent calls that were answered or ignored. Participants were asked to not consider "missed" calls. They selected the three most recent calls from three different people in the last 48 hours, preferably from different social situations (e.g. work/school).

Participants were invited to a lab where they were briefed on how to answer the questions, and select calls from their phones logs. The survey took approximately 30 minutes to complete and participants were paid $10 for their time.

Subjects
The results from the 101 participants who completed the survey are presented here. All participants were university students where 97% of those surveyed were in the 18-30 years age group.

Survey Instrument
The survey consisted of questions organized around three main ideas. 1) Information desired in call handling: what information people liked having or would have liked to have before answering/ignoring a call 2) Information influencing call handling: what information (or lack of) influenced their decisions; 3) Information uncertainty in call handling: what information people knew before the call came in and/or found out as the call came in (from phone, calendar etc.). We also asked if the information/assumptions used by the participants to make call handling decisions were confirmed upon answering the call.

In particular the above questions were probed with respect to items that belonged to the following four broad categories guided by the interruption management framework [4]: 1) Caller identity information; 2) Caller Context - caller's location, activity, mood and people around at the time of call; 3) Call Content - what the call was about in general (e.g. work, social), what the call was about exactly (e.g. reason, task, subject), estimated length of call, was it important to the caller (and receiver) that the call be answered right away; and 4) Caller-Receiver Interaction History - the caller's calling frequency, usual length of calls, calling routine, and reciprocity to calls.

Results

Of the 303 incoming calls surveyed 76% were answered while 24% ignored. The results are summarized in Table 1. The rows describe four broad categories of relational context information 1) caller ID, 2) caller context, 3) call content, and 4) caller-receiver interaction history. The first three columns presents the percentage of calls for which the relational context information was 1) desired, 2) unknown, and 3) influenced call handling decisions. The final three columns presents the percentage of calls for which the information was 4) desired yet unknown, 5) desired, unknown and influenced the call handling decision, and 6) incorrectly attributed by the respondent (e.g. they thought somebody was calling about subject A but on answering they learned it was about subject B). The aggregate rows, presents the percentage of calls for which there was a positive response to any of the sub-items within that category.

Desired and Unknown Call Information
Caller ID was the most desired information for call handling decisions (94%) and was rarely unknown (3%). This result contrasts with call content information which was also highly desired (88% of calls) but largely unknown (66%). The most desired caller context item was caller's mood (50%). Overall call content was desired more than caller context or interaction history (as shown in Table 2.).

		Desired	Unknown	Influencing	Desired & Unknown	Desired & Unknown & Influencing	Incorrect Attribution (n)
Caller	Caller ID	**94%**	**3**%	**92**%	**3**%	**2**%	**3**% **(201)**
Caller Context	Location	42%	50%	29%	18%	3%	8% (102)
	Activity	39%	56%	24%	19%	2%	1%7(82)
	Mood	50%	61%	24%	25%	5%	18% (76)
	People Around	36%	74%	20%	23%	6%	20% (59)
	Aggregate Caller Context	**64**%	**82**%	**43**%	**42**%	**12**%	**24**% **(151)**
Call Content	General Call Reason	77%	27%	59%	18%	7%	13% (138)
	Exact Call Reason	70%	45%	45%	27%	8%	11% (117)
	Length	61%	47%	39%	24%	7%	19% (83)
	Importance for Caller	68%	41%	55%	24%	8%	15% (104)
	Importance for Receiver	65%	42%	51%	23%	8%	9% (106)
	Aggregate Call Content*	**88**%	**66**%	**77**%	**46**%	**20**%	**18**% **(187)**
Caller-Receiver Interaction History	Call Frequency	35%	34%	42%	10%	5%	
	Avg. Call Length	46%	38%	42%	14%	5%	
	Usual Call Time	31%	65%	27%	6%	6%	
	Call Reciprocity	42%	32%	42%	9%	4%	
	Aggregate Interact. Hist.	**62**%	**72**%	**65**%	**28**%	**14**%	

Table 1. Survey data detailing information collected about call handling decisions. (*Exact Call Reason Excluded)

Information influencing Call Handling Decisions

Caller ID (known 97% of the time) influenced call handling decisions 92% of the time. However, as shown in Table 2, call content influenced call handling decisions (77%) more than caller-receiver interaction history (65%) or caller context (43%).

Information Gaps and Misattributions

Respondents desired the unknown call content information 46% of the time and not knowing this information influenced them to answer/ignore calls 20% of the time. For answered calls where respondents' inferences regarding (i) caller identity, (ii) caller context, and (iii) call content, was either confirmed or disconfirmed; it was apparent that individuals fairly routinely made incorrect attributions about the caller context (24% of 151 calls) and call content (18% of 187 calls).

Discussion

Previous research has shown that people base a majority of their incoming cell phone call handling decisions on information regarding 'who the caller is', or 'what the call is about', rather than on their own local context [4]. Our work significantly extends this finding by presenting finer details of information that individuals' desire, know, and utilize, to make call handling decisions. Further we also show the extent to which such information is desired yet unknown and/or misattributed.

Contrasts (n=303)	**Cochran's Q**	**Sig.**
Influence: Call Content vs. Caller Context	87.678	P < .001
Influence: Call Content vs. Interaction History	38.761	P < .001
Influence: Caller Context vs. Interaction History	19.000	P < .001
Desired: Call Content vs. Caller Context	58.333	P < .001
Desired: Call Content vs. Interaction History	68.762	P < .001
Desired: Caller Context vs. Interaction History	.360	Not Significant

Table 2. Contrast of aggregate factors that influenced and are desired for call handling decisions.

The survey data highlights the relative importance and utility of various factors that are desired and influential in call handling decisions. This could aid cell phone designers wishing to prioritize the information presented in restricted display spaces of cell phones and also helps mitigate information overload. For example, call content information was the most desired, influential, and least known in call handling decisions compared to caller-receiver history and caller context; suggesting that provision of call content information should be a higher priority. The findings of this study highlight the potential utility of cell phone designs that provide relational context information (i.e. call content, caller context and caller-reciver interaction history) to support receivers in their call handling decisions.

Acknowledgements

This research is partially supported by the National Science Foundation NSF CNS 0454081 and IIS-HCC 0749389. The opinions expressed are those of the authors and may not reflect those of the NSF.

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