

Should I Take This Call?

Understanding Interruption Response Decision-Making in Mobile Phones

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ABSTRACT

Mobile phones not only increase our availability for communication anytime, anywhere, but also interrupt us anytime, anywhere. This paper empirically examines the role of local context (e.g. activity/location where one receives the call) vs. the relational context (e.g. what the phone call is about and from whom) in how people make decisions to answer or ignore phone call. Using both quantitative (N=101) and qualitative (N=10) methods, we gathered data on people's cellphone handling practices. Analysis of the data reveals that 1) people are influenced by the availability or unavailability of relational context in making call handling decisions and are rarely influenced by their local context alone; 2) people predict the value of a call to be significantly different before engaging in the call than the value they perceive after the call. Our qualitative data confirmed that the low availability of relational context information not only led to misjudgment of call value but also suboptimal call handling decisions. Together our findings suggest that designing cell phone interfaces that display relational context information can support people in accurately gauging the value of incoming calls to appropriate response decisions in social and professional contexts.

Keywords: Interruptions, Cell, Mobile, Phone, Communication

1. INTRODUCTION

Modern day work and social life is inundated with communication technologies such as mobile phones that allow us to be reachable and available at anytime and anywhere. Many workplace domains embrace the use of mobile phones, hoping to benefit from dynamic and up-to-date information exchange and availability for interpersonal communication [22]. The interruptions from incoming calls can be positive or negative [12,16]. When inappropriate, irrelevant, or excessive they can reduce individual productivity, resulting in people resorting to strategies such as turning off the communication technology [13,14]. However, such strategies overlook the potential of interruptions to be valuable, and thus lead to missing important or desired interruptions [12,18,19]. Conversely, if one fears losing important interruptions and

allows all interruptions while engaging in an important task, this may lead to reduced social appropriateness or task effectiveness. In this paper, we explore how people assess the value of an interruption and how that knowledge can be used to aid them to make informed decisions on how to handle incoming communication interruptions.

2. BACKGROUND

While there is consensus on the vernacular definition of an "interruption" as something that breaks the continuity or uniformity of an action or a discourse (Webster Dictionary), researchers have limited or broadened this definition to focus on the context in which it is examined. As a result, research in mitigating the interruption management problem has perceived the value of an interruption in terms of the context in which it occurs. Interruptions are treated as having a negative and positive value based on the interruptee's local context such as where they are socially located, whom they are with, and what their activity is. In particular two aspects of the local context are seen to be the key determinants of the interruption value: 1) cognitive context which includes all aspects that encompass the interruptee's cognitive level of involvement in tasks and how it affects task performance [1,5,13,14,23] and 2) social context which includes all aspects that encompass the interruptee's immediate environment as understood in a social sense such as the place the individual is in, people present within that place and the nature of social activity in the place [4,6,11].

In contrast to focusing on the local context as a determinant of the interruption value, many workplace studies suggest that interruptions are often considered to be beneficial due to interdependencies of work patterns and sociality of work and are desired as a way to deal with, and avoid, crises [7,12,18,19]. One study found that despite letting others know that they were busy, people were significantly likely to answer calls as they seemed to assume that the incoming call content must be important [21]. Such studies indicate that, even when cognitively and socially overloaded, people are often willing and open to being interrupted. This suggests that the value of interruptions cannot be based simply on the local cognitive and social context but also factors beyond this local context, such as who the interruption is from and what the interruption is about

[8,9,10,17]. This non-localized context referred to as the relational context, and encompasses whom the interruption is from, what the interruption is about, under what circumstances is the interrupter interrupting, and the nature of the relationship between the interrupter and interruptee, including the historic interrupter-interruptee interaction patterns defined by the nuances of their relationship [8]. Understanding how to aid people in assessing the value of an interruption requires an understanding of the relative importance of the local context (cognitive and social Context) and the relational context. Grandhi and Jones [8] developed a theoretical framework that explicates the interplay between the local context and relational context in people's interruption response decision making. Using this framework, in this research we first empirically test the importance of relational context in evaluating the value of an interruption in the context of everyday cell phones.

The remainder of the paper is organized as follows: We derive hypotheses regarding the comparative roles of local and relational context based on the theoretical framework, followed by quantitative and qualitative data analyses of cell phone call handling practices. We conclude with a discussion of how our findings inform interruption management tool design.

3. HYPOTHESES

The Interpersonal Interruption Response Management Framework describes the role of the three components of the interruption context; namely the social, the cognitive and the relational contexts in people's interruption response decision making processes in technology-mediated communication [8]. The framing of the interruption response decision making process is based on two widely discussed theories of decision making under uncertainty in initial introductory communication between strangers: 1) Uncertainty Reduction Theory (URT), which posits that high levels of uncertainty prompt individuals to seek information through interaction [2]; and 2) Predicted Outcome Value Theory (POVT) which posits that individuals seek to know the value of a potential relationship through discourse [20]. In accordance with these, when individuals are interrupted by an incoming communication, they try to predict the outcome value of responding to the interruption. This value is defined as the predicted interruption value (PIV), which is the result of the cost-benefit evaluation of one's response to the interruption based on his/her knowledge of the cognitive, social and relational contexts. The PIV guides individuals' decisions about answering or ignoring calls. The framework posits that individuals will engage in an interruption if they perceive the PIV associated with responding to the interruption to be positive and will ignore the interruption if they perceive the PIV to be negative. Our first hypothesis is therefore:

H1: A higher Predicted Interruption Value (PIV) is associated with a greater likelihood of engaging in an interruption (e.g. answering the call).

The framework also highlights the role of uncertainty of relational context in making response decisions. When using the relational, cognitive and social contexts in making an interruption response decision, individuals are aware of their own cognitive and social context at the time of call. However, their knowledge of the relational context (Level of Uncertainty) will vary according to: 1) how much they already know about the incoming call either from previous interactions or other

sources (e.g. one might know that a call from one's boss at 11am on Monday is about weekly updates) and 2) the extent to which the design characteristics of the device allow for this information to be previewed (e.g. subject, urgency/importance levels of an incoming phone call). Thus, the framework makes a distinction between the role of the known local context of the interruptee and the role of the unknown relational context in interruption response decision making. The framework posits that individuals will typically try to reduce uncertainty regarding the unknown relational context so that they can more effectively assess the value of an incoming interruption. Thus, while being uncertain of the relational context, the PIV perceived before engaging in an interruption will be higher than the PIV perceived after engaging in interruption. Furthermore, if individuals are uncertain about the relational context they will be inclined to engage in the call to specifically reduce uncertainty. In other words, individuals will find value in reducing the uncertainty of the relational context. This leads to the second set of hypotheses that show how uncertainty in relational context is related to the predicted interruption value (PIV) as well as to the interruption response decision

H2a: The greater the level of uncertainty about the relational context, the greater the Predicted Interruption Value (PIV).

H2b: The greater the level of uncertainty about the relational context, the greater the likelihood of engaging in an interruption (e.g. answering the call).

H2c: The Predicted Interruption Value (PIV) before engaging in an interruption will be higher than the interruption value perceived after engaging in an interruption.

Previous studies on everyday interruption response decisions show that individuals let the influence of relational context trump the influence of their local context when making their call handling decisions. The local context at a given time and place will remain the same while, the relational context may change depending on the caller identity, call content, caller's context, and the caller's relationship with the person receiving the call. For example, one may be in a meeting suggesting local content is not interruptible by calls in general, but a call from a baby sitter could influence one to answer the call. This leads to the following hypothesis:

H3: The influence of relational context on Interruption Handling Decisions (e.g. answering or ignoring a call) is independent from the influence of cognitive and social contexts.

The framework indicates that call-handling decision is based on one's predicted value of the call. Although cognitive context and social context influence one's call handling decisions, they alone cannot predict the call value that is used to decide upon whether to answer or ignore the call. This is because one would like to know the relational context of the call along with their local context in predicting the value of the call. Thus, while the influence of relational context on call handling decision predicts interruption value (PIV), the influence of local context on its own does not. This leads to the following hypothesis:

H4: The influence of relational context on call handling decisions will be strongly correlated to the Predicted Interruption Value (PIV), while the influence of cognitive context and social contexts on call handling decisions will be not be correlated with the Predicted Interruption Value (PIV).

4. METHOD

To explore everyday interpersonal interruption response practices, we used qualitative and quantitative methods. We surveyed 101 individuals about the three most recent cell phone calls they received in the preceding 24-48 hours that they deliberately answered or ignored. We then conducted semi-structured interviews with 10 of these respondents, selected at random, to assess the face validity of our quantitative findings.

Procedure

In an attempt to mimic the nuanced data gathered from *in situ* collection, this study used a survey directed towards the three most recent calls in the last 24-48 hours that were answered or ignored deliberately. Participants in our lab were asked to use the incoming call history on their devices to select the three calls from three different people, preferably from different social situations about which to answer the survey questions. The survey took approximately 30 minutes to complete and participants were paid for their time.

Participants

The survey was completed by 101 participants (university students, 32% female.), 10 of whom were randomly selected for a semi-structured interview. Most participants were 21-30 years of age while 17 were 16-20 years of age and one was in the age group of 41-50 years. All participants reported receiving on average at least one call per day.

Measures

Survey Study: The items used to measure various constructs were developed based on previous literature associated with the development of the interruption response decision making framework (Grandhi & Jones, 2010). Survey Questions were organized around the following factors.

1. Call Handling Decision: Participants were asked if they answered or ignored the call.

2. Predicted Interruption Value (PIV): Participants were asked what they predicted the value of the call to be before answering/ignoring the call, based on the 7 point Likert scale of nine items used by Bippus et al. (2003) to measure outcome value of a relationship in interpersonal communication.

3. Local Context at the time of call: These questions focused on understanding the social and cognitive contexts at the time of the call: 1) what activity (*Work/business; Study/school; Errands; Social; Other*), 2) what location (*Workplace; Home; Other*), and 3) who was around (*No one; Partner/Spouse; Family; Friends; Work Colleagues; Strangers; Other*).

4. Level of Uncertainty of Relational Context Information (LU): Participants were queried about the relational context information they knew before the call came in and/or as the call came in using a nominal (Yes/No) scale for the following items a) Caller identity information: caller name, number; b) Caller Context: caller's location, activity, mood and people around at the time of call; c) 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, how important it was to the caller (and receiver) that the call be answered right away; d) Caller-Receiver Interaction History:

the caller's calling frequency, usual length of calls, calling routine, and reciprocity.

5. Relational Context influencing in call handling decision: These questions focused on the relational context information that influenced participants' decision to answer/ignore the call for the items outlined above, using a nominal (Yes/No) scale.

6. Local Context influencing call handling decision: These questions focused on the items of the social context and cognitive context influencing the participants' decision to answer/ignore the call, using a nominal (Yes/No) scale.

Semi-structured interview: The semi-structured interview questions asked of the 10 participants were organized around the same three phone calls the participants addressed in the survey. Specifically, participants were probed in order to get richer detail on the nature of the relationship with the callers, their local context, level of uncertainty of relational context, what local and relational context factors they used and how they used them in making call-handling decisions with respect to the three calls.

4. RESULTS

Descriptive Statistics

Our survey recorded a total of 303 incoming calls, of which 76% were answered and 24% were intentionally ignored/unanswered.

Local Context: For the 303 calls surveyed, participants reported

Table 1: Survey Data Detailing Information Collected About Call Handling Decisions (*Exact Call Reason Excluded)			
		Uncertainty of RC in CHD	Influence of RC in CHD
Caller	Caller ID	3%	92%
Caller Context	Location	50%	29%
	Activity	56%	24%
	Mood	61%	24%
	People Around	74%	20%
	Aggregate Caller Context	82%	43%
Call Content	General Call Reason	27%	59%
	Exact Call Reason	45%	45%
	Length	47%	39%
	Importance for Caller	41%	55%
	Importance for Receiver	42%	51%
	Aggregate Call Content*	66%	77%
Caller-Receiver Interaction History	Call Frequency	34%	42%
	Avg. Call Length	38%	42%
	Usual Call Time	65%	27%
	Call Reciprocity	32%	42%
	Aggregate Interaction History	72%	65%

to have received calls in a variety of settings and classified their activities as being related to work/business (12%), school/study (41%), errands (7%) and social (20%) and other (32%) which included activities such as cooking, taking a test, resting/relating. The places included being at work (14%), home (37%) and other (49%) such as eateries, outdoors, bus/car/train.

Relational Context. Table 1 summarizes the use and level of uncertainty of relational context factors at the time of call handling decisions. It is seen that apart from Caller ID, the caller context, call content, and caller-receiver interaction history, are largely unknown.

Use of Local Context and Relational Context in interruption response decision making: For 96% of the 303 calls, participants reported using relational context in call handling decisions. A breakdown of how individual relational context factors are used is provided in Table 1. For calls where local context influenced call handling decisions (87% of the 303 incoming calls), participants reported the influence as being in addition to the relational context factors, suggesting local context is rarely used in isolation.

Hypotheses Tests

Data were analyzed by regressions, t-tests and correlations. Using the GLIMMIX procedure of the SAS software for regression accounted for the lack of independence of the observations (we had 101 participants, each providing three responses which resulted in a total of 303 observations analyzed). All hypotheses were supported, except one variable in H4, as explained below.

H1: A higher Predicted Interruption Value (PIV) is associated with a greater likelihood of engaging in an interruption. **Supported:** ($F_{300}=83.60$ $p<.0001$). This suggests that the more valuable participants thought the call was, the more frequently they answered the call.

H2a: The greater the level of uncertainty about the relational context, the greater the Predicted Interruption Value (PIV). **Supported:** ($F_{297}=31.31$ $p<.0001$). This indicates that the greater the uncertainty of relational context the more valuable participants thought answering the call would be.

H2b: The greater the level of uncertainty about the relational context, the greater the likelihood of engaging in an interruption. **Supported:** ($F_{300}=37.79$ $p<.0001$). This shows that the more uncertain individuals were about the relational context the more they answered the call.

H2c: The Predicted Interruption Value (PIV) before engaging in an interruption will be higher than the interruption value perceived after engaging in an interruption. **Supported:** ($t_{303}=-8.99$ $p<.0001$; Mean before PIV= 33.29; mean after PIV=22.65). A t-test for paired samples showed that the mean perceived interruption value before receiving the call was significantly greater than the mean after engaging in the call, suggesting calls were perceived as having greater value before answering than the actual value.

H3: The influence of relational context on Interruption Handling Decisions (e.g. answering or ignoring a call) is independent from the influence of cognitive and social contexts. **Supported.** A statistically significant relationship was found between Social Context and Cognitive Context used ($\rho=.523$ $p<.001$) in terms of their influence on call handling decisions but the influence of relational context did not correlate with

either of the other two contexts, thus supporting H3. This shows that the influence of relational context is independent of the influence of social context and cognitive context on call handling decisions.

H4: The influence of relational context on call handling decision will be strongly correlated to the Predicted Interruption Value (PIV), while the influence of cognitive context and social context on call handling decision will be not be correlated to the Predicted Interruption Value (PIV).

Partially Supported: Finally, a linear regression indicated a statistically-significant relationship between relational context and PIV ($F_{295}=6.94$ $p<.0089$). While no relationship was observed between social context and PIV, an inverse relationship between cognitive context and PIV ($F_{274}=7.33$ $p<.0072$) was found. That is, the more relational context is used, the greater is the value of the call perceived, and the more cognitive context is used, the lower is the value of the call perceived, and social context did not predict the value of a call.

Qualitative Data from Semi-structured interviews

To obtain a rich descriptive understanding of our participants' call handling decision process, we interviewed 10 people from the pool of 101 survey respondents after they completed the survey. We recorded 235 minutes of semi-structured interviews that were transcribed and analyzed using interpretive principles [15], resulting in the emergence of two themes. While representative quotes (names changed for anonymity) are provided below to illustrate these themes, they also highlight important differences in the experience and perspectives of different participants within these themes.

Theme 1: Call handling decisions were influenced by predicted interruption value and uncertainty of relational context. People made call handling decisions based on how they predicted the value of a call (PIV). If PIV was deemed positive they answered the calls even when they were not open to calls given their local context. Amanda, a female graduate student, shared how she predicted the value of the call to be positive as she knew what the call was about. This made her answer a call from a colleague when she was riding the train and even though she was too tired (*local context*) to take other calls. "I knew the reason why he was calling cause we had discussed it earlier... I knew it was a very important call." In contrast, Jason, a male undergraduate student, working on his homework, was not open to calls (*local context*) and was very uncertain about what the call was about from his brother. Yet he answered the call as he perceived a positive value of the call due to the nature of his relationship with his brother. "He is close to me. that's why I answered it...." Thus, positive interruption value was often associated with important relationships or when recipients desired information from the caller.

When the PIV was not perceived as positive, people explicitly ignored the call. This was based on their local context and/or, a high level of certainty associated with the relational context such as the caller relationship or what the call was about. Amanda explains she ignored the call from an acquaintance when she was tired (*local context* indicating mood and unavailability) as she knew he "was calling just generally" which was later confirmed to be true on receiving a text from him. Similarly, Sam talked about how he ignored a call from a classmate while in the library as he did not perceive a positive value "I just had a conversation with him before, like 5 minutes ago ... and he had to leave so I didn't think it was important"

Theme 2: Respondents desired more relational context information to make informed call handling decisions. Interestingly, some respondents were surprised that even when they thought they could predict what the call was about they could easily be wrong. Bob, a graduate student, shares how a phone call from his friend turned out to be something other than what he expected “Yesterday we discussed about what kind of courses we needed to choose next semester so I think this [call] is his decision and feedback to me [but] no.... He got an allergy and he asked me if I know some pharmacy or drugstore near the campus.” Similarly, Jimmy talks about the call he picked from a friend thinking it was about not getting back to him on something “I thought he was going to be like “I was waiting for your call” and all of that but he just asked some [other] questions...so I was kind of surprised” This suggests that explicit reduction of relational context uncertainty is required to more accurately predict the value of an interruption.

Respondents expressed a desire for, and a belief in, the utility of having various kinds of relational context information. Comments such as these were very typical: “I think it's useful [Call Length] ...like yesterday if I think this call will take me one hour or 20 minutes I would not answer that.” The nature of relational information desired however varied based on the relationship with the caller as well as people's current local context. Charles, with respect to his friend said, “Subject? Honestly from Chuck it wouldn't matter but from someone else yes the subject would”. Cindy, with regards to her sister said “I basically knew everything else, so either the subject or the urgency and importance would have been helpful ...” but when it came to her mother she said “Subject would have been very helpful cause if it wasn't important I would have just not answered my phone ...[Call length] because she could have wanted to talk for hours and I didn't have the time.”

In summary, apart from providing a richer understanding of the survey findings, the interviews highlighted the desire for relational context information as its uncertainty played a role in predicting the value of a call.

5. DISCUSSION

The term ‘interruption’ tends to assume a negative connotation. Our work assessed the validity of the alternative viewpoint put forward by the Interpersonal Interruption Response Management Framework, one that takes an *a priori* neutral view on the value of interruptions, while recognizing that the interruptions resulting from interpersonal communication may be highly desired. By taking a mixed method approach we were able to 1) confirm the importance of the relational context; 2) confirm that the predicted value of an interruption determines the interruption handling decision and 3) provide important new insights into the interpersonal interruption response management process. We unpack each of these points below.

Our survey and interviews showed that participants made decisions to answer or ignore calls based not just on their local context (e.g. tired or at work). Instead, in addition to the local context they considered relational context items such as caller identity information, caller context, and call content to predict the value of an interruption to help them make call handling decisions. When not enough relational context was available, they often engaged in the call, suggesting that they found value in simply reducing the uncertainty of the relational context. Our

interviews elucidated these findings further by showing that the nature of relational context desired by people varied depending on their local context and the relationship with the caller. Survey data indicated that the favorable perception of interruption value is strongly and positively connected to answering a call (H1). This was also illustrated in our interviews where participants viewed calls from certain people to be important irrespective of their seemingly uninterruptable local context. Conversely, if people were uncertain about the call but predicted a negative PIV, they would ignore the call.

Furthermore, our findings show that under high levels of uncertainty of the relational context people answer calls (H2b). The current interface designs of cell phones do not typically provide any information more than the name and the number of the caller. Thus, engaging in a call under these circumstances is possibly to specifically evaluate what the call is about and is seen as valuable to do so – which explains why high levels of uncertainty of relational context predict positive interruption value (H2a). However, the survey data showed that the predicted interruption value before engaging in the call was significantly higher than when evaluated after engaging in the call. The interview responses showed participants could easily be wrong in predicting the reason for the call and hence evaluate it incorrectly before answering it. This highlights how the lack of relational context information hampers accurate prediction of the true value of an incoming call, thus leading to significantly higher but inaccurate predictions of the call value as compared to valuing the call while having full knowledge of what the call was about and why it was being made.

Finally, we saw that users clearly make a distinction between local context and relational context environments and their respective influences on how they predict the value of the call. The influence of local context does not correlate with the influence of *relational context* in interruption response decision making (H3). Furthermore, the influence of these contexts had varying predictions on call value (H4). The more the relational context influenced their call handling decisions, the higher they predicted the value of the call; the more cognitive context influenced the call, the lower they predicted the value of the call; and social context had no influence on value of the call. This suggests that when one is cognitively engrossed in tasks where one is predisposed to not engage in an interruption, the interruption is perceived to be of less value and that our participants cared less about their social context. Our survey participants were mostly students who reported they received the calls in places such as library, home, dorm, and travel that seem appropriate to be interrupted and very few inappropriate places such as classrooms. Thus, what really dictates the decision here is not the social space but their cognitive context. This is further elucidated in our qualitative data where we found that participants tended to answer calls even in public places (on the train). This could also be a reflection of the current social culture where people seem to care less about their social spaces in making call-handling decisions and more about how it cognitively affects them as evidenced by the number of people we see around us who are engaged in phone calls in both public and semi-public spaces.

Our findings have important design implications for communication technology. Major improvements in interruption management can be achieved by designing communication tool interfaces that reduce interruptee's uncertainty about the relational context. For example, the

current mobile phone interfaces provide little information about incoming calls and this could be enhanced by including information about the caller's context, call content, and caller-caller interaction history. Our qualitative data suggests that for non-work social relationships subject, location, importance, and call length are often desired from the caller. Advances in sensor technology, GPS and predictive analytics can make the capture and prediction of caller context such as activity and location possible without user input (such as iPhone traffic alerts to a predicted destination on getting into your car) while caller-receiver interaction history can be semi-automatically provided from recorded call history.

6. CONCLUSION

This study set out to explore the role of the local context and the relational context on interruption decision making through a mixed method study of cell phone call handling practices of 101 individuals. Through regression analysis and corroborating qualitative interviews, our data provides valuable insights and lends promise to the design of effective communication tools that could help mitigate the real-world interruption management challenge resulting from the devices that keep us connected everyday all day.

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