Interrupting or not: Exploring the effect of social context on interrupters' decision making

Rikard Harr
Department of Informatics
University of Umeå
Sweden
rikard.harr@informatik.umu.se

Victor Kaptelinin
Department of Information Science
and Media Studies
University of Bergen
Norway
victor.kaptelinin@infomedia.uib.no

ABSTRACT
In recent decades technology-induced interruptions emerged as a key object of study in HCI and CSCW research, but until recently the social dimension of interruptions has been relatively neglected. The focus of existing research on interruptions has been mostly on their direct effects on the persons whose activities are interrupted. Arguably, however, it is also necessary to take into account the "ripple effect" of interruptions, that is, indirect consequences of interruptions within the social context of an activity, to properly understand interrupting behavior and provide advanced technological support for handling interruptions. This paper reports an empirical study, in which we examine a set of facets of the social context of interruptions, which we identified in a previous conceptual analysis. The results suggest that people do take into account various facets of the social context when making decisions about whether or not it is appropriate to interrupt another person.

Author Keywords
Interruptions; social context; collaboration; interpersonal relation; physical proximity; communication.

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

General Terms
Human Factors; Design; Measurement.

INTRODUCTION
With interactive technologies becoming increasingly pervasive the interruptions caused by the technologies are becoming pervasive, as well. Understanding how interruptions happen, their effect on people and their activities, as well as possible ways to designing technological support for handling interruptions are key research questions in HCI and CSCW [4, 9, 11].

Studies of interruptions have been dealing with a range of issues, in particular: (a) the occurrence of different types of interruptions in various everyday contexts (e.g., [2, 5]), (b) effects of interruptions on interrupted activities, which effects were typically (but not always, see e.g. [15]) found negative [3, 6, 10], and (c) technological solutions, which can help prevent unwanted interruptions from taking place, as well as help users recover from interruptions if they do take place (e.g., [1, 7, 12]).

While conceptual analyses and design explorations of interruptions have undoubtedly produced a number of significant results, they are, arguably limited in the sense that they have mostly focused on the direct effects of interruptions on the persons whose activities are interrupted (that is, *interruptees*). Less attention has been paid to understanding how people decide whether or not to interrupt (that is, understanding *interrupters*). For instance, studies of availability clues, intended to minimize interruptions, are mostly concerned with how to help people provide such clues to others rather than how to utilize availability clues, that others provide.

With some exceptions (e.g. [12, 13, 14]) the social dimension of interruptions has been neglected. As we argue in a previous paper [8], the "ripple effect" of interruptions, that is, indirect consequences of interruptions within the social context of an activity, is underrepresented in existing research. We argue that it is critical to take these into account to properly understand interrupting behavior and to be able to develop advanced technological support for handling interruptions.

In our previous analysis [8] we described a variety of "ripple effects": from "collateral disruption" (the effect an interruption directed at one person may have on other people present, such as a mobile phone ringing during a concert) to "dropping the ball" (a distraction experienced by one person causes delays in activities of other participants in a collaborative activity). We also identified four relevant facets of the social context:

- *interpersonal relation* (whether or not there exist a personal relation between interrupter and interruptee),

- *location* (whether or not the interuptee is located in a context where others could be indirectly disrupted by an interruption),

- *communication* (whether or not the interruptee is involved in communication with others), and

- *collaboration* (whether or not the interruptee is involved in collaboration with others).

We argued that these facets of context are likely to have an effect on how (or if) interruptions are taking place. The aim of the present paper is to address some of the limitations of existing HCI and CSCW research into interruptions by providing empirical evidence about how/if people take social context into account when making decisions about whether to interrupt another person or not. The study seeks to find empirical evidence regarding the following questions:

- Do people take into account social context when making a decision about whether to interrupt?

- What is the relative importance of individual facets of social context when making such decisions?

GENERAL METHODOLOGICAL CONSIDERATIONS

Conducting an empirical study of how people make decisions about interrupting others presents a serious challenge from a research methodology point of view, especially if the aim of a study is to investigate a set of specific facets of social context. Direct observations in natural settings have the advantage of high external validity but are problematic because of practical and ethical constraints. Since the researcher does not have control over the social context, the specific facets of interest may never be observed within the timeframe of the study. In addition, such observations can be difficult to interpret, since the reasons why people make a decision may not be obvious for an external observer. Finally, direct observations in real life contexts can undermine participants' privacy and integrity.

Direct observations in artificial settings allow researchers to model situations, in which phenomena of interest are likely to occur. However, this method is associated with low external validity. Knowing that the situation at hand is not "real" may significantly change the decision-making process in the participants.

Therefore, an approach to studying how people make decisions regarding interruptions, especially suitable for an initial exploratory study, appears to be employing interviews and questionnaires to capture participants' opinions about, and real-life experience with, making such decisions. However, a straightforward approach, that is, simply asking the participants about their opinions and preferences may make it hard for the participants to relate their experience to issues in question.

After considering the concerns mentioned above, we have adopted *scenario-assessment* as a method for investigating the effect of different facets of social context on making decisions regarding interrupting other people. The facets used were the ones that were identified in our previous analysis. We did however decide to change the terminology for one of them from "location" to "physical proximity" as this better captures what is actually meant. We constructed a set of concrete scenarios, each describing a context in which a participant had to decide whether or not to interrupt a certain person. The contexts that we used for this purpose were tax office, bus stop, library, police station, school and accountant's office. Then we produced several variations of each scenario by systematically emphasizing or de-emphasizing certain facets of social context. The participants were asked to assess the probability of trying to establish interaction in the contexts described by each of the variations.

METHOD

Participants
Twenty-five undergraduate students at a Swedish university, 16 males and 9 females, between 21 and 46 years old (average age of 26), fluent English speakers, took part in the study.

Materials
The materials used in the study comprised sets of *assessment scenarios*, each scenario shown on a separate sheet of paper. In every scenario an imaginary context was first described, in which one person was supposed to interrupt another. Then four different additional conditions were listed. The conditions represented four possible combinations of two context facets, each of which could be expressed at two different levels, High vs. Low. For instance, the person to be interrupted could be a personal acquaintance (high level of personal relationship) or stranger (low level of personal relationship), and he or she could be engaged in a collaborative activity with other people (high level of collaboration) or apparently working alone (low level of collaboration). The participants were asked to assess each of the four conditions by assigning a percentage describing the estimated probability, with which they would interrupt the person described in the scenario.

By systematically combining six different conditions (all possible combinations of 4 context facets) and 6 types of context we produced a pool of 36 assessment scenarios. During the study each participant was presented with a set of 6 assessment scenarios. These sets were constructed so that all 36 scenarios were assessed during the study as a whole. The order of 6 combinations of context facets was balanced by using a 6x6 Latin Square design.

Procedure

Copies of assessment scenario sets were printed, sorted, and stapled, to ensure the correct presentation order. Sets were given to students, who were manually filling in the printed copies when sitting in a classroom. One of the authors was present throughout the procedure.

Analysis

The procedure of analyzing the data included the following steps. A table of the 36 scenarios was created, each respondent's estimation of the probability of interrupting under the four conditions filled in and the average values for all respondents calculated. As a final step various calculations were made to look for relative importance of the four facets. An important part of this last step was to rank the weight of difference facets. As all four facets were compared against each other in different scenarios by the creation of different conditions (high vs. low, low vs. high etc.) they could easily be ranked through a grading process. If the average value of making an interruption under the condition that physical proximity is high and interpersonal relation is low exceeds the average value for the opposite, then physical proximity has more weight than interpersonal relation. As all facets were tested against each other, their weights were measured by giving them a value for every time they were considered superior and when summarizing all values the relative weight of all facets were established.

RESULTS

The results show that respondents do take the social context into consideration when deciding whether or not to interrupt another person. In all 36 scenarios it is shown that respondents estimate the probability of making an interruptions as lower if there exist no previous relation, the interruptee is located in a context where others could be disturbed by an interruption, or is involved in communication or collaboration with others. The difference, for all scenarios, between the condition where the facets are assumed to speak in favor of an interruption (i.e. when an interpersonal relation exists, there are few or no bystanders that could be disturbed and the interruptee is not involved in any communication or collaboration) and the opposite, ranges from 47% to 63%.

The degree of influence that the social context has on a decision about whether or not to interrupt does however differ between scenarios and combinations of facets. A scenario that takes place in an accountant's office where the facets interpersonal relation and physical proximity (of other people) are combined in four different conditions shows the largest difference between estimated probabilities of interruption for different conditions (89%). More specifically, according to estimations of the probability of making an interruption, it is 89% more likely that an interruption would occur under the condition that there exist a previous relation and there are

no other people on the scene, than if it were the other way around. The scenario that showed the lowest difference in estimated probability of making an interruption between different conditions is the one that takes place in a tax office and the facets of communication and physical proximity are combined. In that case there was a difference, but as low as $\approx 13\%$. When comparing the estimated probability of making an interruption under the same conditions but in different scenarios it becomes evident that although the estimations are consistent, the range in percentage varies. When, for example, a combination of interpersonal relation and involvement in communication is assessed in the "bus stop" scenario and the "library" one, the difference is as high as 47,8%.

The design of the study ensured that all facets were combined and tested in all conditions, which allows us to make inferences about facets that have more weight than the others. The results show that physical proximity is the facet with most weight (i.e. if there are other people nearby that could be disturbed by the interruption), an interruptee's involvement in communication the second, interpersonal relation the third and interruptees' involvement in collaboration the least dominant. Worth mentioning is however that the difference between physical proximity and communication is only $\approx 13\%$.

Other interesting results are that in some scenarios the strength relationships between different facets differ from the overall pattern presented above. For example in the tax office scenario the interruptee's involvement in collaboration with others, even if with a small margin, outweigh an existing previous relation (with 1,7%), or in the scenario that takes place at a school where involvement in communication outweigh physical proximity (with 6%).

DISCUSSION

This paper continues our previous work on social dimensions of interruptions (see [8]) by presenting empirical evidence of their existence and importance. It complements work on interruptions by showing how people take social contexts into consideration before interrupting others and also by comparing the level of influence of different facets of these dimensions. Exploring interruptions from the perspective of the interrupter, and not only the interruptee, is, in our opinion, a necessary step towards an improved understanding of the phenomena and developing more advanced technological support for interruption handling.

One of the main challenges for HCI and CSCW research into interruptions is finding novel technological solutions that would simultaneously address different, potentially conflicting concerns. On the one hand, the more information about interruptee's current social context is provided to the interrupter, the easier it is for the latter to decide whether or not to interrupt. On the other hand,

providing such information may undermine interruptee's privacy. Understanding how exactly people make interruption decisions can help identify ways to balance these concerns, that is, provide enough information to make a decision without revealing too much. The findings of the study reported in this paper allow us to make to some tentative conclusions about the facets of social context taken into account when making decisions about interruptions.

Even though the study only included a limited number of respondents, the results suggest, in each and every scenario, that people are more likely to make an interruption if there is a previous personal relationship, there is little risk for disturbing other people except the interruptee, and that the interruptee is not involved in communication or collaboration with others. Although there are some exceptions in some scenarios, the overall picture shows how some facets are considered as more important to take into consideration before making an interruption than others. As mentioned above, whether or not there are other people around that might be disturbed by an interruption is experienced as more important than the other investigated facets. Worth mentioning however is that the facet that was shown to be least influential, involvement in collaboration, still had a significant impact on the estimated probability of initiating an interruption by the respondents.

Another important observation is that different contexts (e.g. a police station, library or tax office) have a clear effect on the estimated probability of making interruptions under similar conditions. This could be caused by how the scenarios were described, but it is also likely that respondents co-created the scenarios by adding their own experiences, norms and understandings to these descriptions. This could at least partly explain individual differences found in the empirical data, differences that are partly hidden as a result of our analysis.

Even though it is tempting to consider immediate implications of the findings presented in this paper for design and evaluation of interactive technologies, much more work is needed. It should be established whether the findings could be generalized to a wider population, as well as to technology-mediated communication and collaboration. We are preparing to conduct another set of scenario-assessments to include additional scenarios and a far higher number of respondents with more diverse characteristics in terms of occupation and age. This will further improve the validity of our claims regarding social contexts and interruptions.

REFERENCES

1. Altmann E. M., and Trafton J. G. Task interruption: Resumption lag and the role of cues. In *Proc. CogSci 2004*, Lawrence Erlbaum Associates (2004), 43-48.

2. Ammons S. K., and Markham W. T. Working at home: Experiences of skilled white collar workers, *Sociological Spectrum, 24*, 2 (2004), 191-238.

3. Bailey, B. P., Konstan, J. A., and Carlis, J. V. The effects of interruptions on task performance, annoyance, and anxiety in the user interface. In *Proc. INTERACT 2001*, IOS Press (2001), 593-601.

4. Burmistrov, I. and Leonova, A. Do interrupted users work faster or slower? The micro-analysis of computerized text editing task. In *Proc. of HCI International 2003*, Lawrence Erlbaum Associates (2003), 621-625.

5. Czerwinski, M., Horvitz, E., and Wilhite, S. A diary study of task switching and interruptions. In *Proc. CHI 2004*, ACM Press (2004), 175-182.

6. Dodhia, R. M., and Dismukes, R. K. Interruptions create prospective memory tasks. *Applied Cognitive Psychology, 23,* 1 (2009), 73-89.

7. Hameed, S., Ferris, T., Jayaraman, S., and Sarter, N. Using informative peripheral visual and tactile cues to support task and interruption management. *Human Factors, 51*, 2 (2009), 126-135.

8. Harr, R., and Kaptelinin, V. Unpacking the Social Dimension of External Interruptions. In *Proc. GROUP 2007*, ACM Press (2007), 399-408.

9. Iqbal, S. T. and Bailey, B. P. Oasis: A framework for linking notification delivery to the perceptual structure of goal-directed tasks. *ACM Transactions on Computer-Human Interaction (TOCHI), 17*, 4 (2010), 1-28.

10. Mark, G., Gudith, D., and Klocke, U. The cost of interrupted work: More speed and stress. In *Proc. CHI 2008*, ACM Press (2008), 107-110.

11. Perlow, L. The time famine: Toward a sociology of work time. *Administrative Science Quarterly, 44*, 1 (1999), 57-81.

12. Petersen, S. A., Cassens, J., Kofod-Petersen, A., and Divitini, M. To be or not to be aware: Reducing interruptions in pervasive awareness systems. In *Proc. UBICOMM 2008*, IEEE Computer Society (2008), 327-332.

13. Ritterskamp, C. The Collaborative Nature of Interruption Handling. In *Proc. HICSS 2011*, IEEE Computer Society (2011), 1-10.

14. Tolmie, P., Crabtree, A., Rodden, T., and Benford, S. "Are You Watching This Film or What?" Interruption and the Juggling of Cohorts. *In Proc. CSCW 2008*, ACM Press (2008), 257-266.

15. Zijlstra, F. R. H., Roe, R. A., Leonova, A. B., and Krediet, I. Temporal factors in mental work: Effects of interrupted activities. *Journal of Occupational and Organizational Psychology, 72*, 2 (1999), 163-185.