DESIGNING FOR SOCIAL AWARENESS OF COOPERATIVE ACTIVITIES

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Abstract: Mechanisms supporting a shared representation of activities—or *awareness*—within a group of people are an important prerequisite for successful computer supported cooperative activities. This article highlights the design of awareness mechanisms from a social psychological viewpoint of human behaviour in and within groups. Based on this, *design guidelines* for awareness functions supporting cooperative activities—with an emphasis on promoting social awareness—are proposed and evaluated empirically. Results show that users' awareness was influenced positively as predicted by the design guidelines.

1 INTRODUCTION

For cooperative activities to take place, the people involved need to develop a shared understanding of the context that they are cooperating in and the tasks that they are working on. In face-to-face interaction this is an implicit process, which is commonly supported by nonverbal communication. Tools supporting cooperative activities need to provide for mechanisms enabling this kind of *awareness* in computer-supported interaction as well: "Awareness is an understanding of the activities of others, which provides a context for your own activities" (Dourish & Bellotti, 1992).

Cooperative activities are necessarily social activities. Research focusing on computer supported cooperative learning (CSCL) or work (CSCW) generally stresses the meaning of social processes influencing the shared representations and generation of knowledge, drawing especially on social constructivist theories, e.g. Koschmann (1996). However, long-known, 'classical' social psychological findings and theories providing a plethora of insights into interaction within and between groups have been barely drawn upon to inform the design of cooperative systems (Janneck, 2007).

To start filling this gap, this article highlights the design of awareness mechanisms from a *social psychological viewpoint* and develops *design guidelines* for awareness functions supporting cooperative activities, with an emphasis on promoting *social awareness*.

To put these design guidelines to a first empirical test, several simple awareness functions were added to an existing groupware system and evaluated by means of an experimental design comparing both subjective and objective awareness measures in a field test before and after the new awareness functionalities had been implemented. Results show that users' awareness was influenced positively as predicted by the design guidelines.

This article is structured as follows: Section 2 discusses social issues in cooperative activities, drawing on 'classical' social psychological research on group structures, relations, and dynamics as basis for the design of awareness mechanisms. Section 3 describes related work regarding the representation of social activities in computer-supported interaction. Section 4 introduces design guidelines for implementing social awareness support based on the concepts discussed in section 2. In section 5, an empirical implementation and evaluation of these design guidelines is described. Section 6 concludes this article with a discussion of the results and an outline for future work.

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2 SOCIAL ISSUES IN COOPERATIVE ACTIVITIES

In the following paragraphs, two aspects influencing group work are presented exemplarily. In section 4, they will be related to the design for social awareness in computer-supported cooperative learning and working groups.

2.1 Group Structures and Relations

It is a long-known fact that structures and relations within groups heavily influence the group's success concerning cooperative activities (e.g. Blake & Mouton, 1964; Herzberg et al., 1959).

Centralized structures of communication, dominated by single individuals, threaten to discourage other group members, thus lowering group productivity. On the other hand, structures enabling equal contributions and self-dependent work of all members yield better results (Leavitt, 1951).

Of course, favourable group structures and relations, which are conducive to productive cooperation, cannot be established or even enforced through software support. However, software design can facilitate or impede on cooperation. Awareness mechanisms can serve to make group structures transparent.

2.2 Social Loafing

Group members who benefit from other members' efforts while contributing little themselves are known as *social loafers* (e.g. Latane et al., 1979). In computer-mediated communication, social loafing is often referred to as *lurking*, addressing the problem of the passiveness of—usually—the vast majority of users, while only a small number of participants contribute actively (e.g. Nonnecke & Preece, 2000).

However, Takahashi et al. (2003) report that many of the alleged lurkers nevertheless made a substantial contribution to offline communication in their company by using and actively spreading information they obtained from the intranet.

Exchanging and gathering information online are typical activities in computer-supported cooperation. Quite naturally, though, downloading data from e.g. a shared workspace will leave less traces of activity than lively online discussions. Making this kind of 'passivity'—which might result in activity elsewhere—more visible can be supported by awareness mechanisms.

Social loafing occurs most often when people get the impression that their contribution is unidentifiable or redundant regarding the overall result, so that their lack of contribution will go unnoticed or remain without consequences. Social loafing is reduced when group members take on responsibility for the group result, and when their individual contributions are clear. Awareness mechanisms serve to make individual activities visible.

3 REPRESENTING SOCIAL ACTIVITY

Typical awareness mechanisms include *notifications* of events or changes and *tracking mechanisms* of people's presence ("who is online?") and actions within the shared workspace.

Many cooperative systems support mainly *awareness of tasks* that are worked on within the group (e.g., notification of changes that were made to a document).

The representation of *social activities*—or social awareness—that are often manifested in cursory interactions, leaving no visible or tangible trace (comparable to 'coffee breaks' in face-to-face interactions), is more of a challenge to systems design, meaning to make 'invisible' actions (e.g., browsing the workspace and reading entries) more visible. In the following paragraphs some approaches and examples of representing social activity are portrayed.

The *social navigation* approach aims at enabling users to find relevant information by interpreting traces that other users left behind (Dieberger et al., 2000), thus conveying the history of digital objects (Wexelblat, 1998). However, so far use scenarios for social navigation have been mainly explored in the context of individual navigation through web resources (e.g. customer recommendations—"customers who bought this book also bought…"—or feedback comments on platforms such as ebay.com or amazon.com) and less in the area of cooperative activity.

Erickson & Kellog (2000) call systems that make socially meaningful clues visible *socially translucent*. So-called *social proxies* intend to give an abstract, minimalist representation of real-world activities (Erickson et al., 2002). For example, the communication platform *Babble* (Erickson et al., 2002) portrays chat partners as coloured dots within a circle, moving to the centre when they converse

actively and back to the border when inactive. The audio conferencing system *Talking in Circles* (Rodenstein & Donath, 2000) uses graphical representations of users to show who is participating in conversations: Participants, represented as coloured circles, need to be within 'hearing distance' of a speaker to be able to receive the audio transmission. This way, parallel conversations are possible while making visible who is talking and who is participating in the conversation.

Perry & Donath (2004) use *anthropomorphic representations* to display users' activity in e.g. discussion forums over a longer period of time. These 'stick-figures' look bigger and brighter when the users they represent participate actively, and fade as activity ceases. The number of postings is depicted as small boxes in the figures' 'bellies', and their facial expressions give some insight into the emotional tone of the users' contributions, interpreting emotional keywords in the texts. However, Perry & Donath (2004) admit that users might feel their representations to be wrong, misleading, or even caricatured, resulting in efforts to manipulate their 'stick-figure' by writing compensatory yet senseless postings.

PeopleGarden (Donath, 2002) depicts message board members as flowers, growing and flourishing according to their activity. A message board whose members show low activity will look like a neglected garden with only few and dispersed plants. An active group will be represented as a prosperous garden with a variety of blooming flowers.

Social proxies like PeopleGarden (Donath, 2002) or anthropomorphic representations (Perry & Donath, 2004) deliberately use emotionally appealing and evocative visualizations of social activities, in contrast to more neutral representations (e.g. Erickson et al., 2002 or Rodenstein & Donath, 2000). However, Donath (2002) argues that completely neutral visualizations are never possible anyway, because social activities always evoke judgments on the side of the people involved. Therefore design decisions should explicitly involve knowledge of social processes.

4 GUIDELINES FOR DESIGNING FOR SOCIAL AWARENESS OF COOPERATIVE ACTIVITIES

The social psychological concepts presented in section 2 can be used to evaluate existing approaches of visualizing social activities (section 3) and develop new ideas for designing awareness mechanisms in cooperative systems. In the following paragraphs, this is done in the form of proposals, drawing on the issues of group structures and relations and social loafing.

4.1 Group Structures and Relations

1. *Enable control*: Visualizing social activities within a shared workspace is vital for conveying a sense of social structures and relations. However, people need to retain some control over which of their activities are made visible for other members—and how this is done—to keep their autonomy in use. Making transparent for users how their actions are being visualized helps them to avoid that information they want to keep private is made public.

2. *No customization*: For the reason of transparency, awareness functions should not be customizable.

3. *No automatic interpretations*: Social activities and emotions should be recognizable, but not be interpreted by the software, for this affects users' control and self-management in a very sensible area. This is an argument against deducing emotional states from e.g. the text of postings (like this is done by Perry & Donath, 2004) or even forecasting future user behaviour (cf. Hoffmann & Herrmann, n.d.). In automatically interpreting emotional states, a system suggests emotional competencies and meta-knowledge concerning the social structure of a group, which cannot be sensibly assumed. Erickson (2003) states concisely: "Portray actions, not interpretation".

4. *Do not judge actions*: For the same reason, judgmental visualizations should be seen critically despite the liveliness they undoubtedly convey. Emotionally appealing visualizations like a withering garden or a wimpy and pale stick-figure bear the danger of having a discouraging or offending effect on users and hindering rather than promoting further use in the sense of a *self-fulfilling prophecy* (Merton, 1982). Furthermore, it is problematic that the respective context cannot be taken into account: Groups may differ regarding the number and frequency of postings because they have different conventions and motives for use, but still feel a similar quality of interaction. This is also true regarding individual users: An apparently less active user might simply use more effective strategies when navigating or searching for information (cf. Pape et al., 2005).

4.2 Social Loafing

5. *Make the invisible visible*: Making 'passive' user behaviour—like read access—more visible is important to reflect its significance for cooperation. This is a challenge especially for asynchronous tools, because visualizations of users' current presence within the workspace—conveying a simple and fast impression of other users' presence—are not useful here. Detailed, personalized navigational and activity histories tend to take up much time, screen space, and attention, especially in larger groups. Furthermore, detailed activity accounts conflict with privacy and control issues. Instead, to enable users to grasp activities quickly and intuitively,

6. *aggregate sensible and read access information*: Instead of giving detailed and personalized records of activity, it is recommendable to visualize potentially sensible and read access information in an aggregated form (e.g., "10 of 35 people logged on last week" or "3 of 6 people have accessed this posting"). Abstract or visual representations help to grasp the information without much cognitive load (compared to text-based information). However, the visualization should be non-judgmental and neutral.

7. *No anonymous action*: in contrast to passive participation, active contributions—i.e., write access—should be clearly traceable and attributable to the respective authors to encourage personal responsibility and avoid social loafing. This implies that anonymous interaction is not recommendable in cooperative activities.

8. *Be careful with notifications*: Considering the danger of social loafing and taking into account that 'passive' behaviour like reading other postings, downloading files, or simply browsing the shared workspace for information are significant activities that should be visible for the group, notifications have to be seen critically. There is a danger that users develop a reactive rather than an active mode of usage: If usage is mainly triggered by the system, users will visit the workspace not because of personal motivation, but because they expect an 'incentive' (i.e., new information). Furthermore, this devaluates passive forms of participation, which will not cause any notification. It also brings about a selective perception of group activities, particularly as notifications usually need to be customizable to prevent information overload. This has to be weighed against the convenience of being informed of new postings in a quick and timesaving way.

5 DESIGN AND EVALUATION OF AN ENHANCED AWARENESS SUPPORT

The design guidelines presented in the last section were put to the test by designing and implementing additional awareness functionalities for an existing groupware system that showed a lack of support of social awareness in empirical evaluations (Janneck, 2007). The new awareness functions were evaluated by means of an experimental design comparing both subjective and objective awareness measures in a field test before and after the new awareness functionalities had been implemented. In the following sections, the software, the new awareness features, and evaluation results are presented.

5.1 CommSy

The software that was used as a basis is *CommSy*, a web-based system to support group work, which is used mainly at universities, schools, but also at the workplace. A detailed description is given e.g. by Pape et al. (2002). People work together in shared workspaces, so-called *project workspaces*, providing upload and cooperative editing possibilities, a shared calendar, discussion forums, to-do lists, a billboard etc.

CommSy's design principles emphasize the social aspects of groupware use, such as negotiation of usage rules and group responsibilities. These principles are reflected in design features such as shared editing rights pertaining to almost all entries in the system, no customization, and equal access rights.

Furthermore, the CommSy designers object to autonomous and interpretative system functions. For that reason they were also sceptical of awareness functions, which they viewed as system interpretations of user actions.

However, empirical investigations with a large user basis (over 1500 people using the system on a regular basis were surveyed over several years, Janneck, 2007) showed that the users suffered from a lack of social awareness: Users did not leave any traces within the system unless they actively decided to do so. 'Passive' participation like downloading information or reading each other's contributions was just not visible in the system, even though this was the main use pattern in most use contexts of use. As a consequence, especially the more active users experienced frustration because they felt that their contributions were not being perceived at all.

Therefore it was decided in conjunction with this study to add minor awareness functions that were in accordance with the main CommSy design principles.

5.2 Designing Awareness Functions

The CommSy design already addresses some of the guidelines presented in section 4, such as avoiding customization and notifications and also permitting no anonymous entries. The design requirements for the awareness functionalities can be summarized as follows, answering the three central questions posed by Gutwin & Greenberg (1999):

1. What information should be gathered and displayed to the group?
It is necessary to visualize how contributions are received within a group of users working together. This especially applies to read access information, since written contributions are imminently visible.

2. How should this information be presented?
To enable transparency and shared group awareness in accordance with the CommSy design principles, awareness information must be equally accessible for all group members. To avoid control over individual participation, there should be no personalized access information. Judgemental visualizations should be avoided, preferring abstract illustrations.

3. When, and for what activities, are the different kinds of information important?
Since CommSy was developed to support mainly asynchronous cooperation, awareness functions should display past rather than current actions. The group's interaction rhythm (i.e., how often are members expected to use the system) or important milestones of cooperation (e.g. changes on a document) might serve as reference points.

Based on these requirements, two visualizations of read access information were designed: An *activity display* on the workspace home page and detailed access information for every item in the project room.

Activity Display on the Home Page. The workspace home page already provides an overview of the latest group activities. It can be configured to display all items that were posted or changed within an adjustable time span (e.g. during the last 7 days). Therefore, a glance on the home page is sufficient to gather the latest information from the group instead of having to browse the whole workspace.

In addition, awareness functions conveying an impression of social presence and general level of activity were integrated into the home page. The following information was used (Figure 1):

- The *number of group members who have logged on* within the time span set for the home page to show how many people currently participate in the group work,
- the *read access level* (i.e., the number of page impressions) within this time span to give an impression of the activity level within the project room which can also be compared over time,
- and, contrasting, the *write access level* (i.e., the number of posts) to show that the (possibly) frustratingly low level of active posting is accompanied by a much higher level of "passive" participation, which is equally vital for cooperation but often remains invisible.

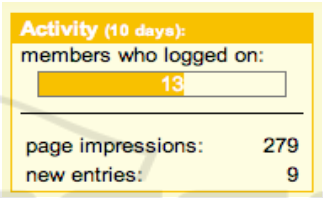

Figure 1: Activity Display on Project Room Home Page.

Detailed Access Information. As evaluation results showed, CommSy users—especially active users—feel uncertain regarding the questions of if and how their postings will be received by other group members and if changes they make will be recognized in time. To address this uncertainty detailed access information was added for each posting, showing the overall number of group members that have viewed this particular entry and also the number of people who visited this page after it has been edited. It is visualized by a bar showing the percentage of project room members who called on this item (Figure 2).

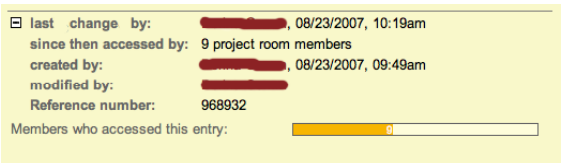

Figure 2: Detailed access information for one posting.

A personalized read access history (as it is provided by many groupware systems) was avoided in accordance with the design guidelines presented in section 4 to prevent misuse as control instrument.

5.3 Evaluation

The awareness mechanisms described above were evaluated by means of a user questionnaire, measuring social awareness. Results were compared with data gathered before the awareness mechanisms had been implemented to test for an increase of social awareness.

560 users filled out the pre-awareness questionnaire, 460 answered the post-awareness survey. Respondents used CommSy mainly in Higher Education contexts. They reflected on use periods of 3-6 months (typically one semester). Project workspaces were made up of groups with an average of 25 members.

5.3.1 Subjective Assessment of Usefulness

Respondents were asked to rate the usefulness of the new awareness information on four-category Likert scales, with positive results: Approximately 60%, respectively, agreed that the activity display on the home page and also the detailed access information had proven useful.

This was especially true for participants regarding themselves as more active than average, with approximately 70% positive evaluations in this user group.

To investigate differences between more active and more passive users, Mann-Whitney-U-tests were calculated for intergroup comparisons. Both users posting a more-than-average amount of entries or considering themselves as more active than average rated the awareness mechanisms significantly better than users who behaved more passively ($p<0.05$).

This is also true for teachers (or moderators of project workspaces, respectively) compared to students/participants ($p=0.000$).

These results reflect the uncertainty of especially active users regarding the reception of their postings, which was already mentioned above. The especially positive evaluation of the awareness mechanisms in this user group provides evidence that the awareness functions alleviate these difficulties and thus encourage active use.

5.3.2 Comparison of Pre- and Post-Awareness Measures

Apart from subjective evaluations it was measured if and to what extent the awareness mechanisms had a positive impact on the perception of social awareness and the level of cooperation. For that purpose pre-awareness and post-awareness survey results were compared.

Both questionnaires asked users to rate their level of agreement to the following statements:

I have a good overview of group activities within the project workspace.

The majority of workspace members participate regularly.

The underlying hypotheses were that both overview of group activities (H1) and perception of participation (H2) would be increased after the awareness mechanisms were introduced because "passive" participation would become more visible. There were no differences in actual participation levels in the pre- and post-awareness condition.

Concerning workspace overview (H1) the hypothesis was instantly confirmed: Users in the post-awareness condition rated their perception of group activities significantly better than users in the pre-awareness condition ($p=0.000$). Active and passive users do not show any differences in their ratings.

Judgements of participation (H2) are more hesitant at first sight: Pre- and post-awareness comparison misses significance by a narrow margin ($p=0.058$). However, looking at the more active users only, participation is rated significantly higher in the post-awareness condition ($p=0.008$). Again, this is evidence for the importance of visualizing read access, or "passive" participation: The affirmation that other members perceived their postings has a positive effect on the active members.

This positive effect was also measured within a second, much larger group of users: Those respondents giving an overall positive evaluation of CommSy as support for group work (85% of respondents) also rated participation significantly higher in the post-awareness condition ($p=0.008$). This is not surprising: Users evaluating CommSy as inadequate generally give lower ratings of the software design and functionality (Janneck 2007). However, results of past surveys show that bad evaluations are mostly due to an insufficient match of software and use context or insufficient introduction and support.

The pre- and post-awareness samples do not differ regarding neither individual characteristics (age, sex, use context, activity and participation, frequency of use, experience regarding CommSy use etc.) nor characteristics of system use or general evaluation of CommSy functions. Respective results have been stable across several years (Janneck, 2007).

Since apart from implementing the awareness mechanisms described above there were no changes

of the CommSy interface or functionality, it is feasible to assume that the increase in social awareness is actually due to the awareness functions.

6 CONCLUSIONS AND FUTURE WORK

When people work together, the social dynamics within the group necessarily impact on the outcome and success of cooperative activities. For decades, social psychology has studied interaction within and between groups. This paper showed exemplarily how these findings can be drawn upon to inform the design of cooperative systems, focusing on supporting social awareness in cooperative activities. An empirical study was conducted to investigate the effects that newly implemented awareness functions—designed according to the guidelines presented here—had on social awareness within groups using the groupware system CommSy.

To sum up results, the new awareness mechanisms were evaluated positively by the users and also led to significantly improved social awareness as compared to the pre-awareness condition: Users feel better informed about group activities, and the vast majority also perceive the general activity level to be higher after the awareness mechanisms were introduced, even though there were no changes in actual participation rates.

This is substantial evidence that "passive" participation, i.e. read access, is crucial for cooperative activities and should be made visible by the software, as outlined in the awareness guidelines in section 4. Especially active users with many posts benefit from the feedback they receive through such mechanisms.

Awareness functions naturally cannot increase individual participation or create incentives for use not otherwise provided. However, this study shows that meaningful awareness mechanisms—sensefully balancing collective information needs and individual concerns of privacy and control—influence the perception of cooperation positively, since they reveal group members' commitment, efforts and activities that are often invisible in cooperation.

It is especially remarkable that even adding such sparse awareness features as it was done with CommSy in this study yielded such clear effects: Not only did the new awareness features lead to an improvement of social awareness—in another study comparing CommSy and the CSCW system BSCW (http://public.bscw.de/en/index.html, e.g. Klöckner, 2002), CommSy received significantly better ratings of awareness support even though BSCW provides much more awareness functions (Wolfhagen, 2006).

Especially the very detailed, personalized read-access information provided by BSCW (showing for each post when it was accessed by what users) raised fears regarding misuse and control and was rejected by the users. Equally, BSCW's extensive automatic notification functions—informing users e.g. when items are posted or changed—did not result in improved awareness compared to CommSy: In spite of notifications, BSCW users felt significantly more often that they unnecessarily called on the shared workspace.

Independent from the results of this study, Wolfhagen (2006) concludes that the "sparse and specific" use of awareness mechanisms in CommSy is more adequate than BSCW's extensive awareness repertoire which might lead to counterproductive "awareness overkill".

Thus, the awareness guidelines presented here—alerting designers to refrain from massive, personalized awareness information and also cautioning against the use of notification mechanisms—could be substantiated in an independent study.

Moreover, another analysis (Janneck, 2007) showed that analyzing CommSy by means of the design guidelines with regard to awareness support lead to similar results concerning the software's strengths and weaknesses as empirical investigations—another evidence for guideline's suitability for analysis and design.

Of course, further empirical tests are needed exploring the consequences of different design decisions with different groupware systems. There are three possible strategies:

1) Analyzing existing software by means of the guidelines and comparing the results with empirical data, as this was done for CommSy (Janneck 2007),
2) comparing use patterns of systems that took different design approaches regarding awareness support (as it was done by Wolfhagen (2006) for CommSy and BSCW), and
3) evaluating prototypical implementations of awareness mechanisms explicitly following the guidelines and their effects on group interaction, as it was done for CommSy in this study.

However, especially with software that is used in real-life contexts by real users and not under test or

laboratory conditions, it will always be difficult to "prove" that certain effects that could be measured were caused by specific singular design decisions: The factors influencing quality, success, and perception of software use are manifold and complex, especially in cooperative settings. Therefore, a triangulation approach as it was sketched above seems the most promising in this regard.

The theoretical basis drawn upon in this study focused on the two areas of group structures and relations and social loafing. In addition, other social psychological concepts need to be explored. The theory of *Social Identity* explaining intergroup relations and their effects on group identification, adherence, and motivation seems especially promising in this respect (Rohde et al., 2004).

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