Group Reactions to Visual Feedback Tools

Joan Morris DiMicco[1] and Walter Bender[2]

[1] IBM T.J. Watson Research Center, 1 Rogers St., Cambridge, MA 02142 USA
[2] MIT Media Lab, 20 Ames St., Cambridge, MA 02139 USA
joan.dimicco@us.ibm.com, walter@media.mit.edu

Abstract. This paper presents findings on how individuals respond to receiving feedback on their participation levels during meetings. Comparing in-lab and natural group settings, repeated use, and differing information displays, we found that individuals vary on how useful and informative they found the feedback. Their ratings were most influenced by how the tool was first introduced to them and whether or not there was redundancy in the feedback.

Keywords: Behavior feedback, face-to-face interaction, computer-supported cooperative work.

1 Introduction

Organizations use groups for making decisions rather than individuals because, by pooling skills, intellectual abilities, and information sources, groups have the ability to make higher quality decisions than individuals working alone. However, group interactions are often complicated by social factors preventing them from realizing their potential [1]. To address this issue, our research has been focused on developing behavior feedback tools that assist groups in realizing their over-reliance on dominant viewpoints in a discussion [2, 3]. We believe that if a group becomes aware of extreme imbalances in its turn-taking and participation, it can assess and determine the best method for correcting its own processes. Towards testing this belief, we developed an application called Second Messenger that reveals information about the ongoing social dynamics within face-to-face groups through social visualizations of speaking patterns and frequencies.

While our central interest has been determining if feedback tools do in fact assist groups in changing their behavior [2], the reality is that if these tools are to be integrated into organizations and used to change real-world decision-making processes, it is critical that we also understand how individuals feel in response to the feedback tools being present. Specifically we want to know if individuals consciously use the feedback made available, if they believe the information provided is informative, if they find the tools useful for their tasks, and perhaps most importantly, how willing they are to incorporate them into their real-world group interactions.

To answer these questions, we ran two studies, one in the lab and one in the field, in order to understand user responses and how they varied across different situations. Our studies found consistent results across user groups and when the results are taken

Y. de Kort et al. (Eds.): PERSUASIVE 2007, LNCS 4744, pp. 132–143, 2007.

as a whole, they provide insight into the factors that most influence perceptions of feedback technology.

This paper begins with a brief background on group decision-making research, an overview our system used to provide feedback to groups about their behavior, and a discussion of related work. Then we present the design and results of our two studies. Our results will show that under all conditions individuals were comfortable with the information shown to the group and found the tools to be more informative and useful, when their purpose was explained. What differed across the conditions was that groups exposed to multiple types of tools found the tools less informative on subsequent uses, and the most useful tool was the one that was provided after a meeting and showed the most detail, as compared with a simpler, during-meeting tool.

2 Background

The reason we suggest behavior feedback tools may assist face-to-face interactions is that group decision-making is fraught with complications. Social psychologists have demonstrated that when groups have decision-making discussions, it is highly likely that they will inadequately share information relevant to the decision [4, 5]. Instead, a group will likely spend its time discussing initial reactions to the decision, to the detriment of considering options suggested later in the discussion [1, 6-8]. And through the process of discussing the prevailing viewpoint, individuals in the group will likely become more strongly committed to their initial inclination [9, 10]. Each of these systematic flaws increases the likelihood that groups will make strong commitments to flawed decisions.

There are different ways of combating this problem, yet the prevailing conclusion is that if groups welcome the consideration of multiple viewpoints and minority opinions into their discussions, information sharing and decision-making will improve [4, 5, 10].

One metric for measuring individual contribution to a group collaboration is to measure the amount of time a person speaks during a discussion, because imbalances between individual contributions can signal that a group is overly relying on the opinions of the most vocal members. As discussed by Weisband, Schneider and Connolly [11], individuals use cues such as social status and physical appearance to form expectations about how much someone will contribute to a discussion, and these expectations actually provide people the opportunities to speak and influence the decision-making process. Studies have shown that individuals with higher social status, yet lower amounts of information to contribute, often speak more and have more influences on final outcomes, than those who speak less [12]. The implication of this finding is that because those who speak the most have more influence on group outcomes, they can draw the group towards their preferred decision outcome, to the detriment of considering other options [1]. While equal participation will not solve the challenges of group collaboration, when there are process flaws, correcting extreme inequality in individual contribution is one mechanism that may rebalance the amount of influence each individual has on the decision outcome.

3 Second Messenger

Second Messenger, our platform for providing feedback to groups, allows for visual displays of participation levels and turn-taking patterns to be shown either during face-to-face meetings or afterwards in the form of a visual replay. By highlighting extreme imbalances, Second Messenger is designed to give feedback to groups which will persuade them to change and improve their decision-making processes.

The system collects group speaking patterns by requiring each person using the system to wear a noise-canceling microphone that detects when he or she is speaking. The application aggregates time-stamped moments of individual speech to create a record of who spoke when in a meeting and uses this log to create visualizations, to be viewed either real-time or post-interaction.

In our first exploration [3], we presented participation information to groups in the form of a histogram, projected off to the side of a room during a 15-minute discussion, as shown in Figure 1. The groups in this experiment were given no explanation as to the purpose of the display and were instructed to use it as they wished. In response to this arrangement, survey responses from the 48 subjects indicate that individuals did not find the display distracting and that they did not find it very useful for the task or informative about the group. The average usefulness rating was 2.69 (std err 0.24) and the average rating for informative was 3.09 (std err 0.27), both on a scale of 1 to 7.

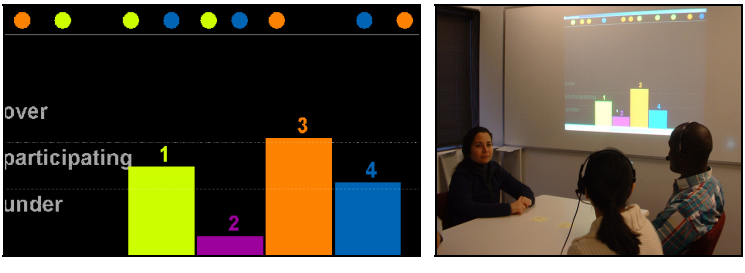


Fig. 1. Histogram display screenshot and shown projected onto wall

In our next iteration on this design, shown in Figure 2, Second Messenger represents each person as a circle, where the size of the circle reflects the relative participation level of the individual. The circles can be arranged with a mouse to reflect the physical arrangement of the face-to-face group members. In this way, there is little ambiguity as to who is represented by each circle. Additionally, the flexible arrangement allows the display to be shown on a tabletop monitor, as an alternative to a wall-projection. The screenshot in Figure 2 shows the relative participation levels of six individuals and the photograph in Figure 2 shows two members of a group using the display on a tabletop monitor.

An alternative display option, shown in Figure 3, is a timeline of who spoke at each moment in the meeting, which is designed to be viewed as a visual replay after a discussion. The circles down the left side represent the individuals and the horizontal lines extending from the circles have vertical blue bars at the moments when that individual spoke. To highlight moments of overlapping speech, translucent vertical red lines are drawn where more than one person spoke. The replay can be viewed with a two-minute or five-minute window, providing a detailed look of the meeting's turn-switching. By watching this display immediately after an interaction, at ten-times the speed of the original interaction (without audio), this display supports a user in reviewing who spoke when and who gained the floor at moments of overlapping speech. Figure 3 shows an entire 20-minute discussion amongst a group of six, which is the same conversation visualized in the screenshot in Figure 2.

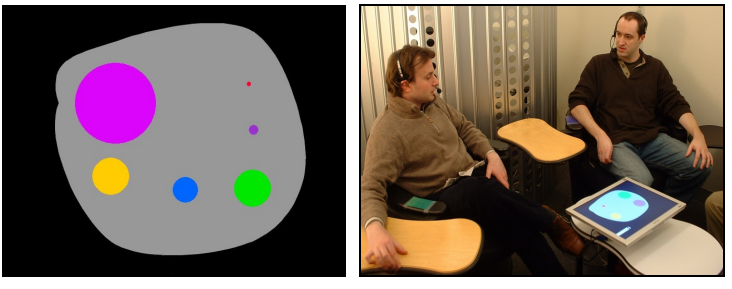


Fig. 2. Circle display screenshot and shown on tabletop display

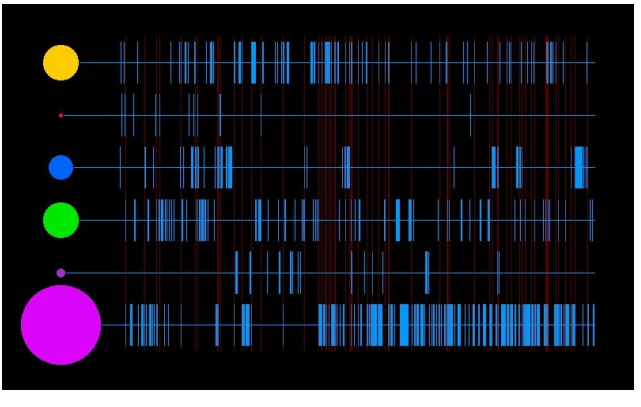


Fig. 3. Timeline display shown as a replay

4 Related Work

The type of detection and visualization of speech data done in Second Messenger has been done in earlier work by Kazman, Hung and Mantei [13] in a conference-calling application and also by Chen [14] in an application for remote classrooms. Both of

these applications provide remote behavior awareness, with a focus was on assisting groups manage who holds the floor.

Providing social tools during face-to-face interactions for the purpose of improving group interaction is a growing research area within ubiquitous computing, as summarized by Iqbal [15]. Kulyk and Sturm [16, 17] experimented with simple visualizations of participation and eye gaze that took the form of circle displays and found preliminary evidence that these visualizations also led to more equitable participation. In terms of personal reactions to the displays, Sturm [17] found that groups were generally satisfied with their tools, felt they were useful, and would want to use them again. They gathered these qualitative reactions from a focus group and early experiments. In another example, Morris, et al. [18] presented personalized, dynamic histograms of speaker participation levels on a shared tabletop display and found that groups with such displays had greater participation equity. Mengis and Eppler [19] looked at the behavioral impact of more complex, information-rich visualizations and found that when groups were supported with visualizations, they would focus more on the construction of the big picture and on common ground in their decision making, and less on conflict and equal participation.

Our work [2] has found that providing visualizations of speaking patterns as a replay, immediately after an interaction as a method of review, produced significant group behavior changes, and for those groups that demonstrated poor information exchange, they exhibited more effective sharing of information in subsequent meetings.

As the evidence mounts that visualizations of social behavior can generate positive changes in face-to-face group behavior, we were motivated to explore in more depth the issues of acceptance and appreciation for these feedback tools. As tool designers, we want groups to welcome persuasive tools into their real-world settings, but if groups do not perceive the tools as helpful, informative, or useful, the tools will never leave the research laboratory. Therefore, we more systematically explored the issues that Sturm, et al. [17] looked at, by asking 76 users in a laboratory study and 12 users in regular group meetings how distracting, useful, and informative our tools were.

5 The Studies

As mentioned, our first study [3] indicated that users of Second Messenger were not distracted by the tool, but also did not find the information to be particularly useful or informative. To examine this issue further, we ran two more studies using our new interfaces, during which we asked more detailed questions. We wanted to know if users actually looked at the display during a meeting, how useful and informative they found a *replay* of information as compared to *real-time* information, how comfortable users were with the shared information, and if they were willing to have this type of display available in other meetings. These questions are listed below in Table 1, as we asked them in our survey.

The first study was run in the lab with 19 groups of four people each using different combinations of the Circle display and Timeline display. The second study was in the natural setting of real-world meetings, where two groups used our Circle display during their regular meeting. The next sections present these two studies.

Table 1. Survey questions asked of all subjects

Asked after real-time feedback:
– Did you look at the display during the task? (yes/no) – Did you find the display distracting? – How useful did you find the display for completing the task? – How informative did you find the display about the group's behavior?
Asked after replay feedback:
– How useful did you find the replay for reflecting on the previous task? – How informative did you find the replay about the group's behavior?
Asked at end of experiment:
– How comfortable were you with having this information shown to the group during the task? – How comfortable do you think the other group members were having this information shown? – Would you want to have this type of information available in other types of meetings you attend? (scale from 'never' to 'always')
All questions were asked on a 7-point scale from 'not at all' to 'very,' except where noted.

5.1 Laboratory Study

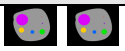
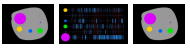
In our lab study, groups of four had two 15-minute discussions, during which they performed two 'hidden profile' tasks, as described by Wittenbaum and Stasser [20, 21]. The basic premise of these tasks is that groups must come to consensus on a decision for which not everyone is provided all of the facts. So the challenge is to share information appropriately to locate the best decision.

Groups were provided either the Circle display during their two discussions (Figure 2) or the Timeline display as a replay after the first discussion (Figure 3), or both displays, one for their real-time discussions and one for a replay. With this design, we were able to measure whether or not groups responded differently to these two displays, if their responses changed during a second usage of a real-time display, and if combining the tools was of benefit to users. Table 2 outlines these three conditions, which we refer to as Lab1, Lab2, and Lab3.

The basic task of the experiment was the same as in our original Histogram experiment [3], but a crucial change was made in the *presentation* of the tools. Before the experiment began, each group was given a full explanation of how the awareness tool (or tools) worked and were told the displays were there to assist in determining if there was an imbalance in the consideration of opinions. All groups were told that overlooking an opinion of someone could lead to inferior decisions. The purpose of this brief lesson in group dynamics was to assist groups in understanding how to use the tools' feedback. By altering the experimental protocol (from no explanation to full disclosure) *and* changing the visual display (from histogram to circles) means we cannot directly compare our findings from this study to our original experiment, but we felt that explaining to groups how the tools could be used would be of great benefit to the users. (Our other publication discussing this study [2] explains how the control groups, who did not see any displays, also received this instruction but did not alter their behavior.)

For the study, a total of 76 subjects were recruited from the university community and randomly assigned to 19 four-person groups to use the tools during their

Table 2. The three different conditions in the lab study

Condition	Displays	Description	Sample Size
Lab1		**Real-time groups**: real-time Circle display shown during two 15-minute discussions	28 people, 7 grps of 4
Lab2		**Real-time + Replay groups**: real-time Circle display shown during two 15-minute discussions, and after the *initial* discussion, replay display shown	16 people, 4 grps of 4
Lab3		**Replay groups**: after a 15-minute discussion, replay display shown before proceeding to next discussion	32 people, 8 grps of 4

discussion tasks. The average subject age was 26, and about three-fourths of the subjects were students and one-forth were members of the larger university community.

Results from the Laboratory Study. In response to the survey questions in Table 1, users reported whether or not they looked at the displays, if they were distracted, if they found them useful or informative, how comfortable they were with this information displayed, and if they would be willing to use these tools in other meetings.

Users reported looking at the displays, not being distracted, and being comfortable seeing the information. Subjects across all three conditions rated the feedback tools in similar ways along several parameters. Almost all subjects reported looking at the real-time display during their meeting (42 of the 44 real-time subjects). Subjects did not find the real-time display to be distracting: the average rating of distraction was 2.55 (1='not at all' and 7='very'). On the questions of how comfortable people were with the information displayed on the tool, all three conditions reported being comfortable with the information (average 5.66 out of 7) and believed others in the group to also be comfortable (average 5.45 out of 7). The averages for each of these questions, divided out into the three conditions, are detailed in Table 3.

Useful and informative. Figure 4 illustrates the ratings subjects gave for how 'useful for the task' and 'informative about the group' they found the displays. The data indicate that there were significant differences between the laboratory conditions ("useful" ANOVA, $F(2,73)=17.808$, $p<0.001$; "informative" ANOVA, ($F(2,73)=5.775$, $p<0.01$). Specifically, the individuals who were shown the *replay* feedback (Lab3, highlighted with an asterisk in Figure 4) found feedback to be significantly *more useful and informative* than those subjects in Lab1 and Lab2 (post-hoc Tukey tests were all $p<0.005$).

We also found that those individuals who saw *both* the real-time and replay feedback (Lab2) did not consider the replay to be more useful or informative than the real-time display. In a t-test comparing conditions Lab2 and Lab3 and their ratings of the replay feedback, it was found that the individuals who *only* saw the replay found the replay to be significantly more useful and more informative ($t(46)=-2.800$, $p<0.01$; $t(46)=-2.900$, $p<0.01$). This appears to be a situation in which providing multiple, redundant sources of feedback diminished the benefit of the individual tools.

*Differences between first and second use***.** In Lab1 and Lab2, groups had real-time feedback available during two discussions (the darkest bars in Figure 4 are the ratings from the second discussion). Within Lab1, there were no changes in how useful or

Table 3. Lab study results found to be consistent across conditions

Condition	Looked?	Distracting?		Comfortable?		Others comfortable?	
	Average	Average	Std Error	Average	Std Error	Average	Std Error
Lab1	93%	2.36	0.29	5.63	0.33	5.38	0.24
Lab2	100%	2.94	0.39	5.56	0.33	5.38	0.26
Lab3	n/a	n/a	n/a	5.74	0.23	5.58	0.19

Table 4. Field study results found to be consistent across conditions

Condition	Looked?	Comfortable?		Others comfortable?	
	Average	Average	Std Error	Average	Std Error
Group1	83%	5.33	0.76	5.17	0.31
Group2	100%	6.33	0.49	5.50	0.43

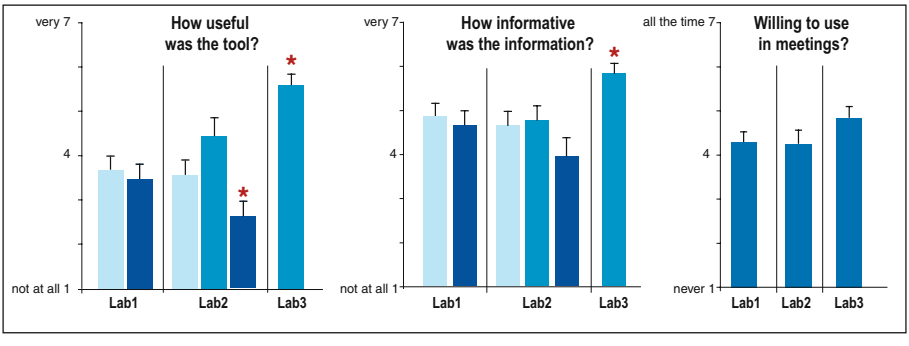


Fig. 4. Results from lab study. Error bars represent standard error of the mean.

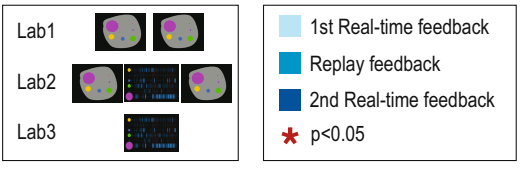


Fig. 5. Legends for interpreting Figure 4

informative the users found the real-time feedback, but in Lab2, where replay feedback was also provided, groups found the second instance of real-time feedback to be less useful than the replay feedback (paired t-test, $t(15)=-3.612$, $p<0.005$). They also reported looking at the real-time display less the second time than the first time (100% to 75% looked, paired t-test, $t(15)=2.236$, $p<0.05$).

This finding provides mounting evidence that a combination of real-time and replay feedback diminishes its usefulness on repeated use, but if the feedback is provided with no redundancy in information, there is no decrease in usefulness on a second usage.

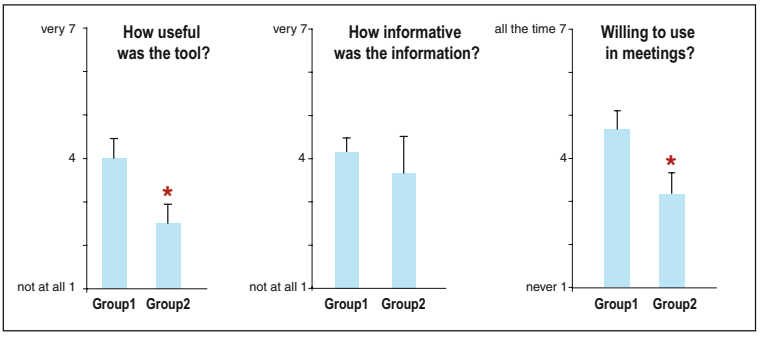


Fig. 6. Results from field study. Error bars represent standard error of the mean.

*Willingness to use again***.** Our final result from the lab study is that users were somewhat willing to use the displays in meetings and there were no differences seen between the conditions. The average response across all conditions was 4.46 out of 7 and the average values from each condition are shown in the right-most graph in Figure 4.

5.2 Field Study

While the lab study described above was designed to determine how factors such as information presentation and number of usages influenced perceptions of the feedback tools, by the nature of controlled experiments, the study could not measure the influence of prior group history or realistic group meeting dynamics. Therefore, we additionally asked two real-world groups to use the real-time Circle display during one of their regular meetings.

The first group (Group1) was a computer science research group with six members. Their hour-long meeting began with a brief status-update period and then one student spent the rest of the meeting soliciting feedback from the group on his research project.

The second group (Group2) was a team of six professionals who teach courses on team leadership and meeting facilitation within our university. They used the tool during an hour meeting with a designated topic and discussion leader.

Both groups were given an explanation of how the tools worked and our theories as to how and why these tools may be beneficial to them, just as the lab groups were told. Additionally, these groups were told to incorporate the tools as they wished, either talking explicitly about them or not, as they felt it was appropriate.

Results from the Field Study. As in the lab study, these users filled out surveys to provide us their opinions on the feedback tools. Overall, their responses did not vary greatly from the laboratory groups.

Real-world users reported looking at the displays and being comfortable with the information shown. Eleven out of the twelve subjects in the field looked at the displays during their meetings. They also reported being comfortable with having the information shown to the group (5.83 out of 7.0) and thought others in the group were also comfortable (5.34 out of 7.0). We find these results encouraging because these

groups were having discussions with real-world consequences and had established relationships with those in the room. The averages ratings broken out by condition are in Table 4.

*Useful versus informative***.** In terms of how useful and informative the real-world groups found the information, the two groups rated the information equally informative as the laboratory groups did (giving an average rating of 3.92 out of 7.0). For how useful the displays were for the task at hand, the group of professional facilitators (Group2) found the displays to be less useful for their meeting than the research group (Group1) (t-test, $t(10)=-2.42$, $p<0.05$).

*Differences in willingness to use again***.** The professional facilitators (Group2) were less interested in using the feedback tool again, as compared to the research group (Group1) (t-test, $t(10)=-2.36$, $p<0.05$). Compared with the laboratory study groups, Group2's rating averaged lower as well.

Along these two dimensions of usefulness and willingness to use, we theorize that the professional facilitators, while finding the displays to be informative, have less use for them in their daily meetings because they are already aware of their meeting dynamics due to their professional focus. Of all of our study participants, they may have found the tool to be redundant with their existing skills and therefore of less benefit.

6 Discussion

The universal findings across all groups, both in the lab and out in the field, were that individuals reported looking at the displays and being comfortable with the feedback being shared with the group. But depending on the condition, individuals differed in how useful and informative they found the feedback tools.

We found that detailed, post-meeting feedback was most well received, being rated as the most useful for the task, the most informative about the group, and as the tool groups were most willing to use again. We found that real-world groups did not differ substantially from our experimental groups, except in that experts in group facilitation found the information less useful and were less interested in having the tool in future meetings. When redundant information was shown, individuals lowered their ratings on how useful and informative the information was during a second meeting. But when the information was novel, either because it had not been presented before or it was not part of the group's natural skill set, groups found the tools to be useful for their meeting and were more willing to use it in future meetings. Compared with our previous experiment [3], where groups received no instruction about the purpose of the tools, these individuals found the tools to be more useful and informative across the spectrum. The average useful rating increased from 2.96 to 4.30 and the average informative rating increased from 3.08 to 5.03 (both on a scale of 1 to 7).

Our main conclusions from these studies are that users respond well to tools that provide them information that they otherwise wouldn't have access to, that they prefer details afterwards as compared to real-time summaries, and when the purpose of the tools is explained, they understand the applicability of the information to their tasks. While our expert facilitator group enthusiastically volunteered to try out Second Messenger during one of their meetings, they were the least enthusiastic about using it

again. This indicates that the ideal user population for feedback tools such as Second Messenger may be those groups that have no prior experience in the domain of improving group processes.

7 Conclusion

Our purpose in building persuasive technology [22] is to create collaborative systems that make groups aware of discrepancies between their decision-making goals and their expressed behaviors. By making groups aware, the system can persuade groups to more thoroughly consider their decision approach and to alter it in productive ways. Our rational for this approach is that social psychologists suggest that one way a group can improve its interaction and consequently its productivity is by having a high-level understanding of its emotional and social interaction [1].

But to develop successful behavior feedback tools for face-to-face groups, it is crucial to design them such that individuals positively respond to them and wish to deploy them in their meetings.

Our goal with these two studies was to gauge how individuals felt about having feedback presented to them in different contexts and in different forms. Given our findings, our advice to designers of social feedback tools is to be less concerned about distracting or making individuals socially uncomfortable, but instead to focus on training individuals on the social purpose of the tool and on providing the most details possible about social behavior within the display, without presenting redundant information.

Acknowledgments. We thank the participants in our studies, particularly the real-world groups, for welcoming our software into their meetings. The Digital Life and information:organized research consortia of the MIT Media Lab provided the funding for this research.

References

1. Janis, I.L.: Groupthink: Psychological studies of policy decisions and fiascos. Houghton Mifflin, Boston (1982)
2. DiMicco, J., Hollenbach, K., Pandolfo, A., Bender, W.: The Impact of Increased Awareness while Face-to-Face. Human-Computer Interaction 22 (2007)
3. DiMicco, J.M., Pandolfo, A., Bender, W.: Influencing Group Participation with a Shared Display. In: CSCW '04, Chicago, IL, ACM, New York (2004)
4. Stasser, G., Titus, W.: Effects of Information Load and Percentage of Shared Information on the Dissemination of Unshared Information during Group Discussion. J. of Personality and Social Psychology 53, 81–93 (1987)
5. Stewart, D.D., Stasser, G.: The Sampling of Critical Unshared Information in Decision-Making Groups: The Role of an Informed Minority. European J. of Social Psychology 23, 95–113 (1998)
6. Whyte, G.: Decision failures: Why they occur and how to prevent them. Academy of Management Executive 5, 23–31 (1991)

7. Bray, R.M., Johnson, D., Chilstrom, J.T.J.: Social Influence by Group Members with Minority Opinions: A Comparison of Hollander and Moscovici. J. of Personality and Social Psychology 43 (1982)
8. Myers, D.G., Bishop, G.D.: The Enhancement of Dominant Attitudes in Group Discussion. J. of Personality and Social Psychology 20, 385–391 (1971)
9. Brown, R.: Group Polarization. In: Brown, R. (ed.) Social Psychology, pp. 200–248. Free Press, New York (1986)
10. Moscovici, S., Zavalloni, M.: The Group as a Polarizer of Attitudes. J. of Personality and Social Psychology 12, 125–135 (1969)
11. Weisband, S.P., Schneider, S.K., Connolly, T.: Computer-Mediated Communication and Social Information: Status Salience and Status Differences. The Academy of Management Journal 38, 1124–1151 (1995)
12. Bales, R.F.: Interaction process analysis: a method for the study of small groups. Addison-Wesley, Reading (1950)
13. Kazman, R., Hung, W., Mantei, M.: Dynamic Meeting Annotation and Indexing. In: 1995 Pacific Workshop on Distributed Multimedia Systems, Honolulu, HI, pp. 11–18 (1995)
14. Chen, M.: Visualizing the Pulse of a Classroom. In: International Conference on Multimedia (MM'03), Berkeley, CA, ACM, New York (2003)
15. Iqbal, R., Sturm, J., Terken, J., Kulyk, O., Wang, J.: User-Centred Design and Evaluation of Ubiquitous Services. In: ACM SIGDOC '05, Conventry, UK, pp. 138–145 (2005)
16. Kulyk, O., Wang, J., Terken, J.: Real-Time Feedback on Nonverbal Behaviour to Enhance Social Dynamics in Small Group Meetings. In: Renals, S., Bengio, S. (eds.) MLMI 2005. LNCS, vol. 3869, pp. 150–161. Springer, Heidelberg (2006)
17. Sturm, J., Iqbal, R., Kulyk, O., Wang, J., Terken, J.: Peripheral Feedback on Participation Level to Support Meetings and Lectures. In: Designing Pleasurable Products Interfaces (DPPI), Eindhoven Technical University Press (2005)
18. Morris, M.R., Morris, D., Winograd, T.: Individual Audio Channels with Single Display Groupware: Effects on Communication and Task Strategy. In: CSCW'04, Chicago, IL, pp. 242–251. ACM, New York (2004)
19. Mengis, J., Eppler, M.J.: Knowledge integration in face-to-face communication and the moderating effect of a collaborative visualization tool (2006), http://www.scientificcommons.org/14519968
20. Wittenbaum, G.M., Hollingshead, A.B., Botero, I.C.: From Cooperative to Motivated Information Sharing in Groups: Moving Beyond the Hidden Profile Paradigm. Communication Monographs 17 (2004)
21. Stasser, G., Stewart, D.: Discovery of Hidden Profiles by Decision-making Groups: Solving a problem versus making a Judgment. J. of Personality and Social Psychology 63, 426–434 (1992)
22. Fogg, B.J.: Persuasive Technology: Using Computers to Change What We Think and Do. Morgan Kaufmann Publishers, Boston (2003)