Effects of Four Computer-Mediated Communications Channels on Trust Development

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ABSTRACT
When virtual teams need to establish trust at a distance, it is advantageous for them to use rich media to communicate. We studied the emergence of trust in a social dilemma game in four different communication situations: face-to-face, video, audio, and text chat. All three of the richer conditions were significant improvements over text chat. Video and audio conferencing groups were nearly as good as face-to-face, but both did show some evidence of what we term *delayed trust* (slower progress toward full cooperation) and *fragile trust* (vulnerability to opportunistic behavior).

Keywords
Trust, social dilemmas, communication, media

Long-distance collaboration is a fact of life for an increasing number of workers. More relationships are being formed and maintained online than ever before, including supplier-purchaser relationships, student-teacher relationships, and even collaboration between employees of the same company [7]. These distant collaborators have an increasingly varied set of computer-mediated communications (CMC) at their disposal, some more complicated and expensive than others. On what basis should workers select communication channels? Although many types of tasks seem unaffected by the communications media used [4] there are a few types of tasks that are inhibited, particularly those with a high affective component or where context is very important [1, 5, 9, 17, 18, 23].

Interpersonal trust is an area that is likely to be affected by mediated communications, but that has not been researched enough. Handy [6] asserts that "trust needs touch", which bodes badly for virtual teams which must find ways to build and maintain trust online.

Why is trust important? In business settings, trust is required in order for coworkers or partner organizations to work together effectively. Without trust, partners will not share information openly, and transactions must be carefully contracted and monitored to prevent exploitation [3]. Workers may also change the nature of collaborations to avoid the need for close coordination [7] or may simply avoid collaborating with others altogether, thus limiting their productive capacity [19]. But if higher degrees of trust can be established, organizations can work more efficiently, and adapt more quickly to changing circumstances [12].

Trust is best defined as a "willingness to be vulnerable, based on positive expectations about the actions of others" [11].

Previous research with shows that it can be more difficult to develop trust in an online setting than face-to-face. Rocco [14] found that six-person groups playing a social dilemma game were able to achieve cooperation quickly and maintain it throughout the experiment when they were face-to-face, but were unable to do so when communicating via email. Wilson [21] also found that trust was inhibited when three-person groups interacted via email rather than face-to-face, although in this study the effects diminished over time.

This is consistent with other experimental studies of CMC, which have shown that text-based interaction is less effective for tasks that have high social-emotive content. (See Bordia [1] for a review of research in this area.) Previous research has shown that text-based CMC increases the sense of social distance between participants, reduces pressure to conform, and may encourage uninhibited behavior. These characteristics might make trust agreements harder to form and maintain.

Most previous research has focused exclusively on text-based CMC, however, especially asynchronous messaging, or email. But what about synchronous communication with chat, or other forms of computer-mediated communications (CMC) such as audio, and video? We should not assume that effects will be the same for every type of CMC. For example while text-based CMC is usually found to foster equal participation in groups [9]; a recent finding shows that

audio conferencing can have the exact opposite effect, encouraging domination by high-status group members [5].

The question then arises, do richer communication channels such as video have effects such as reduced social presence? Would trust development be inhibited in a videoconference? What about a phone conference? Business and individuals make expensive decisions about travel, about purchasing of equipment, and meeting venues based on assumptions about the different media's effectiveness. How well might these assumptions hold up in a large, controlled experiment?

This research will examine trust development in a set of four media conditions. This should clarify whether trust is inhibited in video and audio when compared to f-t-f. Careful analysis of this multi-condition data may also help clarify which affects of CMC arise in which conditions.

Method

Sixty-six three person groups played a social dilemma game called Daytrader.

In experimental research, trust is measured using mixed-motive games called social dilemmas [10]. Well-known social dilemmas include the Prisoner's Dilemma and the Problem of the Commons. Social dilemmas are defined as situations where the best interest of the group as a whole conflicts with the best interest of each individual, so that if each looks out only for themselves, all lose. In a multi-round social dilemma, the maximum group benefit accrues only when each individual agrees to act cooperatively. Social dilemmas vary in how difficult they are depending on the exact rules and payoff structure, but it generally takes some amount of time and some communication in order to reach the required level of trust.

In the Daytrader game, players are given 30 tokens each round of the game and must decide how many of their tokens to invest as an individual, and how many to risk investing with the group. The individual investment yields a guaranteed payoff of 2x the amount put in every round. In the group investment all three players' contributions are lumped together, multiplied by 3, and then distributed back evenly. So an individual can receive triple from the group when everyone contributes, but also risks losing when other players hold back. There was also a bonus of 90 tokens given every five rounds to whichever player made the most money in the previous five rounds. This bonus has the effect of giving a windfall profit to players who contribute less than other group members. (When players invest identical amounts for five rounds, i.e. cooperate, the bonus is split.) Groups play 30 rounds of this game in total, with discussions held after round five, and thereafter every five rounds via one of four media channels.

Media conditions. The four available media channels were: face-to-face meetings, high-quality videoconference, three-way phone conference, and text chat. The high-quality video setup lets each player see each partner on a separate monitor. Each camera was mounted on top of a monitor so as to provide near eye-contact. (figure 1.) The microphones were placed in front of the correct cameras to provide directional sound—a speaker was louder if talking directly to you, and a little softer if facing the third player. The video was also configured to provide gaze awareness. This means that if two other players were talking to each other, you would see them looking across the middle of the setup at each other.

The audio condition used three inexpensive conference telephones, and the text chat condition used ChatSpace, a simple chatroom using standard conventions for contributing to and following conversations. Subjects were identified by their first names in the chatroom, and also introduced themselves by first name in the other conditions.

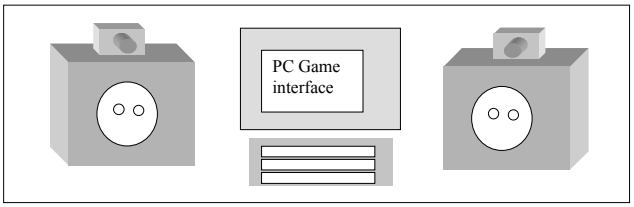

Figure 1. videoconferencing setup—video and audio were directional to allow eye contact and gaze awareness.

Subjects for this experiment were mostly students or others affiliated with the University. All were unacquainted before the study, and never interacted with each other except via their particular experimental condition. Subjects were not allowed to exchange purely social information either before or during the game (the effect of such social information exchange is examined in Zheng, Veinott, Bos, Olson & Olson [22].) Subjects were paid according to how well they did in the game, with each 'token' worth 1 cent, and each participant guaranteed to make at least $15, with actual pay ranging from $20-$30. There were 198 total subjects in the study, 105 male and 93 female, with an average age of 23. There were nine all-male groups, thirty-six mixed gender, and seven all-female groups total, with both gender totals and group compositions distributed more or less equally among conditions.

Pre- and post-questionaires. Before the task, subjects completed a questionnaire measuring their general level of trust, with distracter items included about their attitudes towards risky investments. The pre-questionnaire items were adapted from Rotter [15] and measured general trustingness. The post-questionnaire items were mostly adapted from Butler [2], and asked specifically about game behaviors and attitudes towards other players in the game.

Results and Discussion

Each group's level of cooperation is measured by the group's total payoff, i.e. the sum of the three individual players' payoffs. For clarity, the first five rounds of the game, which occurred before the first discussion period, were discarded. The group's total payoff over the course of

the game was determined the degree of cooperation between players. This is compatible with cooperation measures used in other experimental research using social dilemmas. It is further assumed that in order to achieve a high level of cooperation, the groups must have achieved a degree of trust, and this will be corroborated by results from the post-questionnaire.

Overall, the communication media did affect how much groups were able to make in the social dilemma. ANOVA analysis showed that communication condition had a significant effect on investment, $F(3, 58)=6.4$, $p<.01$. Post-hoc comparison's using Tukey's test showed that the greatest distances between conditions lay between chat and the other three--the text chat groups made significantly lower payoff than each of the other conditions ($p<.05$).

There were no significant post-hoc differences among the other three conditions of face-to-face, videoconference, and audio conference. This is because by the end of the experiment, the video and audio groups were cooperating at high levels, similar to the face-to-face groups. This does not mean that their performance was identical, however, and further analysis of the speed and fragility of cooperation rounds will reveal some differences.

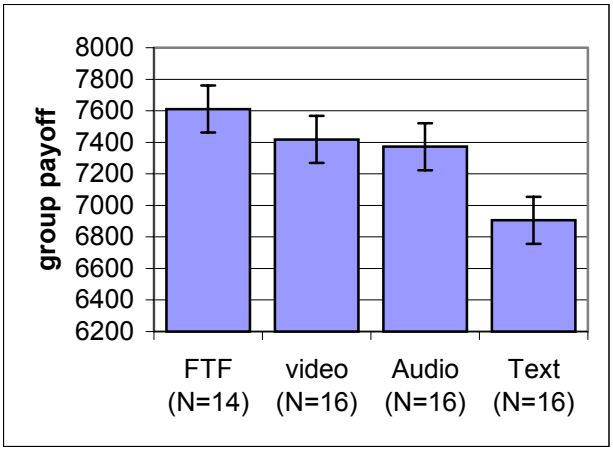

Figure 2. Comparison of average total group payoff in four communication conditions

Post-surveys of trust confirmed that the differences observed are related to trust. Trust in group was measured with an 11-item scale, alpha=.95, consisting of items such as "The other players in the game could be trusted" and "The other players always told me the truth". Players also rated their own trustworthiness (5 items, alpha=.93) and the consistency of their own behavior in the game (3 items, alpha=.76). Each of these three post-measures, averaged by group, had a significant correlation with payoff. Trust correlated with group payoff at .53 ($p<.01$), self-rating of trustworthiness at .69 ($p<.01$) and self-rating of consistency at .61 ($p<.01$). Post-trust also showed significant differences between conditions, and had the same profile of pairwise differences as group payoff.

Mechanisms by which CMC may affect trust

Even though the overall payoffs of the video and audio conditions were not statistically different than the face-to-face groups, closer analysis of the round-by-round data may show differences. We have evidence that there are two separate effects of CMC on trust: delayed trust, and fragile trust.

Delayed trust Previous literature has suggested that CMC may delay trust formation by slowing the rate at which individuals can gather nonverbal cues about partners' trustworthiness [23]. This is most noticeable in text-only communications, but there is also a narrowing of communications channel in other mediated conditions--voice communication strips away visual cues and distorts verbal ones, and even high-quality video narrows the visual field and masks both visual and verbal cues. In the absence of body language, facial expressions, subtle voice inflections, etc. it may take individuals longer to make up one's mind whether to trust a new partner, and to communicate their own trustworthiness.

Round-by-round analysis of group performances give evidence that all three of the mediated conditions delayed trust to some degree. Figure 3 displays the round-by-round trends of the group investment by condition. The maximum group contribution in any given round is 90.

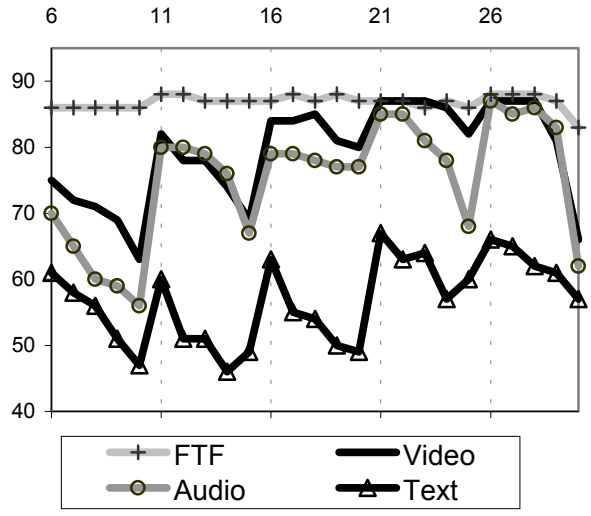

Figure 3. Comparison of round-by-round group investment in four communication conditions

Looking at figure 3, it does seem that the video and audio condition are lower in the early rounds, and converge with ftf only later in the experiment. To test this, we ran a linear regression predicting group investment for each round with two variables: round number, and the interaction of the round number and mediated communication conditions (video, audio, and text chat taken together). The interaction term did predict group investment after controlling for the overall effect of round number (sig <.001, Beta=.685), indicating that the mediated conditions were affected by

round number differently than the ftf groups. To get a clearer picture, we then examined each condition individually, to see if there was correlation between round number and payoff for those groups. We found that round number did significantly correlate with payoff for video (r^2=.17, p<.001) and for audio (r^2=.17, p<.001), showing that groups in these two conditions did improve over time. The effect was not significant for text chat (p<.08), indicating that these groups were unable to improve much over time, and not significant for ftf (p<.79), because the ftf groups started with high cooperation and remained high throughout the game.

These analyses seem to confirm what was evident visually in figure 3, that the video and audio groups, although performing overall almost as well as ftf, took a longer time to reach high levels of cooperation.

Behavioral analysis of group investments show that some of the alternatives to full cooperation were more often used by CMC groups. One strategy that was often employed in mediated groups, especially in the earlier rounds, was the partial agreement. These occurred when groups were not yet ready to cooperate fully (i.e. contribute all of their funds to the group), so they agreed to a partial measure, such as investing half for five rounds, or agreeing to a gradually-increasing schedule. Only two (14%) of the face-to-face groups used partial cooperations, but four video (45%), six audio (38%) and seven text chat (44%) groups negotiated partial cooperations. Because of these small frequencies, however, the differences were not statistically significant.

Mediated groups also sometimes agreed not to cooperate on one or more rounds of the game. (This is different from non-cooperation because of lying or defection, which is analyzed in the next section.) No face-to-face groups ever agreed to rounds of non-cooperation, but two video (11%) four audio (25%) and all 16 text groups agreed to non-cooperation at some point in the game. ANOVA analysis of non-cooperation showed marginally significant difference between conditions for non-cooperative agreements (F (3, 59)=2.6, p<.056).

Fragile trust The effects of fragile trust are also visible in figure 2 as the pattern of vertical dropoffs occurring on a 5 round cycle, with a final dropoff at the end. The dropoffs are the results of defections within the game, typically where one player violates an agreement and the other players rapidly retaliate. The tops of the spikes are the rounds immediately after discussions, (rounds 6, 11, 16, 21, and 26) when cooperation has been re-established. Defection was a constant threat to group cooperation, partly because the bonus system provided a windfall profit to players who held back a small amount from the group.

ANOVA analysis of the total number of defections shows a significant difference between conditions (F (3, 59)=5.2, p<.01) with significant post-hoc differences between text chat and each of the other three conditions.

Another way to look at defections is to examine the size of the dropoffs between discussions visible in figure 3. The dropoffs give a more accurate picture of the destructive effects of defection, because they take into account not only the initial defection but also the other players' retaliatory actions, which may also differ between conditions.

For each round of the game, we calculated a variable called discussion distance, which is the number of rounds since the last discussion. For example rounds six and eleven each immediately followed discussion periods and each have a discussion distance of one, rounds seven and twelve are two, etc. We then also created an interaction term for the combination of mediated conditions (video, audio, and text together) and discussion distance. We found that the interaction term was significant even when controlling for the overall effect of discussion distance (Beta=.26, p<.001). This suggests that the mediated conditions are more vulnerable to defections, and exhibit more fragile cooperation than face-to-face groups. To make sure that this effect was not solely due to the text condition, where defections were most common, we ran this interaction analysis again discarding text condition data, and found that there was still a strong interaction of mediated condition with discussion distance (Beta=.27, p<.001).

The greater number of defections and worsened consequences of defections in this game are best explained by previous findings about social 'deindividuation' in CMC [1, 9, 16, 20]. When people are face-to-face, they have a strong awareness of the presence of others. CMC decreases this other-awareness, and can also decrease the inhibitions the person feels about their own behavior. This disinhibition can sometimes have positive effects, such as the finding that reticent students are more likely to contribute to a group discussion online than face-to-face [8]. But it can also have negative effects when inhibitions are lowered toward socially unacceptable behaviors. Some researchers have noted that rude behavior such as 'flaming' is more common in online environments [9]. In this experiment, the social distance of CMC seemed to encourage those who were tempted to defect from group agreements to do so. It also may have led victims of defection to retaliate more quickly and more drastically.

The increase in defections in the mediated conditions does not mean that CMC causes antisocial behavior. Opportunistic behavior is usually not observed in experiments where the task does not encourage it [17]. But it does mean that when the temptation exists, CMC could make opportunistic behavior more likely.

Implications and limitations of these findings

Communication media makes a difference in trust development, and all mediated communications tested in this experiment had some disadvantages when compared to face-to-face communication. Groups using text chat did the worst, having the most difficulty establishing high trust-based cooperation in the Daytrader social dilemma. Chat

was significantly worse than each of the other three conditions of phone conference, video conference, and face-to-face.

Our findings about the two richer channels, audio and video, are more complicated. These two groups did as well as face-to-face in overall cooperation, and were a definite improvement over text-chat only CMC. However, these two channels still showed evidence of delayed trust, in that they took longer to reach high levels of cooperation. And even after cooperation was established at high levels, audio and video groups had somewhat more fragile trust, being more vulnerable to opportunistic defections and subsequent fallout from defections.

Perhaps the biggest surprise is that the audio and video conditions were almost identical to each other, even though we took great pains to create very high-quality, directional video, but used cheap consumer phone conferencing for the audio. Although we believe there probably are measurable advantages of high quality video interaction, this research does not present evidence of it.

What trust situations do these results apply to? Trust is a broad concept, encompassing the many situations where individuals put themselves at risk. Social dilemma tasks such as used in this experiment elicit exploitative and self-protective behaviors, and thus measure interpersonal trust related to these types of risks. Might there be other kinds of trust? Most definitely. In a professional setting, collaborators also need trust in more mundane things, such as that partners will return phone calls on time, are competent to give a sales pitch to a distant client, or work for a company that will remain financially solvent. Follow-up studies, both in the field and in the laboratory, should continue to identify the specific trust issues that are most relevant for distance work. However, different kinds of trust are not completely independent of each other. Developing trust that a partner will not exploit you is a good start on developing trust that they will fulfill other obligations. And the underlying processes of trust development, such as delayed and fragile trust, as well as underlying psychological mechanisms such as social disinhibition, are likely to be applicable to different kinds of trust.

What guidance does this research offer to managers and developers at this time? Our findings suggest that richer media are generally better for trust building and trust maintenance, although face-to-face is still the gold standard. Workers also need to be strategic about what work situations demand trust. Does a planned collaboration involve new collaborators, or are the workers already familiar with each other? Is opportunistic behavior a particular danger in current collaborations, or not? Results given here may help managers allocate scarce resources of travel and expensive CMC channels to where they will do the most good.

Key limitations of this study are its relatively short duration, and the use of student-age subjects. Research is needed, both in the laboratory and in field settings, about how trust-based relationships develop and erode over time and multiple interactions. Wilson and Straus [10] presents an interesting model for this, and follow-up research at our own lab will also be extending its scope in this direction. Bordia [11] also suggests that research needs to be done to see whether effects of CMC such as uninhibited behavior are due to the ubiquitous use of University students in research; we agree that using older subjects would strengthen findings.

Emerging tools, media types, and collaboration settings will present new challenges in this area, and increasing our understanding of how mediated communications affects trust-based relationships interact should have significant benefits for virtual teams of all kinds.

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