GENERATING AGREEMENT IN COMPUTER-MEDIATED GROUPS

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Abstract

Agreement is an important social outcome often poorly handled by computer-mediated groups, presumably because the computer cannot transmit the necessary rich information. A recently proposed cognitive model suggests richness is not the key to social agreement, and that group agreement can be generated by the exchange of anonymous, lean text information across a computer network. This experiment investigates this theory. Self-chosen groups of five completed three answer rounds on limited choice problems while exchanging a few characters of position information. These asynchronous, anonymous computer-mediated groups generated agreement without any rich information exchange. The key software design criteria for enacting agreement is proposed to be not richness, but dynamic many-to-many linkage. The resulting "electronic voting" may be as different from traditional voting as e-mail is from traditional mail. It may also imply a new generation of groupware that recognizes social influence.

THE AGREEMENT PROBLEM

It is not enough for groups to simply produce decision task solutions to be effective. They also need agreement about, and confidence in, those solutions to implement them (Boje & Murnighan, 1982). Even a single group member opposed could "throw a spanner in the works" of decision implementation. Agreement may thus be considered a group interaction outcome as important as decision quality (Maier, 1963). This may explain why groups spend significant amounts of time simply establishing common ground or agreement (Olson, Olson, Carter, & Storrosten, 1992). Agreement is especially important for equivocal decisions, common in life, where it is necessary to socially enact agreement (Daft, Lengel, & Trevino, 1987). To do nothing, or be indecisive, in such situations may be the worst of choices.

However meta-analyses of groupware research suggests that while computer-mediated support can improve task focus and performance (Dennis, Haley, & Vandenberg, 1996; Pinsonneault & Kraemer, 1989), it often reduces, or has no effect on, agreement and confidence (Fjermestad & Hiltz, 1999b; McGrath & Hollingshead, 1991; McLeod, 1992). For example a comparison of face-to-face (FTF) and CMC groups for both preferential and intellective tasks found no differences in task solution quality, but while seven of eight FTF groups reached consensus, only one of eight CMC groups did so (Adrianson & Hjelmquist, 1991). As is common in such cases, the authors attributed the lower agreement to the computer medium's inability to transmit rich social influence context cues (Sproull & Kiesler, 1986). In a collaborative writing task, computer-mediated groups also had substantially more difficulty co-ordinating their work than FTF groups, the authors concluding: *". . . the major problem, achieving consensus about how to proceed, seems much less amenable to technological intervention."* (Kraut, Galegher, Fish, & Chalfonte, 1992).

Computer groups also seem to take significantly longer to reach consensus than face-to-face groups (Hollingshead, 1993), and consistently report lower satisfaction (Straus, 1996). The suggestion that computers support task rather than social interaction has a long research history (Hiltz, Johnson, & Turoff, 1986; Ho & Raman, 1991; Siegel, Dubrovsky, Kiesler, & McGuire, 1986). However there is an equally long history reporting no difference between computer and FTF groups in generating agreement (Watson, DeSanctis, & Poole, 1988, Sep), and in a recent review, 58 of the 67 studies measuring consensus showed no main effect for computer-mediated by FTF (Fjermestad & Hiltz, 1999a). And some studies report computer-mediated groups generate *more* consensus than FTF interaction (Lea & Spears, 1991; Postmes & Spears, 1998). Clearly the issue is still open. Indeed, the problems of computer-mediated agreement seem no clearer now than twenty years ago, when two leading small group researchers observed:

> "*In sum, there is substantial agreement among researchers and observers of small group tasks that something important happens in group interaction which can affect performance outcomes. There is very little agreement about just what that "something" is* . . ." (Hackman & Morris, 1975).

We propose that the generation of social agreement is a central aspect of group interaction. It is certainly becoming clear that group interaction is more than the simple exchange of factual information (Dennis, 1996).

BACKGROUND

Early researchers conceptualised "group" as entity with independent existence, postulating a "group mind" operating apart from its members (McDougall, 1921). Lewin saw groups as entities in the individual's "life space" of psychological events (Lewin, 1948). Such conceptualizations were cut short by Allport's view of "group" as a nominal fallacy, stated in his famous dictum "there is no psychology of groups which is not essentially and entirely a psychology of individuals." (Allport, 1924 p4)). Consequently group cohesion became defined as "the total field of forces acting on members to remain in the group" (Festinger, Schachter, & Back, 1950). It has generally been operationalized as the sum of the interpersonal attractions between group members (Shaw, 1992), considered to be "the 'cement' binding together group members" (Schachter, 1951 p229), and widely regarded as the main cause of group agreement (McGrath & Kravitz, 1982). This separated group interactions into task and socio-emotional (SE), implying distinct cognitive processes for task and SE information (Bales, 1950). The reduced bandwidth of computer communication provided a ready explanation of the problems of early computer-mediated interaction (Sproull & Kiesler, 1986), and implied computer communication without rich personal presence, or social context, would involve the dry and arid exchange of informational facts and figures. However the computer communication explosion of the last decade has had scant regard for such expectations. E-mail, still mainly the exchange of lean black on white text, is anything but socially barren. Much of the information on the world wide web is text, yet sociologists now study the norms, beliefs, language and socialization of Internet groups as they would any other human group (Giese, 1996 May; Surrat, 1996 May). This contradiction between theory and practice has led to a wide divide between practitioners and researchers. We propose the task vs socio-emotional model behind these expectations, now over forty years old, needs to be re-evaluated.

A COGNITIVE THREE-PROCESS MODEL

Social identity theory has reinvented the concept of “group” as a cognitive rather physical entity, much as Lewin envisaged (Abrams & Hogg, 1990). Its main proposition is that the influence of the group is distinct from the direct personal influence of the people in it, and also from any physical benefits of group membership. As evidence, it has been shown that cohesiveness can occur in groups that mediate failure (Turner, Hogg, Turner, & Smith, 1984), and also in groups whose members have poor interpersonal relations (Hogg & Turner, 1985; Turner, Sachdev, & Hogg, 1983). This view implies that Bales socio-emotional factor is really dual, and can be split into a social (or group influence) factor, and an emotional (or personal influence) factor. A recent computer-mediated study strongly supports this view (Reid, Malinek, Stott, & Evans, 1996). This separation is also supported by a meta-analysis showing that computer depersonalisation does not in general reduce group influence (Postmes, 1997), a view proposed by the social identity model of deindividuation (SIDE) (Reicher, Spears, & Postmes, 1995; Spears & Lea, 1992). This gives a theoretical position with three, not two, core cognitive processes driving group interaction (Whitworth, Gallupe, & McQueen, 2000) :

1. *Resolving task information:* Using and contributing to informational influence, which allows the individual to analyze task information and argument, ideally resulting in physically valid solutions.

2. *Relating to others:* Using and contributing to personal influence, which allows small, usually dyadic, interactive relationships, ideally resulting in trust, mutual understanding, and intimacy.

3. *Representing the group:* Using and contributing to *normative influence,* which allows groups of any size to maintain a common identity and act as one, ideally resulting in group unity of action or agreement.

This cognitive three-process (C3P) model proposes three inherently distinct processes, with different purposes, which can operate independently. However in normal FTF group interaction they work in parallel across the same behavior set, and their purposes complement each other (although they often impose contradictory demands on group members). This overlap is possible because the proposed processes are cognitive, and their effects can confound in behavior. For example the behavioral state of agreement can arise from any or all of informational influence (following common facts), personal influence (following commonly trusted individuals) or normative influence (following a common group position). This situation of having to infer causal processes is not new to research. Agreement can also arise in a group of randomly responding individuals by chance. Probability theory helps distinguish chance from non-chance effects based on the properties of a random theoretical process. Similarly each of the three processes has properties that allow it to be distinguished as a cause. For example agreement from task resolution should require task information exchange, agreement from personal influence should require signed interaction and personal context, and agreement from normative influence should require information about the group position.

The C3P model suggests that the purpose of normative influence is to allow unity of action in a group choice situation, much as a herd or flock must stay together when moving, or the group as an entity will cease to exist. Intellectual choices can be seen as a form of behavioral choice, and decisions as intended behavior, so this process can be evoked by group choice situations (where choice consequences accrue to the entire group). The C3P model proposes normative influence is the primary means by which groups generate agreement, and that it can operate independently from informational and personal influence. Computer-mediated experiments provide evidence for this, showing that “persuasive arguments” (Vinokur & Burnstein, 1974) are not necessary for normative influence, and how much individuals move to a common position seems unaffected by removing arguments from simple position information (Sia, Tan, & Wei, 1996). This suggests that the exchange of position information alone can create agreement, even without the exchange of arguments. This is not to say that task information exchange *cannot* cause agreement, but in this model it is not considered the primary means groups use to generate agreement, nor necessary for that process.

What is necessary is that the individual perceives themselves as a member of a group (i.e. "identifies" with the group), that the group is facing a behavioral choice with common consequences, and that group members can compare their choice position to that of the group. In a discussion a member’s position (e.g. agree or disagree) may be implied by their comments, and this has also been called the comment 'valence' (Hoffman & Maier, 1961). For each group member to be aware of the dynamically changing position information of all other group members requires many-to-many interactive communication, and this, not richness, is proposed to be the prime requirement for groups to enact social agreement.

If normative influence can operate independently from personal relating, social generation of agreement should be independent of anonymity, contradicting views like: “*Groups operating under higher levels of anonymity will have lower levels of group cohesiveness, unanimity, and member influence than will groups operating under lower levels of anonymity*.” (Valacich, Dennis, & Nunamaker, 1992 p106, Proposition 4). Indeed, anonymity has no effect on computer-mediated group polarization (Sia et al., 1996), an effect attributable to group influence (Hogg, 1992). The C3P model also suggests enacting agreement does not require the surfacing and resolution of nascent conflict (McGrath, 1990), as logical or personal conflicts are irrelevant to normative influence, which disregards logic and individuals.

In summary, current theories suggest the social enactment of agreement in group choice situation requires:

1. A rich communication medium (to transmit social influence).
2. Task information and argument (to give reasons for agreement).
3. Signed interaction (to allow personal influence).
4. Resolution of conflict (to remove disagreements).

By contrast the C3P model suggests groups can enact agreement using only many-to-many exchange of lean choice position information, i.e. *without*:

1. Rich communication (only simple position information is exchanged).
2. Task information exchange (normative influence needs no reasons).
3. Signed interaction (normative influence is impersonal).
4. Conflict resolution (normative influence ignores disagreement).

If this is correct, groupware theory and practice based on the social/task dichotomy must be expanded to accommodate a third process.

The research question addressing these conflicting theoretical predictions was:

Given a computer-mediated group that members identify with, facing a behavioral choice whose consequences accrue to the group, can normative influence alone, without personal or informational influence, generate group agreement?

HYPOTHESES

The proposed normative process requires that subjects see themselves as members of a group facing a choice situation, and are aware of both their own and the group's choices. For a democratic group, the group position is that of the majority. If the normative process can operate independently, these conditions alone should generate agreement (actual and perceived), and increase awareness of other group members. In addition, providing information on group members positions tends to elevate confidence if there is agreement, but reduce it if there is disagreement (Sniezek, 1992). If agreement increases, and subjects are aware of this, member confidence in their (and the group's) position should increase. Their long term acceptance of the group position, or commitment, should also increase, as this also correlates with confidence (Sniezek & Henry, 1990), as does group perceived correctness (Sniezek, 1992). Finally if normative influence is a natural group process subjects should be more satisfied when it operates. These arguments suggested that for subjects in a computer-mediated group facing a common choice task :

Hypothesis 1. *The exchange of anonymous group position information alone will increase:*

a. *Group agreement*

b. *Choice confidence*

c. *Other group member awareness*

d. *Perceived group agreement*

e. *Public commitment to the group position*

f. *Perceived group choice correctness*

g. *Perceived procedure satisfaction*

The null hypothesis was that there will be no group interaction effect.

Normative influence, like all other forms of group influence, operates on the individual's uninfluenced or independent position. Position change will depend on the strength of the original position and the strength of the normative influence. The latter can be expected to vary with the degree of the rest of group agreement (Whitworth & Felton, 1999). If after exchanging position information members increase agreement, repeating the exchange will involve increased normative influence. Individuals who did not change position the first time may do so second time if everyone else agrees against them. The effect should naturally diminish as the group unifies:

Hypothesis 2. *Repeated exchange of anonymous group position information will continue to increase agreement and confidence, although at a decreasing rate.*

The exchange of group position information can be contrasted with the exchange of interpersonal confidence information. An individual's confidence indicates his or her state or feeling about something. It does not change the choice position they have taken. Confidence is essentially sender, not task or position information, and so is part of the C3P relating process. Relating is here proposed to involve the mutual exchange of sender information allowing a sense of closeness and trust. If IE is anonymous, as in this experiment, participants cannot recognize who communications are from, and so relationships cannot develop. If interpersonal relating cannot operate, information used primarily by that process should have no effect, hence:

Prediction 1. *The exchange of anonymous confidence information will not affect any of the measures in hypothesis 1.*

A negative statement like this cannot be proven, as a null hypothesis cannot be formulated, but it remains a prediction.

METHOD

Research strategy

The research strategy involved:

1. Minimising C3P task information analysis and inter-personal processes.
2. Manipulating support for the proposed normative process.

Personal influence was minimized by making interaction anonymous. Relating is difficult when who contributed what is unknown. Informational influence was minimized by excluding exchange of any descriptive information or argument regarding the choices facing the group. Supporting normative influence required a sequence of exchanges of group member position information. Removing that support required a control identical in every way, except for these exchanges. In this design the same software supported both control and treatment, i.e. it was a *computer-mediated vs. altered computer-mediated design* (Burke & Chidambaram, 1995; Lea & Spears, 1991). Effects found relative to the control can thus be attributed to the isolated process.

Task

The research strategy of isolating normative influence excluded tasks requiring factual discussion of arguments or personal relationships and trust. In generative tasks member positions are emergent rather than pre-determined, making measurement of agreement difficult. Negotiation tasks do not involve a common group identity, and execution tasks fall outside the realm of computer interaction. This meant a choice task, either intellective or preferential. We chose a laboratory experiment to demonstrate unequivocally the process proposed under controlled conditions. Such methods are typically not realistic, as control, realism and generality unavoidably present a "three-horned dilemma" to the researcher (McGrath, 1982). That this process operates generally is predicted by the C3P model, but demonstration of this must be left to other studies. In this study, groups chose from four options, which allowed a precise measure of group agreement to be calculated (Whitworth & Felton, 1999). This was repeated 12 times per set, six being intellective choices and six preferential (McGrath, 1984). For example:

1. Intellective	**2. Preferential**
FINGER is to ARM as TOE is to: A. leg B. foot C. knee D. hand	*What is the best length of stay when parents visit their grown children's families once a year?* A. 20 days B. 10 days C. 5 days D. 1 day

The intellective (or right/wrong) questions followed the style of IQ tests (ACER, 1982; Reid, Jackson, Gilmore, & Croft, 1981). The preferential questions followed the style of the Estimates and Information sub-tests of the Motivational Analysis Test (MAT), which were designed to vary with individual motivational differences (IPAT, 1975). Three matched choice sets were created, one for each treatment level.

Independent variables

The main independent variable was information exchange (IE), with three levels:

I. *Blind*. No IE - individuals made their choices alone.

II. *Group aware*. Individuals made their choices given anonymous position information from other group members only.

III. *Confidence aware*. Individuals made their choices given both anonymous position and confidence information from other group members.

For II and III there were three exchanges or votes:

1. *First vote*. Always blind.
2. *Second vote*. After group first vote.
3. *Third vote.* After group second vote.

Questions were of two types:

1. *Intellective*.
2. *Preferential*.

This gave a three-way randomised block factorial design (Table 1). As subjects chose their groups, repeated measures were taken - every subject was under every treatment level. The design assumption of a circular covariance matrix (Winer, 1971) was confirmed using the SPSS Mauchly test for all main effects.

Information exchanged	**First Vote**	**Second Vote**	**Third Vote**
Blind	Intellective		
	Preferential		
Group	Intellective	Intellective	Intellective
aware	Preferential	Preferential	Preferential
Confidence	Intellective	Intellective	Intellective
aware	Preferential	Preferential	Preferential

Table 1. Research design

There were six IE treatment orders and six ways three tests could be allocated to each treatment. This gave 36 session types, which for groups of five required 180 subjects. Only 90 subjects however were available. As an order effect was expected, IE treatment levels were randomly allocated equally to order positions 1, 2 and 3. The tests were also randomly allocated equally by order. It was not possible to also allocate tests equally to all treatments, so this was done randomly.

Under the *blind* treatment subjects voted only once, unaware of others votes. The *group aware* treatment involved three votes per choice. The first was blind, but after that group position information became visible. Subjects could not second vote until all of their group had voted once, or third vote until everyone had second voted. The first two votes were straw votes **-** subjects could vote *Don't know* if they had no opinion, but the final vote represented the group's answer and required they take a position. Position information was exchanged in the form:

A A A B ? Group
Position: Option A

The above indicates three group members chose answer A, one chose B, and one voted *Don't know*. Vote feedback was in order of choice option, not person voting, so it was anonymous. The display shows the group position as the majority (A), but could also show a blank field (indicating no decision yet), or report "*Group Vote Hung"* if no majority was possible (e.g. AABBC).

The *confidence aware* treatment required the exchange of confidence information. Trials showed a single confidence symbol was easy to understand and remember (Table 2).

Confidence	Symbol
Very confident	!!
Confident	!
Fairly confident	*blank*
Not very confident	½
Not confident at all	¼

Table 2. Confidence symbols

For the confidence aware treatment, information was exchanged in the form:

A¼ A¼ A¼ B!! B!!	**Group**
Position: Option A	

The above shows the majority choosing option A were not at all confident, while the minority felt very confident B was the correct answer.

Dependant variables

Agreement

Agreement can be measured by *commonality* (the number of people with the same position (Lorge, Fox, Davitz, & Brenner, 1958, p364)) or *consensus* (the percentage of unanimous groups (Sniezek, 1992)), but both measures ignore the varying degrees of agreement possible in groups. Some experiments have used a more sensitive measure based on fuzzy set theory (Sambamurthy & Chin, 1994; Tan, Wei, & Krishnamurthy, 1991; Watson et al., 1988, Sep), but this only works with interval data, not nominal data such as limited-choice tasks usually produce, and requires data in the form of voting probabilities (Tan, Teo, & Wei, 1995). The measure used in this study can be applied to interval, ordinal and nominal data. It is based only on the actual voting pattern, and hence can be applied to non-interacting groups. The situation involved N group members facing a problem with K choices. Disagreement was conceptualized as the square of the distance apart of the choice positions held by two group members. If they held the same position, the distance was zero, and disagreement was zero. Otherwise, for nominal data, their disagreement was 1. Averaging the disagreements with other group members gives an individual's disagreement, and averaging across group members gives the group disagreement (**D**). This gives:

$$\mathbf{D} = \frac{1}{N.(N-1)} \sum_{1 \le i \le K} \sum_{1 \le j \le K} d_{ij} \, f_j \, f_i$$

where f_j is the *n*umber who chose the *jth* option, and for nominal data $\mathbf{d_{ij}}$ is 1 if $i \# j$ else it is 0. For nominal data the maximum **D** is 1.0, so group agreement (**A)** can equal **1 – D** (see Table 3). A detailed derivation is given elsewhere (Whitworth & Felton, 1999). The minimum **A** of 0.0 (everyone disagrees) is not possible with five group members but only four choices. The line in Table 3 indicates where the group moves from majority agreement to having no majority. Agreement scores were averaged over 12 items.

Response	Example	Agreement
Unanimous	AAAAA	1.0
All but one	AAAAB	0.6
3-2 split	AAABB	0.4
3-2 majority	AAABC	0.3 **agreement**
Hung group	AABBC	0.2 **disagreement**
Maximum disagreement	AABCD	0.1

Table 3. Group agreement for N=5 people, K=4 choices

Immediately after choosing one response option, subjects were asked "How confident do you feel that this answer is correct?" and could respond:

5. Very confident
4. Confident
3. Fairly confident
2. Not very confident
1. Not confident at all

If subjects voted *Don't know* this question did not appear. Subjects were asked to choose *Don't know* only if they had no confidence in any option. In this case confidence was scored as 1 ("Not Confident at All"). Scores were averaged over 12 values.

Subject perceptions

Subject's perceptions of the interaction were measured on the constructs in Table 4. Each was measured by both a positive and negative question, to counter response bias. The questions were given in a mixed order.

Construct	Question
Perceived agreement (PA) *Feeling in agreement with the group*	**PA+** I think I agreed with most of what the group decided
	PA- I think I generally disagreed with what the group decided
Public commitment (PC) *Public commitment to the group position*	**PC +** I 'd be happy to sign my name to the answers our group produced
	PC- I wouldn't like the answers of our group to be made public
Task correctness (TC)	**TC+** I think our group gave good answers
Feeling the group position was correct	**TC-** Our group probably got quite a few questions wrong
Procedure satisfaction (PS)	**PS+** This is a good way to make decisions
Feeling the interaction procedure was a good one.	**PS-** I didn't enjoy using the computer system this way
Other awareness (OA) *Feeling aware of other group members*	**OA+** I was aware of the other group members through the computer
	OA- I didn't really think much about others during this test

Table 4. Subject perceptions: Constructs and questions

Subjects answered on a seven point scale:

7 Strongly Agree
6 Agree
5 Agree slightly
4 In the middle
3 Disagree slightly
2 Disagree
1 Strongly disagree

Score correct

The six intellective items in each set allowed a task performance measure. Score correct, the group's total correct answers, was a value from 0 to 6. If the group could not agree (a hung vote) the answer was marked incorrect. No hypothesis was formed for score correct as it is not logically independent from agreement. A group must agree, or form a group position, before that position can be judged correct or not. A group that cannot agree cannot be correct. Conversely, if they can agree, even with no task knowledge, for a limited choice task they will occasionally be correct by chance. Where subjects tend to be correct (e.g. an easy task) normative influence should improve score correct, but where they tend to be incorrect (e.g. a cognitive bias) it should reduce it. Normative influence can be expected to "crystallize" the group in either direction (Thorndike, 1938). The expected effect depends on whether the blind percentage correct is above or below chance.

Subjects

Subjects were ninety first and second year students, from business and computer courses, approximately equally male (56%) and female (44%). Most were between 18 and 20 years old, with no prior groupware experience. They were invited to form groups of five for a competition, with a stated first prize of movie tickets, plus a small course credit, as an individual incentive. Freedom to choose their groups meant subjects accepted their group membership. Students were asked to devise group names, and took a keen interest in coming up with names like the "Lamborgreenies" and the "Smelly Cats". This also helped establish group identity.

Experimental procedure

The experimental procedure was:

1) *Consent and commitment.* Students completed a consent form in class. It was emphasized that the entire group must participate or not at all. The attendance rate was high - only one person did not show up (they were substituted).

2) *Allocation to computers.* On entering the room subjects could sit at any computer with their group's color (e.g. "Lamborgreenies may choose any computer with a yellow sticker on it"). Computers were placed so members could not see the screens or faces of others in their group.

3) *Preliminary questionnaire.* Subjects answered a short questionnaire to measure their group's non-task cohesiveness, in terms of belonging and morale (Bollen & Hoyle, 1990).

4) *Introduction.* Subjects were told not to communicate face-to-face, and any group that did so could be disqualified. Monitors noted no attempts at face-to-face interaction.

5) *Training.* Subjects answered three practice questions while group/confidence aware. This trained users in system mechanics, confirmed group identity, and established the computers were operating correctly. After the first vote some members were invited to publicly disclose their votes to establish the reality of the group situation, and any questions were answered. If no decision was made they voted again.

6) *Complete test and record perceptions (3x).* After completing each test, subjects individually rated their perceptions of that method (blind, group or confidence aware).

7) *Overall comments.* Subjects were asked **"**How in general did you feel about these sessions?" and could make free form comments on their experience.

8) *Competition results.* The scores of all groups were calculated and published. The winning group received movie tickets, and the others a consolation prize packet of sweets.

Software

The experiment required purpose-designed groupware. FORUM DGSS, involved over 10,000 lines of code. It was written by the first author over three years, then used by more than a thousand people (for meeting agendas, an electronic magazine and class feedback) before its experimental use. The experimenter could define the environment, using over 150 interaction rules like mail availability, add rights, and vote visibility. It was effectively a groupware environment generator (DeSanctis & Gallupe, 1987). FORUM DGSS defined the treatments, gathered subject perceptions, and received final comments. It portrayed the group position in an understandable way, managed the many-to-many exchange of position information, and devolved control to group members (DeSanctis, Poole, Dickson, & Jackson, 1993). Subjects worked at their own pace, using the following main menu as a procedural “road map”:

1. Exit session
2. Practice
3. Practice feedback
4. Set 1
5. Set 1 feedback
6. Set 2
7. Set 2 feedback
8. Set 3
9. Set 3 feedback
10. Comment on whole session

Experimenter interaction was minimal. The main screen showed 12 choice items, with the current one shown in detail above this list. If it required voting, an eye-catching prompt flashed “*Press V To Vote”*. Pressing *N* (Next) found the next question requiring voting.

RESULTS

Data

FORUM generated 54 raw data files (3 sets with 18 groups), giving 1,512 result records (12 questions by 18 groups for 7 vote sets), each involving five people in 2 decisions (vote and confidence). There were 12 missing values (one person missed a third vote) so some ANOVA calculations involved only 17 groups. The complete experiment involved over 15,000 individual vote decisions. Of the 4320 first and second votes, only 89 (or 2.1%) were *Don’t know*.

Information exchange effects

The mean blind agreement was 0.41, approximately a 3-2 split, while the group aware agreement averaged 0.84, nearly unanimous (Table 5). This difference was highly significant (Table 6), supporting hypothesis 1a. The null hypothesis of no group effect was rejected. The group and confidence aware treatments were not significantly different, as expected by prediction 1. The results for vote confidence matched those for agreement, supporting hypothesis 1b. Knowing the confidence of others however produced no additional benefit in agreement or confidence.

	Blind	**Group aware**	**Confidence aware**
Agreement	0.41 (0.08)	0.84 (0.10)	0.83 (0.08)
Confidence	3.44 (0.42)	3.99 (0.46)	4.03 (0.44)
Score correct	3.11 (0.27)	3.94 (0.25)	4.39 (0.20)
Agreed group decisions	82 (52%)	102 (66%)	108 (73%)
% correct (of agreed)	68%	66%	73%
Mean time in seconds	419 (93.8)	991 (316.7)	976 (225.3)
N	18	17	18

Table 5. Final vote mean (SD) values by IE

The group aware treatment significantly improved score correct (Tables 5, 6). The mean individual scores correct by treatment showed a similar pattern (3.07, 3.97, and 4.26).). However this effect could be due to normative influence, as the blind group was more correct (52%) than chance (25%). When calculated as a percentage of agreed group decisions, score correct actually fell slightly from blind (68%) to group aware (66%). The increase in score correct was entirely accounted for by the increase in agreement. This illustrates how operational measures can confound process effects. The results do not suggest subjects are using other member's votes as rational task information to make better decisions (Deutsch & Gerard, 1965). Interestingly, the small difference between group and confidence aware remained after this correction. The additional voter confidence information, although not significant here, may still weakly effect group agreement.

The group and confidence aware tests took longer, the extra time reflecting the extra work done (Table 5). Each group/confidence aware decision required 3 votes, and each vote took on average 27.3 seconds per question, compared to 35 seconds per question for a blind vote.

Source	df	SS	F	Sig of F
Agreement	2	2.107	160.95	< 0.001***
Blind vs Group aware	1	2.106	242.65	< 0.001***
Group vs Confidence aware	1	0.000	0.003	0.958 ns
Confidence	2	19.89	41.09	< 0.001***
Blind vs Group aware	1	3.89	62.83	< 0.001***
Group vs Confidence aware	1	0.05	1.22	0.287 ns
Score correct	2	14.39	5.20	0.011**
Blind vs Group aware	1	12.01	9.08	0.008**
Group vs Confidence aware	1	2.38	1.65	0.217 ns

Table 6. ANOVA results by IE

The after-test questions all showed highly significant differences between the blind and group aware situations, except for one, and no difference between the group and confidence aware situations (Table 7). Subjects in the group aware treatment felt more aware of other members, more in agreement with the group, that the group's answers were more correct, happier to sign their name to the group results, and that this was a better way to make decisions, supporting hypotheses1c, 1d, 1f and1g. However while signing one's name to the group answers was significant, making group results public was not. Perhaps members do not feel personally responsible for group public actions.

	Mean (SD)			ANOVA	
Question	**I Blind**	**II Group aware**	**III Conf. aware**	**I vs II**	**II vs III**
OA+. *I was aware of the other group members through the computer*	2.37 (1.86)	5.30 (1.55)	5.44 (1.61)	128.58 (***)	1.38 (ns)
PA+. *I think I agreed with most of what the group decided*	4.08 (1.52)	5.60 (0.99)	5.40 (1.19)	78.93 (***)	2.22 (ns)
PS+. *This is a good way to make decisions*	3.09 (2.04)	4.59 (1.69)	4.89 (1.65)	60.79 (***)	5.51 (ns)
TC+. *I think our group gave good answers*	4.27 (1.70)	5.42 (1.19)	5.46 (1.07)	46.30 (***)	0.02 (ns)
OA-. *I didn't really think much about others during this test*	4.42 (2.02)	2.82 (1.47)	2.83 (1.39)	44.91 (***)	0.01 (ns)
PC+. *I 'd be happy to sign my name to the answers our group produced*	4.38 (1.76)	5.30 (1.36)	5.40 (1.19)	34.46 (***)	0.66 (ns)
PA-. *I think I generally disagreed with what the group decided*	3.43 (1.46)	2.60 (1.31)	2.74 (1.41)	22.30 (***)	1.04 (ns)
TC-. *Our group probably got quite a few questions wrong*	4.00 (1.59)	3.21 (1.62)	3.32 (1.66)	15.46 (***)	0.67 (ns)
PS-. *I didn't enjoy using the computer system this way*	3.86 (1.94)	3.34 (1.70)	3.07 (1.75)	10.89 (***)	2.27 (ns)
PC-. *I wouldn't like the answers of our group to be made public*	3.60 (1.71	3.39 (1.51)	3.38 (1.57)	1.23 (ns)	0.00 (ns)

*Table 7. Subject perception statistics (N=90) (*** = p < 0.001, ns = not significant)*

Normative influence seems a powerful force in group decision making. As one subject noted:

> *"Discovered the power of the group to influence others in decision making . . . Very aware of the group in the decision making process even though not being able to communicate with them. In the last test* {Blind} *it was very hard to make decisions without the support of the group."*

Vote number effects

Analysis by vote number showed *when* effects occurred - did members move to agree immediately or wait until the final vote? While most change occurred on vote 2, agreement and confidence also increased significantly on vote 3 (Tables 8, 9). Group and confidence aware treatments showed similar vote change patterns, as would be expected from a common underlying process.

	Vote 1	**Vote 2**	**Vote 3**
Agreement (N = 17)	0.43 (0.06)	0.74 (0.08)	0.84 (0.24)
Confidence (N = 18)	3.17 (0.88)	3.73 (1.01)	3.80 (1.03)

Table 8. Mean (SD) by vote number

Source of variation	**dF**	**SS**	**F**	**Sig. of F**
Agreement	2	1.573	411.13	< 0.000***
Vote 1 vs 2	1	1.503	569.15	< 0.000***
Vote 2 vs 3	1	0.083	69.58	< 0.000***
Confidence	2	19.89	41.09	< 0.000***
Vote 1 vs 2	1	4.28	50.01	< 0.000***
Vote 2 vs 3	1	0.05	7.42	0.014 *

Table 9. ANOVA by vote number

The data show a curvilinear relation with diminishing returns. Hypothesis 2 was supported, suggesting normative influence continuously operates against the inertia of an individual's previous choice. If normative influence were a one-time effect, exchanging personal confidence may have had no effect because there was no room for further improvement. However since normative influence had a continuing effect, if personal confidence had any influence it should have added something.

The results so far can be summarized:

Hypothesis 1. *The exchange of anonymous group position information alone will increase:*

- ***a.*** *Group agreement (Supported).*
- ***b.*** *Position confidence (Supported).*
- ***c.*** *Group member awareness (Supported).*
- ***d.*** *Perceived group agreement (Supported).*
- ***e.*** *Perceived public commitment to the group position (Partially supported).*
- ***f.*** *Perceived group position correctness (Supported).*
- **g.** *Perceived interaction procedure satisfaction (Supported).*

Hypothesis 2. *Repeated exchange of anonymous group position information will continue to increase agreement and confidence, although at a decreasing rate (Supported).*

Prediction 1. *The exchange of anonymous confidence information will not affect any of the measures in hypothesis 1 (Expected result).*

Question type

There was a small but significant difference between the mean agreement for the intellective and preferential questions (0.36 vs 0.39, SD = 0.31,0.32, N=750). Subjects were also less confident on preferential questions than intellective ones (3.78 vs 3.64). The main effects found were the same for both question types.

Interactions

A multi-factor repeated measures analysis showed no interactions between information exchanged, vote number and question type (Table 10). Where two interaction contrasts were calculated, the average is given.

Source	Agreement	Confidence	Score Correct
IE by vote number	0.330 ns	0.444 ns	0.220 ns
IE by question type	0.460 ns	0.182 ns	N/A
Vote number by question type	0.394 ns	0.532 ns	N/A
IE by vote number by question type	0.741 ns	0.234 ns	N/A

Table 10. F test interactions

Control variables

A chi-squared analysis showed no significant treatment order effect. However comparing agreement between tests (for vote 1) showed small but significant differences (Table 11).

Measure	Test A	Test B	Test C	Chi-Square Sig.
Agreement	0.45	0.39	0.41	0.004**

Table 11. Agreement and confidence by test

Could these differences have caused the main effects? Even if each treatment had been done entirely with one test (which was not the case), the expected agreement difference would be only 0.06 (the test A vs test B difference). The treatment difference found was 0.42, which is seven times larger. However the main effect could explain the test differences, as the latter are all in the direction predicted by the uneven allocation of test to treatment (tests A and C were allocated 15 and 12 times respectively to the group and confidence aware treatments, while test B was only allocated 9 times).

Pre-experiment cohesion

While belonging and morale correlated highly together (r = 0.794, *p = 0.000*), neither correlated with any later measure. The group influence found seems a property of the situation, not the standing group, and seems independent of individuals knowing each other personally, as was also found in the original conformity studies (Crutchfield, 1955).

Subject perception constructs

Construct correlations

It was expected that negative and positive responses would load together within each construct. However the within construct correlations for two factors were not significant (Table 12). It was difficult to see why "*I think I agreed with most of what the group decided*" did not correlate significantly with "*I think I generally disagreed with what the group decided*." This result was surprising, suggesting that agreeing and disagreeing with a group are not simple opposites.

Construct	Correlation	Significance
Other awareness (OA+, OA-)	-0.441	< 0.000 ***
Task correctness (TC+, TC-)	-0.389	< 0.000 ***
Procedure satisfaction (PS+, PS-)	-0.283	0.007 **
Public commitment (PC+, PC-)	-0.250	0.018 ns
Perceived agreement (PA+, PA-)	-0.218	0.039 ns

Table 12. Within construct correlations

Factor analysis

A principle components factor analysis with varimax rotation was carried out on the average of the group and confidence aware treatments (since both showed similar subject perception responses). Three factors emerged, accounting for 62% of average response variance (Table 13, loadings under 0.3 not shown).

Factor	Question	Loading
1. Group identification	PA+	0.82
	TC+	0.78
	PS+	0.76
	PC+	0.74
2. Individual identification	PA-	0.71
	TC-	0.68
	PC-	0.65
	OA-	0.55
	PS-	0.53
3. Other awareness	OA+	0.88
	OA-	-0.70
	PS-.	-0.37
Total % variance explained		**62.1%**

Table 13. Factor analysis of subject perceptions

Factor 1. Group identification

Factor 1 loaded the positive questions from the perceived agreement, task correctness, procedure satisfaction and public commitment constructs. It seemed to represent member's identification with the group, and explained about one third of the response variance. All these questions correlated strongly and significantly with each other (Table 14), suggesting a single underlying process affecting all variables, and a single attitude to the group as a whole, including apparently distinct aspects. The correlation between TC+ and PA+ was particularly high (43% common variance), and agreeing with the group associated strongly with a belief that the group answer was correct. Participants agreeing with bad answers just to "go along" with the group would have given a negative relation between TC+ and PA+. As one subject commented, they *liked* the group because it generated *good* answers:

> *I liked working with our group. . . . being able to see the votes and confidence of other team members enabled me to make a good answer.*

Since the experiment was designed so the main influence process operating was normative, this suggests that a significant proportion of subject's confidence in task solution correctness (over 40%) can arise from the normative influence (without task information analysis).

Factor 1	TC+	PS+	DA+
PA+	0.656***	0.504***	0.549***
TC+		0.535***	0.553***
PS+			0.393***

Table 14. Factor 1 correlations

Factor 2. Individual identification

Factor 2 loaded mainly negative group responses - how the individual disagreed with the group, felt it was often wrong, did not wish group decisions to be made public, didn't think much of others and didn't enjoy the interaction method. This was interpreted as an assertion of individual identity apart from the group.

Factor 3. Other awareness

The third factor loaded mainly the two other awareness questions. It was interesting that neither OA+ nor OA- loaded on factor 1, implying awareness of others and of the group are not the same thing. In this factor PS- correlated significantly with OA- (r = 0.418***), but not with OA+. It appeared that not thinking of others related to not enjoying the session, but the reverse was not true.

Overall comments

Of 61 voluntary comments, 27 (44%) stated the group and confidence aware treatments were the best. Of these 8 did not distinguish the two treatments, but 19 felt the confidence aware method was clearly best. This was the most common theme of all mail messages:

Hmm I felt the see votes and confidence was the best, it allowed as to compare our answers and change them if we felt the rest off the group had a valid point.

I think that the first way (votes and confidence) is the best one, because it relates more to what can really happen during a meeting. I found the two others ways inefficient…

... test one (confidence aware) *was really the only one that would be worthwhile, as it is much easier to make a group decision based on the weighting that each member gave their answer to each question.*

The definitiveness of these views was surprising, given that the confidence aware method had no additional effect on either subject's choices or method ratings.

DISCUSSION

The experiment suggests that normative influence exists, and is distinct from informational and personal influence. If this view is correct, it has major theoretical and practical implications.

Theoretical implications

Social influence and richness

This experiment found that the exchange of a few bytes of anonymous textual information was sufficient to produce major changes in group agreement. This lends credence to the few studies where distributed electronic groups have shown *greater* agreement than FTF groups, rather than less (Lea & Spears, 1991; Postmes & Spears, 1998; Sia et al., 1996). By contrast, groups enacting agreement without a rich medium or rich information exchange is not predicted by cues-filtered out approaches like media richness theory (Daft et al., 1987), social information processing theory (Walther, 1992) and cues restricted theory (Sproull & Kiesler, 1986). Likewise theories that see agreement arising from individuals exchanging rational information would not expect this effect (Huber, 1984; Malone, Grant, Turbak, Brobst, & Cohen, 1987). Any theory that equates the "group effect" with the personal influence of its members would not expect anonymous, computer-mediated interaction to support enacted agreement. These results also question the view that agreement generation requires the surfacing and resolution of conflict. No sources of conflict were investigated. No reasons were given to convince people to change position. No personal context or social presence was provided. No basis was offered for the development of trust, nor persuasion of any form. There was certainly nothing that could be called a discussion. A more impersonal and information lean form of interaction could hardly be imagined, yet 66% of group aware decisions were unanimous (compared to 8.8% blind), and a majority decision was reached in all 204 cases. While interpersonal relating may use rich sender context information, normative influence seems an impersonal process, based on the exchange of position information alone. It is the influence of the group as a whole, not the individuals in it.

Given subjects were only exchanging a few characters of text without interesting discussions or personal involvement, we expected them to find the experiment boring. Yet they attended sessions closely, looking with interest for the group view on each question. They responded as if the information exchanged was rich. Some even volunteered they found it *fun*:

> *I enjoyed using this system.*
>
> *This was quite fun however the blind test was annoying due to the fact that I could not compare my answers with other members of the group.*
>
> *This is a very interesting and wonderful way to make decisions.*

Group position information seems naturally arousing, even without information about the task or other people. Its "richness" seems to arise because this information is important to people in groups.

The effect of confidence

The exchange of vote confidence information in essentially the same manner as vote position had no effect on agreement or confidence. Adding awareness of the other's confidence did not improve confidence (what created confidence was congruence with the group position). Yet of the comments mentioning treatment differences, 70% considered the confidence aware treatment the best method. Had interpersonal relating been possible, no doubt this would be true. However in this experiment, anonymity meant relationships could not be formed, and so as the model predicted, confidence information had no effect. Subjects were not influenced by the stated confidence of an anonymous communicator. A similar computer-mediated experiment, based on the Social Interaction Sequence model (Stasser & Davis, 1981), predicted that exchanging confidence information would enhance agreement, and tried three times to experimentally confirm this expectation. Each attempt gave the result predicted by the C3P model - no effect (Lowry, 1993). The author concluded: "*The results of this study suggest that a confidence feature may not be contributing to a distributed group's ability to reach agreement. … This finding is counter-intuitive; one would expect a subject to change his or her opinion more often when the majority has high confidence than when they have low confidence.*" (Lowry, 1993, p 16). Negative findings from studies of person-to-person influence seem to imply computer groups cannot generate social agreement. The C3P model suggests the focus has been on the wrong process.

Cognitive processes

Once a physical process is defined and operating in place, no other process can operate in the same place unless the first process stops. This is not true for cognitive processes. We may respond a certain way because it is correct *and* because we wish to please someone *and* because it is a group expectation. Conversely any cognitive process can influence any behaviour. In this experiment, normative influence increased score correct as well as agreement, though the position information exchanged probably didn't improve subject's task understanding. We can consider the change in score correct as a *by product* of a cognitive process aimed at generating agreement. Likewise better task information analysis can lead to higher agreement, if everyone calculates the "right" answer. In this case agreement can be seen as a by product of task analysis. Agreement could also be a by product of better personal relationships. It is this confounding of multiple purposes in behaviour that makes group interaction so difficult and subtle a topic of research. Fortunately each process has distinct properties, allowing researchers to isolate processes and estimate effects. For example, in a computer-mediated brainstorming experiment, the following model was proposed for FTF groups: (Casey, Gettys, Pliske, & Mehle, 1984):

$$\mathbf{P}_{\mathbf{FTF}} = \mathbf{P}_{\mathbf{Individual}} + \mathbf{I}_{\mathbf{Information}} + \mathbf{I}_{\mathbf{Social}}$$

where **P** is performance and **I** is influence. The social influence term ($\mathbf{I}_{\mathbf{Social}}$) incorporates both the interpersonal and normative influences of the C3P model. Computer subjects believed they were brainstorming with the aid of a computer, but in fact were receiving the ideas of other group members, matching the FTF treatment in task information, but not in social effect, as they had no basis to respond to social influence, giving:

$$\mathbf{P}_{\mathbf{Computer}} = \mathbf{P}_{\mathbf{Individual}} + \mathbf{I}_{\mathbf{Information}}$$

The experimental design allowed model components to be estimated from the results, showing that FTF social influence caused a massive performance decrement (- 41%), while the positive synergy effect of factual information exchange was quite small (+ 6.5%) (the authors suggested even this effect was an artifact caused by subjects “tweaking” ideas to give variants recorded as different but really the same). This supports the conclusion of many face-to-face studies, that synergy is rare in groups (McGrath, 1984). The negative effect of social influence seemed primarily because increasing the common ideas (and agreement) reduced the number of different ideas brainstormed. The removal of the "negative" social factor seems the main cause of current computer brainstorming successes. A recent study suggests that electronic brainstorming provides little or no benefit over non-interacting or nominal “groups” (which also have no social influence) (Pinsonneault, Barki, Gallupe, & Hoppen, 1999). While normative influence is generally beneficial for groups, for the isolated and particular task of brainstorming, it is not, e.g. the same group influence process that reduces brainstorming performance increased score correct in this experiment.

The C3P model suggests an extension of Casey et al's model:

$$\mathbf{P_{FTF} = P_{Individual} + I_{Information} + I_{Personal} + I_{Group}}$$

In this experiment the model (by design) was:

$$\mathbf{P_{Computer} = P_{Individual} + I_{Group}}$$

That individuals were affected by *both* the group position ($\mathbf{I_{Group}}$) and their own position ($\mathbf{P_{Individual}}$), may explain the surprisingly low correlation between PA+ and PA-. One subject reported:

> *I enjoyed the session. I can now see how we are easily led by decisions others have made and make strongly. I'm not sure if I would like to make all my decision this way - I feel I would be strongly pulled in the majority direction rather than going with what I truly feel and know.*

This comment expresses well a dynamic tension between normative influence and individual judgement. For important decisions, one might expect people to prefer more processes to be referenced, i.e. perhaps important actions must not contradict known task information and argument ($\mathbf{I_{Information}}$) *and* must involve people we trust as recommendors or sources ($\mathbf{I_{Personal}}$) *and* must be acceptable to the group we represent ($\mathbf{I_{Group}}$). This offers a convincing reason why people in groups are often dissatisfied with computer-mediated interaction - it only offers task information exchange. For example, without knowing the source (based on relational information exchange), people may simply not *believe* the information exchanged by the computer (Dennis, 1996). Unsolicited comments indicated that in this experiment subjects missed the availability of other two processes:

> *I found it slightly frustrating not being able to communicate or discuss the questions..*
>
> *I felt the influence of others in my decisions. Where I felt my decision to be correct, and saw the entire group disagree, I felt powerless to influence them.*

Subjects at times felt powerless to exert personal or rational influence on others. While isolating an underlying psychological process is recommended for research purposes, practical groupware should involve all processes in a complementary manner.

Practical implications

The size of the normative effect suggests electronic voting could be a mainstream activity in groupware.

Electronic voting

E-mail seems to increase the number of interpersonal relationships people enter into, their "social connectivity" (Hiltz & Turoff, 1985), by lowering the "messaging threshold", or psychological cost to the user, of sending a message (Reid et al., 1996). Messages are sent by e-mail which wouldn't warrant a letter. This increased spontaneity means e-mail is seen as more akin to a telephone call than a written letter (Lea, 1991). Electronic voting may be as different from our traditional concept of voting as e-mail is from traditional mail, and for the same reason – the computer makes things so easy. A FTF vote is major effort in counting. In this experiment each subject voted 168 times over a one hour period without obvious strain and many with obvious interest. The computer did all the work. Electronic voting may be the key to computer-mediated interaction (CMI) in groups, just as e-mail was the key to CMC. CMI involves group-to-group connectivity, as well as person-to-person connectivity. This requires software designed for many-to-many rather than one-to-one linkage.

Many-to-many linkage

If communication richness is not the key to the generation of agreement, what is? We suggest the critical feature is many-to-many (MTM) linkage - the merging of information from many individuals into a single signal that is then broadcast to all members. A physical medium like sound does this naturally - when a crowd claps, individual sounds merge into the group sound each participant hears. But while merging 100 claps creates a single powerful sound, merging 100 e-mails supporting the same view does not create a powerful e-mail (unless it be powerfully long, repetitive and boring). MTM interaction can be dynamic, as in a choir where the individual continuously affects the group sound, and the group sound continuously affects the individual. Such groups singing unaccompanied often slowly change key, but it is common experience they always do so together. Electronic voting can achieve the same effects, but in a way quite different from the traditional vote, which is a single, isolated, and occasional activity, carried out in formal anonymity, and used only when groups can't agree by other means. Most current groupware voting seems designed on the concept of a formal, rational vote. Position information, if available at all, is buried in menus, not available at the moment of voting, or not in the form of a group position (e.g. mean of 4.3 vs "Slightly Agree"). Voting is isolated from other activities, not dynamic, and often requires the entire group to stop while a central facilitator initiates the voting tool. Dynamic normative influence is difficult to investigate, and empirical studies of dynamic groups are relatively rare (Sniezek, 1992, p139). The process here envisaged is public, ongoing, voluntary, and threaded within mainstream communications, much as *informal voting* is proposed to occur during FTF group discussions (Hoffman & Maier, 1964). The effect is that the individual is aware of the group position at all times. This experiment illustrated how this can be done. Using this method, computer-mediated groups on current distributed networks, like the Internet, could enact agreement.

Voting as social influence

Using voting as a social as well as a rational tool offers new ways of interaction such as voting before discussing (Whitworth & McQueen, 1999). It can also create problems. Online voting not only shows the group position, *it influences it*. Social voting is influence as well as information, and computer polls of public opinion can change the very opinion they purport to measure. In small groups this causes order effects to occur. The first members to declare their position influence the rest, and the last may encounter powerful normative influence. Hence in this experiment subjects could not see the group position until they voted, and could not vote again until everyone in the group had voted. If exchanging positions has such powerful effects, groupware must provide some system guarantee of vote integrity, to avoid unethical manipulations. Repeat votes must also be recognised, distinguishing 10 votes from 10 different people from 10 votes from the same enthusiastic individual. One solution is an unalterable "signature" to verify the communication, whether e-mail or e-vote.

Interaction protocol

Computer-mediated interaction makes demands beyond computer-supported interaction, which *adds* computer-support to existing face-to-face, synchronous control techniques. However as real-time interaction is not available on most networks, CMI must *replace* those controls with asynchronous methods. In essence, the software must take on the role of facilitator. FORUM DGSS devolved control to end-users, who worked at their own pace. At any moment during the experiment no-one knew who was working on what (except the computer), as people might be all on different questions. Voting was initiated at the individual level, not through a central facilitator starting the voting tool, as occurs in the "tool kit" groupware design approach (Daniels, Dennis, Hayes, & al, 1991). Subjects did not all work on question 1 together, and then move to question 2, and so on. Initially some subjects tried this, waiting for others to vote before moving on, but soon dropped this approach, and began using the "To Do" function to hop from question to question, wherever voting was required. The computer knew what they had and hadn't done, and made it seem as if the group was gathered there at the moment they came to vote. The need for synchrony to keep order disappears if the computer keeps order.

Final word

The C3P model suggests that while factual information exchange is important, an equally significant proportion of group activity may be simply a push for agreement, regardless of logic. The idea of groups as rational individuals exchanging task information to arrive at logical solutions may be a false one. If real life problems rarely respond to rational analysis (Daft et al., 1987), to rely on reason alone is unwise. We should not presume nature got it wrong in providing alternatives to reason. Friendships extend our perspective beyond the present selfish moment. Groups extend us to consider more than our small self. The view that what is good for the group is good for its members has a lot to commend it. Likewise without friends we could trust no-one, and reason fails without trustworthy information. But is not normative influence just "herd instinct", that turns individuals into automatons that mindlessly follow a mindless group? (Janis, 1972) To think this is to think the processes proposed are mutually exclusive. They are not. Normative influence works *better* when each group member individually thinks through the problem to the best of their ability. Indeed not to think for yourself is not to contribute. Group identification requires individuals to *act from a group perspective*, not to act as robots. For example, given half the questions asked had no objectively correct answer, the frequency of *Don't know* responses we found (2.1%) seems low. Why didn't subjects choose *Don't know* more often on the straw votes? Perhaps because it is not helpful to the group. If everyone responded this way, no group position could emerge. If each individual makes their best choice, normative influence simply gives the group closure on the choice that best represents the group.

Without normative influence, the cities and societies we live in would not exist. What is disparagingly called conformity, is also the essential "glue" that holds us together in an equivocal world. Group identification can extend individuality as well as deny it, as confidence and motivation increase when people are not alone but part of a larger group. This non-rational process makes us social beings. As a part of our nature, we must accept it. This "irrational" process may be the only solution to prisoner's dilemma problems, where rational but selfish individuality ensures that everyone loses (Poundstone, 1992). Groupware design should be based on what groups actually do, not what we think they do or would like them to do. Computer-mediated groups need normative influence for the same reason FTF groups do: to generate group unity. Without unity, groups cannot act as groups. Rather than trying to eliminate such "irrationality", or regarding it as a "flaw" of human nature, groupware designers should recognize and accept this cohesive process as a valuable aspect of what groups actually do. Support for group influence and the generation of agreement should be an essential feature of any groupware system.

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