Chapter XIX
Measuring Disagreement

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ABSTRACT

Agreement is an important goal of computer-mediated and face-to-face groups. This chapter suggests a measure of disagreement in groups facing limited choices, as in a multichoice questionnaire. It defines a disagreement score between two people, then takes one person's disagreement as the average of their pair-wise scores with the rest of the group, and finally, defines the group disagreement as the average of its member's disagreement. This gives a standard disagreement scale (from 0 to 1) for any group response pattern, for any size group, facing any number of choices. It can be inverted to give agreement, though this does not necessarily predict group coalescence. It is encouraging that when the method is extended to ranked, interval, or ratio scale data, it is equivalent to the score variance, and that it also matches an ecological diversity measure. Unlike variance, this measure can be used with categories, and gives both individual and group values. Being standard, it offers a single score in cases where the group size and number of choices faced is unknown, for example, online computer-based group feedback. Examples are given of how the measure can be used.

INTRODUCTION

Many real-life tasks are "equivocal," or ambiguous, so no amount of information analysis will resolve them (Daft, Lengel, & Trevino, 1987). They require the group to "enact" agreement, that is, create it without rational basis, for example, one cannot (today) find convincing reasons to drive on the left side of the road or the right (the Romans chose the left so the sword arm faced oncoming strangers), but it is still crucial that we all drive on the same side.

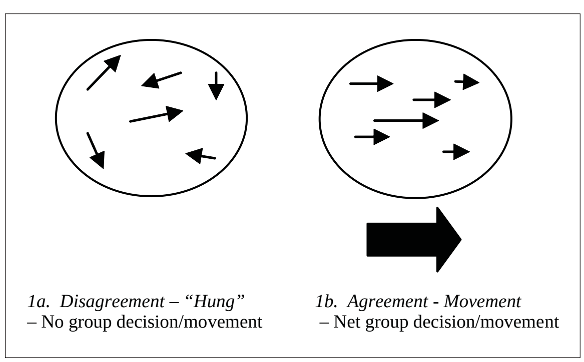
Agreement may be as important a group output as task resolution and decision quality (Maier, 1963). A group must first agree to even create a decision with any quality. An individual making a rational decision can be correct or incorrect, but groups have an additional possibility: unable to agree. This is illustrated in Figure 1, showing a group whose members (the small arrows) have choices in a decision space. In 1a, their decisions cancel out, giving no net group decision. Only in 1b, with agreement, does the group as a whole decide (large arrow). Two thousand years ago, Aesop expressed the social value of agreement:

A lion used to prowl in a field where four oxen also dwelt. Many a time he tried to attack them; but whenever he came near they turned their tails to one another, so whichever way he approached them he was met by the horns of one of them. At last however they fell a-quarrelling among themselves, and each went off to pasture alone in a separate corner of the field. Then the lion attacked them one by one and soon made an end to all four. (Aesop's Fables, ca. 600BC)

Agreement can be considered an independent output of social activity, distinct from task quality or quantity (Whitworth, Gallupe, & McQueen, 2000). If agreement is important, that powerful social processes maintain it is not surprising. Forty years ago Asch gave subjects a simple perceptual task, to choose the longer of two lines (Asch, 1952). They completed the task correctly 99% of the time when acting alone. However, when given the same task in a group where six other group members had chosen the clearly shorter line as longer, 76% of subjects went along with the group for at least one of six trials. The conformity effect had surprising strength in the face of unequivocal contradictory sensory evidence. In the autokinetic effect, a stationary point of light appears to move when viewed in total darkness (Sherif, 1936). People viewing such lights alone arrive at stable (but different) estimates of how the light moves, but when they view it publicly in a group, their estimates converge until they closely resemble each other. The same process caused the dropping of idiosyncratic behavior in groups. Speech samples of five-person groups over 4 months showed metaphor usage idiosyncrasies decreased, until a single metaphor category dominated (Owen, 1985). Conformity research suggests that generating agreement is one of the more important things that groups do when they interact.

Modern software is becoming more social, for example, chat, bulletin boards, online voting and reputation systems, common spaces, and e-mail lists. If agreement is important for physical social interaction, it is also important for electronic social interaction. However, current research in computer-mediated communication (CMC) is at best confusing. Meta-analyses of groupware research suggest that while it sometimes improves task performance (Dennis, 1996; Pinsonneault & Kraemer, 1989), it often reduces or has no effect on agreement and confidence (Fjermestad & Hiltz, 1999; McGrath & Hollingshead, 1991; McLeod, 1992). A major groupware review concluded: "It is obvious that the relative lack of ability to reach consensus is a problem for groups using GSS (group support systems)." (Fjermestad & Hiltz, 1999). This matches earlier findings that while computer support improves task performance, it often reduces or has no effect on agreement (Mc-

Figure 1. Agreement and social action



Grath & Hollingshead, 1991; McLeod, 1992). A comparison of face-to-face (FTF) and computer-mediated communication groups found no task quality differences, but while seven of eight FTF groups reached consensus, only one of eight CMC groups did so (Adrianson & Hjelmquist, 1991). In a collaborative writing task, computer-mediated groups had substantially more difficulty coordinating 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 seem to take significantly longer to reach consensus than face-to-face groups (Hollingshead, 1993), and consistently report lower satisfaction (Straus, 1996). The suggestion is that computers support task rather than social interaction (Hiltz, Johnson, & Turoff, 1986; Ho & Raman, 1991; Siegel, Dubrovsky, Kiesler, & McGuire, 1986).

One conclusion from these findings is that the low agreement is due to the low computer communication bandwidth, implying that rich, video-style communication will enable social agreement. Many millions of dollars have been spent developing hardware and software to increase electronic media richness. However, recent evidence suggests another view, as strong computer-mediated agreement can be created with lean interaction (Whitworth, Gallupe, & McQueen, 2001), and some studies report computer-mediated groups generate *more* consensus than FTF interaction (Lea & Spears, 1991; Postmes & Spears, 1998). The key to consensus, it is proposed, is the communication channel linkage (one-to-one, one-to-many and many-to-many), rather the channel richness (Whitworth et al., 2000).

In the resolution of an important and complex issue like how online groups generate agreement, measurement is critical. Research cannot proceed unless the construct in question is defined. We analyze the construct of disagreement, and present a new measure suitable for computer-mediated interaction.

DEFINITION

Agreement on a physical level can be conceived as sameness of behavior, as in a herd or flock that moves together (in a cohesive way). Its value is that without behavioral agreement, herd members would wander apart, and the herd would cease to exist as a social unit. Likewise, agreement on an intellectual level can be seen as sameness with respect to intellectual "positions"; for example, given a choice between say buy, hold or sell. When individuals choose the same position, we say they agree. When they choose different intellectual positions, we say they disagree. However, even given this construct, how to measure it is not obvious.

A simple measure is *commonality:* the number of people who choose a common option (Lorge, Fox, Davitz, & Brenner, 1958, p364). This, however, only uses the choices for the majority option, and ignores the variation among the rest. Another method is to instruct the group to reach *consensus* or unanimity; then calculate the percentage of unanimous groups (Sniezek, 1992). This also ignores relevant information, namely the degree of agreement in groups who achieve less than complete unanimity. Some experiments with electronic groups used a measure of group agreement derived from the mathematics of fuzzy set theory (Spillman, Spillman, & Bezdek, 1980), and calculated by computer program (Sambamurthy & Chin, 1994; Tan, Wei, & Krishnamurthy, 1991; Watson, DeSanctis, & Poole, 1988,). However, this measure requires interval data, not the nominal data produced by questionnaires (Tan, Teo, & Wei, 1995). For example, it could not apply to the buy, sell, or hold case mentioned previously. It also requires the group data provide voting probabilities for the options. A measure will now be proposed that does not require known voting probabilities. It uses the actual group response pattern, and also applies to nominal data (where people choose from a set of nonnumerical options).

Table 1. Definition of terms

Term	Meaning
N	Number of group members.
K	Number of response options.
A, B, C,..	Different response options.
f_j	Number who chose the *jth* option.
$\mathbf{d_{ij}}$	Disagreement between one person who chose option *i*, and another who chose *j*, where *i* and *j* are undefined.
$\mathbf{d_i}$	Disagreement of one person choosing option *i* with the rest of the group.
D	Average disagreement of the group.

The core construct proposed is that *the disagreement between two group members is the distance apart of their positions on the given issue.* Naturally, two people may disagree on one issue but not on another. This common-sense concept applies both physically and intellectually. In a herd moving together, the distance apart of its members is small. Likewise, when many people in a group choose the same intellectual position, their intellectual distance apart is also small. The basic terms that will be used are defined in Table 1, given a group of N people facing K discrete choices.

INDIVIDUAL DISAGREEMENT

Consider N group members facing K mutually exclusive choices A, B, C, … ($N > 1$, $K > 0$). For example, suppose five people must select one of four colors. We first define the disagreement between two people, then the individual's disagreement with the rest of the group, then the group disagreement as the average of the individual disagreements.

What is the disagreement ($\mathbf{d_{ij}}$) between any two people? From this construct, if they choose different colors the disagreement is one, and if they choose the same color it is zero:

$$\mathbf{d_{ij} = 1 \text{ if } \mathit{i} \# \mathit{j}, \text{ else } d_{ij} = 0}$$

Table 2. Individual disagreement (d) for N=5, K=4

Individual	Rest of group	d	a
A	AAAA	0.0	1.0
A	AAAB	0.25	0.75
A	AACD	0.5	0.5
A	ABBC	0.75	0.25
A	BCCD	1.0	0.0
A	BBBB	1.0	0.0

This is just the disagreement between two people, but for a given person, their pair-wise disagreements with the rest of the group can be averaged. An individual's disagreement ($\mathbf{d_i}$) is then the sum of their disagreements with each other group member, divided by the number of pairs (N-1):

$$\mathbf{d_i} = \frac{1}{(N-1)} \sum_{1 \le j \le K} \mathbf{d_{ij}} f_j$$

where f_j is the number of people who chose option *j*. If everyone chooses the same option, there is no disagreement ($\mathbf{d_i = 0}$), while if everyone chooses different options, there is maximum disagreement ($\mathbf{d_i = 1}$). Table 2 shows how **d** varies for five people choosing from four colors: A, B, C, and D.

In this case, an agreement inverse can be calculated: **a = 1 – d**. This measure matches the use of the index of the actual number of mutual friendships in a group divided by the number of possible mutual friendships as "one of the best indicators of a group's cohesion" (Dimock, 1986, p. 123).

GROUP DISAGREEMENT

The group disagreement (**D**) is now the average of the disagreements of all its members:

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

Table 3. Group disagreement (D) for N=5 and K=4

Group response	Example	D	A
Unanimous	AAAAA	0.0	1.0
All but one	AAAAB	0.4	0.6
3-2 split	AAABB	0.6	0.4
3-2 majority	AAABC	0.7	0.3
Hung group	AABBC	0.8	0.2
Maximum disagreement	AABCD	0.9	0.1

The minimum **D** value (0) is when all group members agree (see Table 3). The maximum value of 1.0 (everyone disagrees) is impossible with five group members but only four choices, as some people must agree. The line at D = 0.75 indicates where the group moves from being "hung" to having majority agreement. An inverse measure (of agreement) can again be calculated: **A = 1 – D**.

ADVANTAGES

The advantages of **D** and **d** as measures of group and individual disagreement are

1. **Simple: D** and **d** can be calculated manually for small groups. Just average each person's pair-wise disagreements; then average for the group; for example, for three people, each person can have an average disagreement (with two others) of 0.0, 0.5, or 1.0. In the first case, they disagree with no one, in the second they disagree with one other, and in the last they disagree with both others. **D** is then the average of the **d** values for all the group members.
2. **Sensitive**: This measure shows all levels of disagreement, not just majority; for example, a group response of *AAABC* (**D** = 0.7) shows more disagreement than a group response of *AAABB* (**D** = 0.6).
3. **Valid:** The core construct has content validity, based on a meaningful definition of disagreement.

Table 4. Maximum D by N for low K

Group size	Number of Options			
	K = 2	K = 3	K = 5	K = 10
2	1.000	1.000	1.000	1.000
3	0.667	1.000	1.000	1.000
5	0.600	0.800	1.000	1.000
10	0.556	0.733	0.889	1.000
100	0.505	0.673	0.808	0.909
1,000	0.501	0.667	0.801	0.901

4. **Scaled:** The measures offer a fixed scale, from 0 (unanimity) to 1 (everyone disagrees), for any group size or number of choices, allowing comparisons between different numbers of people and choices.
5. **Adaptable:** Can measure at group (**D**) or individual level (**d**), depending on the research unit.

Maximum D

For a few choices, as the group gets bigger the maximum disagreement decreases (Table 4). The maximum of 1.0 is only possible if each person can make a different choice. If there are more group members than choices (N > K), then it is impossible for everyone to disagree, and the maximum **D** is less than 1. In general, as *N* gets very large, $\mathbf{D}_{max}$ tends towards *1 - 1/K*. For example, in the case where there are two solution choices (*K = 2*), as *N* becomes very large, $\mathbf{D}_{max}$ tends to 0.5.

Measure properties

This measure may say something about the nature of groups. When one person disagrees in a group of five, they go from disagreeing with no one to disagreeing with everyone, and their individual **d** changes from *0.0* to *1.0* (Table 2). Such a major change, from zero disagreement to maximum disagreement, can be expected to be difficult, and perhaps is why conformity is so powerful. Likewise, one dissenter moves the group **D** almost half the scale (**D** = *0.4*) (Table 3); so for a small group, one person disagreeing is a major event. This effect reduces as group size increases: in a group of 10, the **D** change is *0.2*, and for a group of 100, it is only *0.02*, that is, one person's dissension has less impact on larger groups.

Though its maximum varies with the number of choices, **D** itself is independent of *K*. A group response pattern AAABB has a disagreement of 0.6, whether the group faces two choices, four choices, or a thousand. However, disagreement depends on *N;* for example an individual in a polarized pair facing two choices has a disagreement of 1.0, but a person in a polarized group of 1,000 has only half that disagreement (because 499 people agree with them). Given this property, the measure can compare groups of different sizes, which is useful when research cell groups have missing members.

Numeric Data

This measure can also apply to ranked, interval, and ratio scale data, as its concept of distance apart still applies. It just means giving disagreement scores beyond 0 and 1; for example, when selecting a color from lime green, mint green, sea green, and deep purple, the lime green to purple distance could be taken as 2, while the lime green to mint green disagreement is taken as 1. When this is done for interval data, it is gratifying that **D** can be shown to be equal to twice the variance (Whitworth & Felton, 1999). The doubling occurs because averaging the **d** values counts each pair-wise disagreement twice, once for each participant. That **D** also works for interval data suggests it is a valid measure for categorical data (where a variance cannot normally be calculated). This approach also gives individual disagreement measure, while in contrast, one cannot normally calculate the "variance" of a single data point, still less regard the total variance as the average of individual point "variances."

Further support for the generic nature of this measure comes from mathematical ecology. Simpson's measure calculates the ecological diversity of a habitat with *N* creatures and *K* types of species (Pielou, 1969, p. 223). If all creatures are of the same species, the diversity is low, whereas if each animal is a different species, the diversity is high. This measure can be shown to equate to the group disagreement **D** (Whitworth & Felton, 1999). It is interesting that two such different situations, each with different logics, can give equivalent mathematical formulae. *Perhaps there is a higher dispersion concept that incorporates disagreement, variance, and ecological diversity as specific* cases.

Choices that are not Mutually Exclusive

The logic presented here can be extended to the case where the choices are not mutually exclusive. Suppose a group faces choices where each option can be accepted or not, and the group can accept any, all, or none of the options. Each option can be considered a yes/no choice in itself, and **D** can be calculated for that option. The choices can be

Table 5. Probability distribution for N=5, K=4

Group Response	Example	Group Disagreement	P ( )
Unanimous	AAAAA	**0.0**	4/1024
All but one	AAAAB	**0.4**	60/1024
3-2 split	AAABB	**0.6**	120/1024
3-2 majority	AAABC	**0.7** mean = 0.75	240/1024
Hung group	AABBC	**0.8**	360/1024
Maximum disagreement	AABCD	**0.9**	240/1024

Table 6. Probability distribution for N=6, K=4

Group Response	Example	Disagreement	P ( )
Unanimous	AAAAAA	**0.00**	4/4096
All But 1	AAAAAB	**0.33**	72/4096
All But 2 Solid	AAAABB	**0.53**	180/4096
All But 2 Split	AAAABC	**0.60**	360/4096
All But 3 Solid	AAABBB	**0.60**	120/4096
All But 3 Split 1:2	AAABBC	**0.73**	1440/4096
All But 3 Equi-Split	AAABCD	**0.80**	480/4096
Hung Group	AABBCC	**0.80**	360/4096
Max Disagreement	AABBCD	**0.87**	1080/4096

compared according to the agreement each generates. Averaging these values over all the options will give a measure of the group disagreement for the choice set as a whole.

Probability Distribution

Assuming all solution options are equally likely to be chosen by all group members gives the probability distribution shown in Table 5, for N = 5 and K = 4. The **D** distribution is positively skewed, as there are more ways a group can disagree than they can agree. The mean **D** value is 0.75, halfway between a 3-2 majority and a hung group (see the line in Table 5). The Table 5 probabilities reflect a null hypothesis that all solution options are equally likely, either because subjects do not know which option is correct (a difficult choice), or find the choices equally attractive (an unbiased choice). By contrast, for an easy problem like 2 + 2 = ?, the response pattern will differ significantly from the Table 5 probabilities.

Table 6 represents the same values for N = 6 and K = 4, where again the 0.75 value represents the movement from majority to indecision. In a similar way, tables can be derived for any combination of N and K.

Limitations

These measures must be used carefully in situations where causality is unclear, as agreement can be a cause as well as an effect. For example, studies show the first person advocating a position better predicts the group final decision than predecision group preferences (McGuire, Kiesler, & Siegel, 1987). The first advocate seems to influence or "lead" the rest of the group. Yet when no prior discussion was allowed, their "influence" disappeared. The first advocate was actually reflecting rather than directing the group, like a group process tuning fork (Weisband, 1992). The caution is not to assume causality in a group interaction.

D is a process-independent measure of disagreement, and makes no assumptions about how a group state came about. Equally, it need not predict future group states, though it may be used in models that do. For example, in a group of eight facing four choices, a polarized split (AAAABBBB) gives a relatively low disagreement of **D** = 0.57, while a majority of five with the rest of the group split over all options (AAAAABCD) gives a higher disagreement of **D** = 0.64. Yet the latter is more likely to reach consensus based on a normative process. That polarized groups, where the group splits into two opposing subgroups, show relatively high agreement is not a problem with the measure, as each pole contains many pair-wise agreements. This is shown when a polarized group splits into two, as then, each group has full agreement (for each new group, **D** = 1.0). Group disagreement and the likelihood of consensus seem two different dimensions, one measuring the current state, and the other predicting a future state.

EXAMPLE APPLICATIONS

This measure can be used wherever agreement is an important outcome for groups facing categorical choices. Some examples are:

1. **Diagnostic Situations:** For example, online doctors diagnose a patient's condition.
2. **Expert Analyses:** For example, online experts assess disaster prevention options.

3. **Leadership Selection:** For example, bulletin board members elect a leader
4. **Product Evaluations:** For example, a group of customers selecting a product

Whether it is three doctors with different diagnoses, or three computers with different space shuttle launch decisions, the issue of agreement arises commonly when groups choose then act. Agreement here is the precondition for correctness, as a group must first agree to be wrong or right. Indeed, in some cases, making a choice may be more important than the choice made. The measure **D** is especially useful for online interaction, because it is standard and can always be calculated, even if N and K are unknown at first. For example, in a diagnostic case, the number of doctors and diagnoses may be initially unknown. Whether for 7 people making three choices or 10 people making two choices, **D** produces a single summary score, suitable for graphical display, for example, a bar graph.

The measure can also be used in cases where agreement is a secondary group measure. For example, students can, after reading a textbook chapter for homework, answer online multichoice questions on various topics prior to class. This can tell an instructor which topics are unknown, and be used to direct valuable class time. The primary computer generated measure is the % correct for each question, but the computer could also generate disagreement as a secondary measure. For example, low correct but low disagreement suggests the majority understood something, but were perhaps fooled by a distractor, while low correct and high disagreement suggests no common understanding at all. Since most multiple-choice questions are categorical, not ranked, a statistical variance cannot be calculated here. Correctness and disagreement for category data can be compared to mean and variance for interval data. There are many cases where current measures provide choice means, but it would be useful to also know the group disagreement, for example, reputation systems tell how many people like you choose a given book, but not how many people like you do not.

This measure can be used in dynamic online social interaction, where the agreement output can be fed back into the system as an input; for example, selecting an online board or project leader. Voting for a leader is as important for online interaction as for face-to-face, yet most bulletin boards are appointed dictatorships. Why not elect online leaders democratically? One reason is that voting is more complex than it appears. For three or more choices, it may be impossible to translate individual choices into a valid group choice, as Arrow's paradox formally states (Arrow, 1963). To give a simple example, suppose two candidates support the majority 60% view but split that vote, getting 30% each. A third minority candidate may then get the highest vote of 40%, even though the majority oppose their view. Some suggest this is how Hitler came to power. One way to avoid this problem is to repeat the vote. Face-to-face voting is usually such an expensive procedure that this is not an option, although the Vatican cardinals repeat vote until a decision is reached. In online voting, repeating a vote is much easier as the computer collects and counts the votes. To computerize online voting, one needs some measure of whether the group is done, or needs to vote again. An automated measure of agreement could trigger the group to vote again or not. In some cases, trivial candidates could be deleted, eventually giving a binary vote where Arrow's paradox does not apply. Agreement should not be thought of as a static quantity, but as an evolving group dynamic where people affect people in a recursive way (Hoffman & Maier, 1964).

Finally, the individual level of this measure can tell individuals how much they disagree with the group on a given topic. Such feedback about what others think is naturally important to people in a social setting (Whitworth et al., 2000). In a study of voting before discussing, high disagreement was used to trigger the topics a group needed to talk about (Whitworth & McQueen, 2003). This focused the group on topics they disagree on, and let them ignore topics they already agreed upon. While one might expect such feedback to create conformity, it can also be a springboard for change. The authors found cases where individuals who disagreed with the entire group used the ensuing discussion to convince the others of their point of view. If one knows an idea generates disagreement, it can help the person know they must make a good case for it to succeed. It should not be assumed that group dynamics work only one way.

A RESEARCH EXAMPLE

The following illustrates how **d** and **D** can be used in dynamic online groups. Anonymous online groups had to decide a group response to 12 multichoice questions, each with four response options. The groups had three voting rounds, and between each round, members were told how their choice compared with the others. For example, they could find themselves in the minority (**d** ≥ *0.75*) or in the majority (**d** < *0.75*). First, they voted without seeing how others voted. On their second vote, however, they saw the group first vote, and likewise on the third vote, they could see their group's second votes. Each round, subjects could change their vote if they wanted to. Table 7 shows how the % who changed their position varied with individual group disagreement (Whitworth & Felton, 1999). Overall, only about a quarter of subjects changed their initial vote, but in general, the more subjects disagreed with the rest of the group, the more likely they were to change their original position.

But the individual disagreement (**d**) alone was not the sole predictor. It also depended on the degree the rest of the group agreed to disagree with them. A **D** score, called **Drest,** was calculated *for the other four members* of the group. Table 8 shows the possible **d** and **Drest** combinations; for example, ***A**AAAB* is an individual (in bold) who chooses option A and finds one other group member disagrees with them. Note that not all combinations of **d** and **Drest** are possible. Table 9 shows the percentage vote change broken down by **d** and **Drest,** with the subject numbers in brackets**.** It suggests individuals change their initial vote depending not only on how many disagree with them, but also on how much the others agree among themselves:

1. For **d = 0.0,** there is a low probability that another solution will be accepted, as three group members would have to change position. Only 1% of those who found that everyone else agreed with them changed their position.
2. For **d = 0.25,** the alternative probability has increased, though only slightly, as two group members would have to change position. The percentage vote change also rises slightly, though it more than doubles the amount for **d** = 0.0.
3. For **d = 0.5,** the subject is still in the majority. If the opposing two agree, their alternative position could form a majority if the voter changed to it. The vote change likelihood is twice as high if the others agree (8.3%) than if they disagree (3.8%).
4. For **d = 0.75,** the individual is now in a minority of two, so vote change rises dramatically to 35%. Again, it is higher if the others all agree (45%) than if they disagree (15%). Even if they disagree, the vote change is still twice that found than when **d = 0.5**.
5. When **d = 1.0,** the subject disagrees with everyone else, so are unlikely to form a majority. In this case, four disagreeing with the subject produces no more effect than three, so perhaps a normative threshold has been reached. In this case, the maximum vote change pattern is **A**BBCC, where two other options compete for the group majority, that is, where the group member has the casting vote.

Table 7: Percent vote change by individual disagreement

Vote 2	**Individual disagreement**				
	0.0	**0.25**	**0.5**	**0.75**	**1.0**
% changed vote	0.8%	2.0%	7.1%	36.3%	72.6%
N	479	403	368	355	551

Table 8. Vote patterns, individual by rest of group disagreement

Individual disagreement	**Rest of group disagreement**				
	0.0 AAAA	**0.5 AAAB**	**0.67 AABB**	**0.83 AABC**	**1.0 ABCD**
0.00 Disagree with no one	**A**AAAA				
0.25 Disagree with one		**A**AAAB			
0.50 Disagree with two			**A**AABB	**A**AABC	
0.75 Disagree with three		**B**AAAB		**B**AABC	**B**ABCD
1.00 Disagree with all	**D**AAAA	**D**AAAB	**D**AABB	**D**AABC	

Table 9. Vote change by d & Drest

Individual disagreement (d) when choosing option A	**Rest of group disagreement (Drest)**				
	0.0 AAAA	**0.5 AAAB**	**0.67 AABB**	**0.83 AABC**	**1.0 ABCD**
0.00 Disagree with no one	**1.0%** (1625)				
0.25 Disagree with one		**2.9%** (886)			
0.50 Disagree with two			**8.3%** (289)	**3.8%** (261)	
	AAAA	**ABBB**	**BBCC**	**ABBC**	**ABCD**
0.75 Disagree with three		**45.0%** (238)		**25.3%** (190)	**14.7%** (34)
	BBBB	**BBBC**	**BBCC**	**BBCD**	**ABCD**
1.00 Disagree with all	**66.1%** (369)	**68.4%** (247)	**77.0%** (61)	**60.3%** (78)	

The above suggests the following propositions on how group members create agreement:

1. **Inertia:** Individuals will tend to maintain their previously adopted position (about 75%).
2. **Isolation:** Individuals will change if their current position is unlikely to form a majority (0-45%).
3. **Conformity:** Individuals will change if an alternative option is likely to form a majority (2-20%).

A small amount of random change can also be expected to occur, at about 1%. These propositions could form the basis of a computer simulation of normative group behavior.

CONCLUSION

Disagreement is an important group output; for example, a group may resolve an issue by majority vote, yet still spend time discussing to reduce disagreements. If groups see agreement as important, then it is important to measure it. Facilitators can use online agreement measures taken prior to a meeting to adapt their meeting style for groups with higher disagreement. A group may find feedback on whether their agreement is going up or down over time useful. Quantifying the agreement a meeting produces can make it easier to justify the time groups spend generating agreement. These measures are particularly suitable in computer-mediated groups, where disagreement can be computer calculated. A standardized measure of group disagreement can be used in a wide variety of online situations.

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KEY TERMS

Computer-Media Properties: The computer medium has different properties from a physical one; for example, *asynchrony* (the message sending and receiving can be independent of time). Another property is *media richness*, the ability of a medium to convey meaning. An important media property when enacting agreement is *linkage*, which can be one-to-one, one-to-many, or many-to-many. One-to-one occurs when two people converse, one-to-many occurs with any broadcast or speech, but many-to-many is less-well known. An example is a choir: each singer hears everyone else, and each contributes to the total sound. This is possible because air allows sound signals to merge, so many sounds can combine into one sound. **Normative Interaction** means the whole choir can move off key, but individuals will not. Many-to-many computer-mediated communications can occur if the information system is designed correctly, and allows many-to-many exchange of merged group member position information (Whitworth et al., 2001).

Computer-Mediated Communication (CMC): In face-to-face interaction, information is exchanged by physical world activity. In computer-mediated communication, a computer network replaces the physical world as the medium of communication. In one sense, all technology operates in a physical environment, but in another sense, the technology is the environment through which communication occurs. In this view, telephone, CMC, and face-to-face (FTF) are all just communication environments. FTF communication is just as mediated (by the physical world) as CMC is mediated by technology.

Disagreement, Group: The degree that members of a group adopt different positions, whether physical positions, as with a herd, or intellectual positions, as with a group voting on an issue (See **Group**). If everyone adopts the same position, then the disagreement is zero.

Disagreement, Individual: The degree that one member of a group adopts a different position from the rest of the group.

Equivocality: Can mean any ambiguity or uncertainty that involves two or more choices, but in information systems, it generally means uncertainty that cannot be resolved by gathering or analyzing information (Daft, Lengel, & Trevino, 1987), for example:

1. Social decisions, like how people greet each other, that are enacted by social norms, where “right” is simply what everyone does.
2. Relational decisions, like who to marry, where how one decides affects the outcome; for example, if one commits to another that commitment can make the decision “right.”
3. Wicked problems where what is unknown is not just the problem but its context, as when a group must decide how it will make decisions before it can begin to make a decision (Reeves & Lemke, 1991).

In equivocal situations, groups enact decisions using **Normative Interaction**.

Group: Though there are many definitions of “group” (e.g., see Hogg, 1992, p. 4), a generally accepted one is any set of people who consider themselves to be a group (DeSanctis & Gallupe, 1987). The group in this sense emerges from the perceptions of its members as being part of it, and so is distinct from a simple aggregate or set of entities.

Normative Interaction: Normative interaction is a social process whereby members try to match their behavior to what they see as the group position. This "conformity" seems the prime force generating agreement in groups. Unlike rational analysis, it does not need verbal interaction, and unlike interpersonal interaction, it works with any size group. Social identity theory (Hogg, 1992) offers a psychological basis, namely that members identify with groups to which they belong; for example, U.S. citizens identify themselves as "American," even though that group contains millions. Normative interaction requires that group members are aware the position of the rest of the group, each individual is carefully "positioning" themselves so as not to be out of step with the rest of the group, maintaining the identity of the group and consequently, their own identity as a part of that group. A high-linkage medium can do this. See **Computer-Media Properties**.