

THE PROCESS OF COMMUNICATION IN FACE TO FACE VS. COMPUTERIZED CONFERENCES;
A CONTROLLED EXPERIMENT USING BALES INTERACTION PROCESS ANALYSIS

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INTRODUCTION

A computerized conference (CC) is a form of communication in which participants type into and read from a computer terminal. The participants may be on line at the same time--termed a "synchronous" conference, or may interact asynchronously. The conversation is stored and mediated by the computer.

How does this form of communication change the process and outcome of group discussions, as compared to the "normal" face to face (FtF) medium of group discussion, where participants communicate by talking, listening and observing non-verbal behavior, and where there is no lag between the sending and receipt of communication signals? This paper briefly summarizes the results of a controlled laboratory experiment designed to quantify the manner in which conversation and group decision making varies between FtF and CC. Those who wish more detail are referred to the literature review which served as the basis for the design of the experiment (Hiltz, 1975) and to the full technical report on the results (Hiltz, Johnson, Aronovitch, and Turoff, 1980). This paper is excerpted from a longer paper on the analysis of communications process in the two media and their correlates (Hiltz, Johnson and Rabke, 1980).

OVERVIEW OF THE EXPERIMENT

The chief independent variable of interest is the impact of computerized conferencing as a communications mode upon the process and outcome of group decision making, as compared to face-to-face discussions. Two different types of tasks were chosen, and group size was set at five persons. The subjects were Uppsala College undergraduate, graduate and continuing education students. The communications process or profile was quantified using Bales Interaction Process Analysis (see Bales, 1950).

In computerized conferencing, each participant is physically alone with a computer terminal attached to a telephone. In order to communicate, he or she types entries into the terminal and reads entries sent by the other participants, rather than speaking and listening. Entering input and reading output may be done totally at the pace and time chosen by each individual. Conceivably, for instance, all group members could be entering comments simultaneously. Receipt of messages from others is at the terminal print speed of 30 characters per second.

Even when all five participants are on-line at the same time, there is considerable lag in a computer conference between the time a discussant types in a comment, and when a response to that comment is received. First, each of the other participants must finish what they are typing at the time; then they read the waiting item; then they may type in a response; then the author of the original comment must finish his or her typing of a subsequent item and print and read the response. There is thus a definite "asynchronous" quality even to "synchronous" computer conferences. As a result, computer conferences often develop several simultaneous threads of discussion that are being discussed concurrently, whereas face to face discussions tend to focus on one single topic at a time and then move on to subsequent topics. (See Hiltz and Turoff, 1978, for a complete description of CC as a mode of communication).

A variable of secondary interest is problem type. Much experimental literature indicates that the nature of the problem has a great deal to do with group performance. One type of problem that we used is the human relations case as developed by Bales. These are medium complex, unsettled problems that have no specific "correct" answer. The second type was a "scientific" ranking problem (requiring no specific expertise), which has a single correct solution plus measurable degrees of how nearly correct a group's answer may be. The ranking problem, "Lost in the Arctic", was adapted for administration over a conferencing system by permission of its originators (See Eady and Lafferty).

The experiments thus had a 2 x 2 factorial design (see figure one). The factors were mode of communication (face-to-face vs. computerized conference) and problem type (human relations vs. a more "scientific" ranking problem with a correct answer). These factors constituted the "independent variables." Each problem-mode condition included a total of eight groups.

Figure 1

Design of the Experiment
Two by Two Factorial with Repeated Measures:
Blocks of Four

	Task Type A	Task Type B
Groups		
Face-to-Face	4	4
Computerized Conference	4	4

BACKGROUND: THE BALES EXPERIMENTS AND INTERACTION PROCESS ANALYSIS

Working at the Laboratory of Social Relations at Harvard, Bales and his colleagues developed a set of categories and procedures for coding the interaction in small face-to-face decision-making groups which became very widely utilized and generated a great deal of data about the nature of communication and social processes within such groups.

Coding of the communications interaction by Interaction Process Analysis involves noting who makes a statement or non-verbal participation (such as nodding agreement); to whom the action was addressed; and into which of twelve categories the action best fits. These categories are listed in subsequent tables and explained below. The distribution of communications units among the twelve categories constituted one of the main dependent variables for this experiment. We expected significant differences associated with mode of communication. We also expected some differences associated with task type. We did not feel that we had enough information to predict the directions of these differences. For almost every category, we could think of some arguments that would lead to a prediction that the category would be "higher" in CC, and some reasons why it might be lower.

METHOD

The number of Bales units per face to face group was much greater than the number for a cc group. Therefore, each individual and group was transformed to a percentage distribution among the twelve categories. Then statistical tests were performed to determine if there were any significant differences in IPA distributions associated with mode of communication, problem, order of problem, and the interaction among these variables in relation to the percentage distribution for each of the Bales categories.

There are many different ways in which the percentages could be computed. To take full advantage of the design, we computed the percentage distribution for each individual, in each condition. Thus, we actually have the Bales distributions for each of 80 individuals in a face to face conference, and in a computerized conference.

The mode of analysis was a two by two factorial nested design. If there was no significant group effect, then the error terms could be "pooled", meaning we could use the 80 observations as independent observations for statistical test purposes. We also performed a non-parametric test on the data for each Bales category, which gave us similar results.

DIFFERENCES ASSOCIATED WITH COMMUNICATION MODE

Two of the detailed analysis of variance tables on which the summary here is based are included as an Appendix. Note that the analyses were first performed separately for the two problems, using communication mode as the independent variable. For each problem, we tested the significance of mode of communication, order (whether it was the first or second problem solved by the group), and the interaction between mode and order.

Listed in figures two and three is a summary of the statistical results of the 2⁴ analyses of variance which examined observed differences between communication modes for each of the two tasks. The first two columns show the mean percentage of communications in each category. For example, in the first table, results for Forest Ranger, the first column shows that on the average less than 1% of an individual's communications were verbally "showing solidarity", but in CC, 3.22% fell into this category. The third column shows that the results for the 16 groups in the nested factorial design were significant at the .005 level, meaning that the probability of the observed differences occurring by chance in a sample this size is one in 200. The fourth column shows the level of significance if the group was not a significant variable and the observations could be pooled, with the 80 individuals treated as independent observations. In this case, group was significant, so the pooled analysis could not be done.

In looking at these data, there is an apparent coding problem. Even for the Forest Ranger problem, face to face, we obtained a somewhat different distribution of coding than did persons coding problem discussions such as this who were directly trained by Bales. (See Bales and Borgatta, 1955, p. 400 for the complete distributions). Our coding has 20% more of the statements classified as "giving opinions" than Bales and Borgatta code, and correspondingly lower percentages in all of the other categories. This means that our results cannot be directly compared to those of other investigators, since apparently the training for coding interpreted many more statements as representing some sort of analysis or opinion than "should" be there, according to the distributions obtained for similar studies by Bales and his colleagues. (Other possible explana-

tions are that Upsala College has produced an unusually opinionated and analytic set of students or that the effect of pre-experimental training in cc raises opinion giving even in subsequent FtF discussions.) It does not affect the comparisons among problems and modes for this study, since all of the coders were coding the data with the same guidelines and interpretations. In the majority of cases, the same pair of coders coded both the CC and FtF condition for the same group. In any case, the seven individuals who did the coding had been trained to an acceptable level of reliability.

Figure 2

Summary of IPA Results for Forest Ranger by Mode of Communication and Order

Bales Category	Average		P Significance	
	FtF	CC	By Group	Pooled
Shows:				
Solidarity	.79	3.22	.005	GS
Tension Release	3.98	.83	.0005	.0005
Agreement	13.19	4.79	.0005	.0005
Gives:				
Suggestions	4.70	9.21	.10	.10
Opinion	54.21	53.92	X	X
Orientation	12.81	16.10	.10	.02
Asks for:				
Orientation	3.27	1.58	.05	GS
Opinion	2.88	5.36	.01	.01
Suggestions	.30	.62	.25	.20
Shows:				
Disagreement	4.85	2.39	.05	.05
Tension:	.81	2.16	.05	.01
Problem 1st	.28	1.68		
Problem 2nd	1.33	2.64		
Antagonism:	.75	1.67	X	X

GS = Group significant cannot pool by individual

Figure 3

Summary of IPA Results for Arctic by Mode of Communication and Order

Bales Category	Average		P Significance	
	FtF	CC	By Group	Pooled
Shows:				
Solidarity	1.66	2.44	.10	.05
Tension Release	7.70	1.60	.0005	.0005
Agreement	13.35	6.82	.01	GS
Gives:				
Suggestions	3.56	4.89	.20	.10
Problem 1st	2.95	6.1		
Problem 2nd	4.17	3.61		
Opinion	42.99	57.80	.005	GS
Orientation	14.58	11.81	.25	GS
Asks for:				
Orientation	3.72	1.62	.025	.0005
Opinion	5.15	7.46	.20	GS
Suggestions	1.14	.58	X	GS

Shows:

Disagreement	3.51	2.46	X	GS
Tension:	1.52	.64	.025	.005
Antagonism:	1.11	1.86	X	GS
Problem 1st	.77	.73		
Problem 2nd	1.45	3.00		

GS = Group significant cannot pool by individual

DISCUSSION OF THE RESULTS

The twelve categories in Bales Interaction Process Analysis can be combined into four main functional areas. Categories 1-3 and 10-12 are the "social-emotional" functions, oriented towards internal group process. The first three are called "social-emotional positive", while 10-12 are "negative". Categories 7-9 are "Task oriented", giving answers or contributions to solving the problem faced by the group, and categories 4-6 are varieties of "asking questions" in the task oriented area.

It will be noted, by way of further introduction, that there are some very strong differences in the profiles, even in the same medium, depending upon the type of task faced by the group, and that there is some interaction between task type and medium. For example, more tension was shown in the arctic problem in the CC condition; more in the Forest Ranger problem in the FTF condition.

We will take each of the categories, describing more fully what is included in them, and then discuss the extent to which there appear to be significant differences between the media in the relative prevalence of communications of that type. We will also try to explain the possible reasons for or implications of significant differences that are discovered.

1. "Shows solidarity, raises other's status, gives help, reward"

Included in this category are initial and responsive acts of active solidarity and affection, such as saying "hello" and making friendly or congenial remarks to "break the ice"; praising or encouraging the other(s); giving support or sympathy or offers of assistance; urging harmony and cooperation. These are all overt attempts to improve the solidarity of the group.

Note that there is a significantly greater amount of "showing solidarity" in computerized conferencing. This is probably because much of the behavior of this type in a face to face situation is non-verbal, such as smiling in a friendly manner while nodding encouragement. Non verbal acts in this category are not codable from the tapes of the discussions. In the CC condition, however, the participants realize that they must put such things into words.

Another possible explanation is that the greater tendency towards overt, explicit showing of solidarity is an attempt to compensate for the perceived coldness and impersonality of the medium.

2. "Shows Tension Release, jokes, laughs, shows satisfaction"

This includes expressions of pleasure or happiness, making friendly jokes or kidding remarks, laughing.

There was significantly more tension release overtly expressed in the face to face groups. Much of this was waves of laughter, particularly in the arctic problem. The participants did not put this into words in the conference when typing. Observing them, however, there was much private laughter and verbal expressions showing "tension release", but these do not appear in

the transcript. It is part of the private "letting down of face" that occurs but is not communicated through the computer.

3. "Agrees, shows passive acceptance, understands, concurs, complies"

This occurs as concurrence in a proposed course of action or carrying out of any activity which has been requested by others. There is significantly more agreement overtly expressed in face to face conferences than in computerized conferences. We suspect that this is related to the pressure to conform created by non-verbal behavior and the physical presence of the other group members. In any case, it is undoubtedly related to the greater difficulty of CC groups in reaching total consensus.

4. "Gives Suggestion, direction, implying autonomy for other"

Includes giving suggestions about the task or suggesting concrete actions in the near term to attain a group goal. There is a tendency for more suggestions to be given by more people in computerized conferencing. This is part of the equalitarian tendency for more members to actively participate in the task behavior of a group in CC. In one of the problems, the difference was statistically significant at the .05 level; whereas in the other, it was sizable but did not reach statistical significance.

5. "Gives opinion, evaluation, analysis, expresses feeling, wish"

Includes all reasoning or expressions of evaluation or interpretation.

This is the most frequent type of communication for both problems and both modes. For the Bales problem, there was no difference in its prevalence associated with mode of communication. For the Arctic problem, however, there was a large and statistically significant difference, with more opinion giving in the CC condition.

6. "Gives Orientation, information, repeats, clarifies, confirms"

This includes statements that are meant to secure the attention of the other, (such as "There are two points I'd like to make..."), restating or reporting the essential content of what the group has read or said; non-inferential, descriptive generalizations or summaries of the situation facing the group. There are no clear differences here. Whereas there is a statistically significant difference in the direction of giving more orientation in CC for Forest Ranger, for the other problem, the difference is reversed.

7. "Asks for orientation, information, repetition and confirmation"

There is a significant tendency for this to occur more often in face to face discussions. This is probably because of the frequency with which a group member does not hear or understand the pronunciation of a sentence or partial utterance. In CC, people are usually more careful to state their thoughts clearly, and the recipient can read it several times rather than asking for repetition if it is not understood the first time or is later forgotten. We have noticed many CC participants going back and looking at comments a second or third time; in a face to face discussion, they would probably ask something like: "What was it you said before about x?".

8. "Asks for opinion, evaluation, analysis, expression of feeling"

This occurs more frequently in computerized conferencing. For one of the problems, the difference reached statistical significance, whereas it did not for the other. This tendency to more frequently and explicitly ask for the opinions of all the other group members, as well as to more spontaneously offer ones own opinions and analyses in CC, does seem to qualitatively be characteristic of the medium.

9. "Asks for suggestion, direction, possible ways of action"

This includes all overt, explicit requests, such as "What shall we do now?". It is not very prevalent in either medium, and there are no significant differences.

10. "Disagrees, shows passive rejection, formality, withdraws resources"

This includes all the milder forms of disagreement or refusal to comply or reciprocate. This is also an infrequent form of communication, but it occurs more in face to face discussions than in CC.

11. "Shows tension, asks for help, withdraws out of field"

Includes indications that the subject feels anxious or frustrated, with no particular other group member as the focus of these negative feelings. The results on this are rather puzzling. We end up with a statistically significant tendency for there to be more tensions when in CC for the Forest Ranger problem, but in FTF for the Arctic problem. Substantively, the proportion of these communications is very small in any case, and therefore, the small differences are not important.

12. "Shows antagonism, deflates other's status, defends or asserts self"

This includes autocratic attempts to control or direct others, rejection or refusal of a request, deriding or criticizing others.

This is infrequent in both media and there are no significant differences.

EFFECTS OF ORDER

For the most part, it did not matter whether the CC or the FTF discussion was held first. However, more suggestions were offered on the arctic problem if it was discussed in CC as the first problem, but more in FTF discussion if the FTF was preceeded by a CC condition. This is consistent with the tendency for CC to promote more giving of suggestions; apparently, the tendency carries over to a subsequent face to face conversation. This raises the interesting possibility that the group process and structure can be permanently changed by the experience of interacting through CC, a change that will carry over even to communications in other modes. Other pieces of evidence from other studies, including self reports of participants in long term field trials, indicate the same possibility.

CONCLUSION

Our investigation confirms the hypothesis that there are some significant differences in the group communication process between face to face and computer mediated discussions. Such differences seem to be associated with other characteristics of the medium, such as the greater tendency for minority opinions to be maintained, rather than a total group consensus emerging. In a fuller analysis (Hiltz,

Johnson, Aronovitch and Turoff, 1980) we show that the observed differences in interaction profiles are highly correlated with the ability of a group to reach consensus and with the quality of group decision reached.

APPENDIX

**Analyses of Variance
Bales Categories by Mode and Problem
2x2x4 Nested Factorial
Arctic
Individual % Data
Bales Category 1 - Shows Solidarity**

Order of Problem	Means Mode of Communication			
	FTF		CC	
	1st	1.6893	2nd	2.4348
		1.6228	2.4437	2.0333
		1.6561	2.4392	

Nested Design

Source	SS	df	MS	F
A	12.2673	1	12.2673	3.9004
B	.0166	1	.0166	.0053
A x B	.0285	1	.0285	.0091
C/AB	37.7414	12	3.1451	1.3745
S/ABC	146.4430	64	2.2881	
Tot.	196.4967	79		

Table Values For F
1 and 12 df=.75
12 and 64 df=1.90

Source	SS	df	MS	F
A	12.2673	1	12.2673	5.0618*
B	.0166	1	.0166	.0068
A x B	.0285	1	.0285	.0117
WG	184.1844	76	2.4234	
Tot.	196.4967	79		

Table Value for F
1 and 76 df=3.97
*Significant

A = mode
B = order
C/AB = error term for AB, and A x B
S/ABC = error term for C/AB
WG = Pooled error term

The pooled design yields a significant difference between the FTF and CC conditions. The CC conditions show a greater percent of their comments in the category of shows solidarity.

**2x2x4 Nested Factorial
Forest Ranger
Individual % Data
Bales Category 3 - Agrees**

Order of Problem	Means Mode of Communication			
	FTF		CC	
	1st	14.1900	2nd	5.4645
		12.1921	4.1183	8.1552
		13.1910	4.7914	

Nested Design				
Source	SS	df	MS	F
A	1411.0740	1	1411.0740	32.8693*
B	55.9134	1	55.9134	1.3024
A x B	2.1232	1	2.1232	.0495
C/ABC	515.1580	12	42.9298	.6774
S/ABC	4056.1449	64	63.3772	
Tot.	6040.4135	79		

Table Values for F
 1 and 12 df=4.75
 12 and 64 df=1.90
 *Significant

Pooled ANOVA

The following pooled design is not really necessary since one finds the variables significant as above.

Source	SS	df	MS	F
A	1411.0740	1	1411.0740	23.4598*
B	55.9134	1	55.9134	.9296
A x B	2.1232	1	2.1232	.0353
WG	4571.3029	76	60.1487	
Tot.	6040.4135	79		

Table Value for F
 1 and 76 df=3.97
 *Significant

A=mode

B=order

C/AB=error term for A, B, A x B

S/ABC=error term for C/AB

WG=Pooled error term

The nested design yields a significant difference between the FTF and CC Conditions. The FTF conditions show a greater percent of their comments in category 3-Agrees.

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