

Placement of Authority and Communication Pattern in Workplace Groups --- The Consequences for Innovation

Jean Carletta, University of Edinburgh
Simon Garrod and Heidi Fraser-Krauss, University of Glasgow

Keywords: workplace groups, communication, teams, meetings, innovation

Abstract

Group discussion is typically made up of a series of pairwise conversations. Using a corpus of workplace meetings in which decision-making authority is placed either in one individual or in the group as a whole, we demonstrate that both kinds of discussions are dominated by such conversations. However, in the groups with one authoritative individual, the same pairings recur, some people say more than others, and the authoritative individual dominates and controls the discussion, no matter how many people are present. In the groups which hold authority jointly, participation is more equal and more pairings are represented, but these properties degrade as discussion size increases. Current management theory about "teams" suggest that groups which have joint authority make better and more innovative decisions but that teams should be kept small. The theory of output/input co-ordination links these suggestions with the communication pattern differences observed.

Author Notes

Jean Carletta, Human Communication Research Centre, University of Edinburgh; Heidi Fraser-Krauss and Simon Garrod, Human Communication Research Centre, University of Glasgow.

This work has been funded by a grant from the Economic and Social Research Council (UK). We would like to thank The Institute of Work Psychology, of the University of Sheffield, for making the initial contacts to companies for us, Stephen Gifford and Christopher Brew for advice on the construction of ranking metrics, and David McKelvie and Richard Tobin for programming support.

Correspondence concerning this article should be addressed to Jean Carletta, Human Communication Research Centre, University of Edinburgh, 2 Buccleuch Place, Edinburgh EH8 9LW, Scotland. Electronic mail may be sent to J.Carletta@edinburgh.ac.uk.

Introduction

It has long been known that status affects the way in which people communicate. Communications in all but the smallest groups are centralized around group "leaders" (Hare, 1981; Homans, 1951). Group members talk most to others of similar status, with information reaching the leader and being disseminated via lieutenants (Homans, 1951). Within a group discussion, high status participants generally talk more and make more task-oriented utterances, while low status participants are often not even asked for information which only they have (Berger, Rosenholtz, & Zelditch Jr., 1980). Status affects not just the exchange of information but also the exchange of ideas. People are reluctant to express ideas in groups when higher status participants are present, and the groups are less likely to record the ideas which are expressed (Silver, Cohen, & Crutchfield, 1994). People also like leaders to be in control; participants dislike workplace groups where there is a high status chair but ordinary members participate fully anyway and propose solutions to the group's problems (Berkowitz, 1955).

Status and leadership are crucial issues for modern workplace groups because they are thought to affect group performance. Guzzo and Dickson (1996 p. 324) contrast "traditional work groups" with "autonomous work groups", defined as "teams of employees who typically perform highly related or interdependent jobs, who are identified and identifiable as a social unit in an organization, and who are given significant authority and responsibility for many aspects of their work, such as planning, scheduling, assigning tasks to members, and making decisions with economic consequences (usually up to a specific limited value)."¹ Although many studies have been done on the consequences of implementing autonomous work groups, especially on productivity, turnover, and attitudes, the results have been mixed. However, one suggestion (Guzzo & Dickson, 1996 p. 326) is that the benefits of autonomous groups arise in turbulent environments where "innovation" is required. Innovations are commonly defined as "responses to environmental change or means of bringing about change in an organization"; an organization innovates with "the implementation of an internally generated or a borrowed idea --- whether pertaining to a product, device, system, process, policy, program, or service --- that was new to the organization at the time of adoption (Damanpour & Evan, 1984 p. 393)." Innovation has long been linked to effectiveness (Mahoney & Weitzel, 1969) and change is currently seen as crucial in the face of stiff competition (Bowles, 1994). However, deciding what to change is difficult because the best changes often affect more than one part of the company, with no one person or group understanding all of the issues involved. Innovation requires both information and ideas to be freely exchanged between different functions within the same organization. The greater the rate of change in the external environment, the higher the rate of problems arising which do not break down neatly along organizational structure lines, and the greater the need for organic management systems (Burns & Stalker, 1966). One approach is for senior management to identify current problems and opportunities, and then to

¹ This terminology is somewhat unfortunate, since it has little to do with autonomy as defined by Homans (1951). Homans (p. 175) considers groups to be autonomous if the external environment has no influence on differentiation within the group. Other sources call these groups "informal" (Argyle, 1969 p. 230). Clearly Guzzo and Dickson's traditional groups are non-autonomous in Homans' terms, since the external environment dictates who has final authority within the group. However, even Guzzo and Dickson's autonomous groups are non-autonomous in Homans' terms, since by their definitions, all workgroups are created by external organizations from which their purpose is derived (Guzzo & Dickson, 1996) and from which roles and some status characteristics will be inherited (Berger et al., 1980). The notion of authority used by Guzzo and Dickson conforms to Homans' definition that "If an order given by a leader to a member of his group is accepted by the member and controls his activity in the group, then the order is said to carry authority (p. 418)," as long as one replaces "leader" with "group as a whole" for autonomous groups.

commission cross-functional problem-solving "teams" which cut across the organization's structure in order to address them. Companies have varying success with teamworking, but some companies are satisfied that they have tried to use teams when they have made only very small changes to traditional working practices, while others see teams as a radical shift (Guzzo & Dickson, 1996 p. 324). In particular, some companies' teams are autonomous, and others retain a designated group manager who has the final authority to make decisions. Since having individual authority over a group will give the manager relatively high status, one might expect where authority is placed in the group to affect whether or not ideas and information are freely exchanged and hence how well they introduce changes.

Our goal is to address the question of how the effect on communication of where authority is placed might account for autonomous work groups being thought better than traditional ones at generating and implementing innovations. There are two key parts to innovation: having the ideas about what to change in the first place, and having them accepted by the group. Previous work suggests that active discussion is important for both. Research scientists have their creative breakthroughs when they are talking to each other, not when they are sitting at their desks (Dunbar, 1996). Since good ideas might come from any combination of job functions, the best team discussions involve individuals who represent all of the relevant skills, but with each member of the team taking a unique role so that they will participate actively rather than waiting for someone else with the same expertise to step in (West, 1994). Meanwhile, the ethnomethodological literature suggests that people are loath to miss meetings because they fear they will have no influence on outcomes if they do not attend (Boden, 1994; Schwartzman, 1988). Decisions are the result of "the intense and intimate realtime involvement of the interaction order" for which "you had to be there (Boden, 1994 p. 99)." Such comments suggest that autonomous work groups might be better at generating and agreeing upon innovations if their meetings were characterised by active multi-party interaction in a way that traditional work group meetings are not. However, Parker (1988) showed that even in groups made up of unfamiliar male university students, "pairs of speakers hold the floor for periods of time while the other two group members listen. After some time, one of the listeners takes a turn, the floor-holding pair loses the floor, and either a new floor-holding pair takes the floor or the old pair regains it (p. 968)." These groups are likely to be less affected by status differences than any occurring in the workplace. In this study, we examine the communicative patterns of discussions from autonomous and traditional workgroup operating within manufacturing companies in order to determine whether autonomous groups have more active discussions than traditional ones. We consider differences in the predominance of pairwise conversations and in the diversity of the pairs which interact, with attention to the special role of the person in whom authority is placed in a traditional group.

Method

Group Selection

The companies were selected from the IWP² database of small-to-medium sized UK manufacturers. The managing directors of five companies were approached on the basis of prior classification with the intention of constructing a data set which included both autonomous and traditional groups. The managing directors themselves identified one group for recording, with the constraint that the group chosen must perform cross-functional complex problem-solving, by which we meant that the group must be solving problems which group members could not solve singly and that the group must do a reasonable amount of their business in meetings, drawing their members from different parts of the business. We agreed to record a series of whole

² Institute of Work Psychology, University of Sheffield.

meetings for each group lasting at least six hours in total and including at most six meetings. In two cases meetings turned out to be from different groups than the one identified, giving us six groups in total with one to six meetings per group. The researchers formed judgments about whether or not the groups were autonomous using Guzzo and Dickson's definition and based on conversations with the managing directors and group members during access negotiation and before and after meetings. In all cases, the classification concurred with the original prediction from the database originators. For a profile of the data set, see table one. The complete collection is of 21 meetings, 9 from autonomous groups and 12 from traditional ones. The groups and companies are described in the appendix along with the reasons for how they were classified.

Table One: Profile of the Data Set

	Printing Group 1	Printing Group 2	Heating Group	Casting Group	Lighting Group 1	Lighting Group 2
number of meetings	5	1	6	6	2	1
total hours recorded	4.25	1.75	6	6	8	1.5
total number of contributions	815	326	1335	3281	2638	445
meeting sizes	4-6	7	6-10	6-10	4-5	6
group size ^a	8	7	11	12	5	6
group type	aut.	aut.	trad.	trad.	aut.	aut.

^aGroup size is difficult to assess in work groups where members are drafted in to suit the situation. The sizes given indicate the total number of people who attended the meetings observed.

Our method of selecting groups was well-suited to address the question of how innovation arises in small manufacturing firms. Laboratory studies can not be made to bear directly on this question because the participants do not have enough investment in the process. We deliberately recorded meetings within the normal working practice of naturally occurring groups whilst interfering in that practice as little as possible. In our experience, once initial agreement to participate in a study has been negotiated, companies are more than willing to change their group structure or meeting practices to match what they think is wanted. Of course, the data resulting from such a method is unlikely to be as tightly controlled as that resulting from a laboratory experiment and therefore requires careful interpretation. Discussion size was a complicating factor for our data because attendance at meetings varied from week to week. The autonomous group discussions in our data set were smaller than the traditional ones; all of our autonomous group discussions involved four to seven people, whereas the traditional ones involved six to ten. This confusion may be unavoidable since autonomous work group meetings appear to be naturally smaller. Within a broad remit, the autonomous groups decided themselves what their goals should be and how best to meet them. They had to make clear plans or dissolve, and so they often explicitly discussed what topics should be addressed at individual meetings and who should be present. People prefer discussion groups of around five members because they give each person enough time to speak whilst not placing too much prominence on each person (Hare, 1981; Slater, 1958), and large groups tend to divide into smaller ones (Hare, 1952). Thus autonomous groups may keep their discussions small. On the other hand, there was no pressure on our traditional groups to justify their own existence. They all used the same agenda week after week, giving no basis for deciding who should attend.

Data collection

Past work in this area has used two different methods of data collection. Bales (1951) developed a coding system which noted order of speaking and classified utterances by function but which could be applied during the group discussion, given the lack of recording technology at the time. McGrath (1984) suggested that Bales' coding could not be applied reliably from audio or video recordings, but others have had some success with coding systems of comparable subjectivity and complexity, at least with dyads (Carletta et al., 1997). Other work (Dabbs Jr & Ruback, 1987; Jaffe & Feldstein, 1970; Parker, 1988) has relied solely on the pattern of on/off vocalisations by individuals within the group. Obviously such a method will not allow content to be analysed. Our own approach is different from either of the previous ones; we use recordings in order to prepare an accurate transcript of the discussion. Our choice is motivated by the eventual desire to use the content of the meetings and the fact that it would be impossible to obtain the co-operation of real work groups if we needed to use the sort of close individual microphone recording which makes the vocalisation approach feasible. Audio recording was done with two PZM microphones linked to different channels of a high quality tape recorder; the microphones were set up so as to maximise channel differentiation but to be unobtrusive enough that participants would not move them. A single video camera was trained to record the gross movements of as many of the participants as possible; this record was used to aid speaker identification during transcription.

Transcription and coding

Transcribers were able to agree very reliably who made any one contribution; using the kappa statistic, $K=.93$, $k = 2$, $N = 230$, with an average of 2% and a maximum of 6% non-backchannel contributions left as unidentified. Audio typists transcribed complete contributions in order according to when they began but did not code finer timing information. A contribution was defined as a period of speech from one individual in which the only major pauses coincided with silence from the other speakers, so that the pause was likely to be caused by the speaker thinking and not by the speaker listening to someone else's contribution. Under this definition, speakers cannot follow themselves in the speaking order. Overlapped speech was transcribed, but parts of the meetings which were so badly overlapped that we could not track individual contributions or during which two conversations occurred at the same time were omitted. There were five places where two conversations occurred at once; in each case the overlap was under a minute long and contained five or fewer contributions in either conversation. Other omitted overlaps were very short and infrequent. In total, roughly one minute per hour of the transcripts was omitted. In addition, backchannel continuers, which express agreement, interest, or understanding in two-way conversations (Clark & Schaefer, 1989) but are usually absent during long "reporting" turns in meetings (Boden, 1994), were not included when calculating contribution sequences, partly because they are not attempts to take the floor (Schegloff, 1982) and partly because they are too brief and quiet (Oreström, 1983) to transcribe reliably. Given a transcription which included as many backchannels as we could identify, transcribers could agree on whether an utterance was a backchannel or something more substantial to be included in the turn-taking sequence reliably enough for the gross measures of speaker order and contribution rate used, $K=.71$, $k=5$, $N=111$. Note that badly overlapping contributions and backchannels have usually (Jaffe & Feldstein, 1970; Parker, 1988) but not always (Dabbs Jr & Ruback, 1987) been omitted in work based on vocalisation.

Autonomy, discussion size, and patterns of communication

Our first question is whether pairwise conversations dominate our autonomous group discussions any less than they do our traditional ones. Such dominance could

take several forms. The most obvious measure is the proportion of contributions which occur within such conversations³; more contributions outside them means more group interaction. However, two discussions with the same proportion of contributions in conversations can still differ in conversational structure. In particular, two discussions could have the same proportions, but one might contain a small number of long conversations, and the other a large number of shorter, more fragmented conversations with short competitions for the floor between them. One would consider the latter to be more interactive because the speakers change more often. The best measure of the degree of fragmentation in a discussion is the overall proportion of new floor contexts, since these begin each pairwise conversation. Another less direct measure is the proportion of contributions which occurs during long conversations.

Even if two discussions are equally dominated by pairwise conversations, they can still differ in which group members participate in these conversations. Our next question is how equally the group members who were present at a discussion participated in it. Equality of participation can be measured using the distance between the observed number of words spoken by each participant and the number one would expect if all participants had participated equally, and then inverting it.⁴ It is also useful to consider how much individuals vary in their own participation, since this gives a sense of how habitual their behaviour is. Variation in participation can be measured by considering the difference in the proportion of words each individual contributes in two meetings with comparable attendance. Discussions can be considered more active if they have more equal participation, with participants varying the amount that they contribute. We also consider how often all of the different pairs of participants address each other. Since group discussions are linked by the relevance of adjacent contributions, this can be measured by counting the number of times each participant speaks before or after each other participant. Consider the general patterns of interaction in the first Heating Firm and Printing Firm meetings (figures one and two, respectively), which are characteristic of these groups as a whole. The Heating Firm meeting is traditional and the Printing Firm one, autonomous. In the graphs, participants are represented as squares labelled with a letter. The heaviness of the line connecting any two participants reflects how often they made adjacent contributions in the meeting relative to other pairs of participants in the same meeting.

³ Note that this is not the same as counting contributions which occur in Parker's "floor" contexts, since the first and second contribution of each conversation can be in any of Parker's contexts.

⁴ Stephan and Mishler (1952) suggested that if one arranges the number of utterances for individual speakers in a group in rank order, there is a relatively fixed proportion between each number and the next one. This suggestion has been used more recently to parameterize computer simulations of group discussions (Stasser, 1988; Stasser & Taylor, 1991) but with the comment (Stasser, 1988) that this is more appropriate when "there are no procedural constraints on participation (i.e., members compete freely for discussion time) nor roles (e.g., discussion leader) that set differential participation norms." Certainly one would expect participants in work groups to have roles which are differentiated further than those in Stasser and Taylor's mock juries. Fixed proportions did not fit our data well; the coefficients of variation for the proportions in our discussions ranged from .04 to .6, with a mean of .31. This variation was wide enough that despite this precedence we did not consider it appropriate to use Stasser's parameter in rating equality of participation.

For simplicity, let E represent $\left(\sum_{p \in P} W_p\right) / |P|$, the total number of words spoken by participants in a meeting divided by the number of participants. In groups with completely equal participation, each

participant says E words. Observe that $\sum_{p \in P} ((W_p - E)^2 / E)$ reflects average distance from equal participation because it is 0 if all participants speak equally and $E|P|(|P| - 1)$ at its maximum, where one person says all words in the meeting. Therefore, we used the formula

$1 - \left(\sum_{p \in P} ((W_p - E)^2 / E)\right) / E|P|(|P| - 1)$ to scale the scores between 0 and 1, with better equality of participation represented by scores at the higher end of the scale.

Figure 1. How often each pair of participants made adjacent contributions in one traditional group meeting from the Heating Firm.

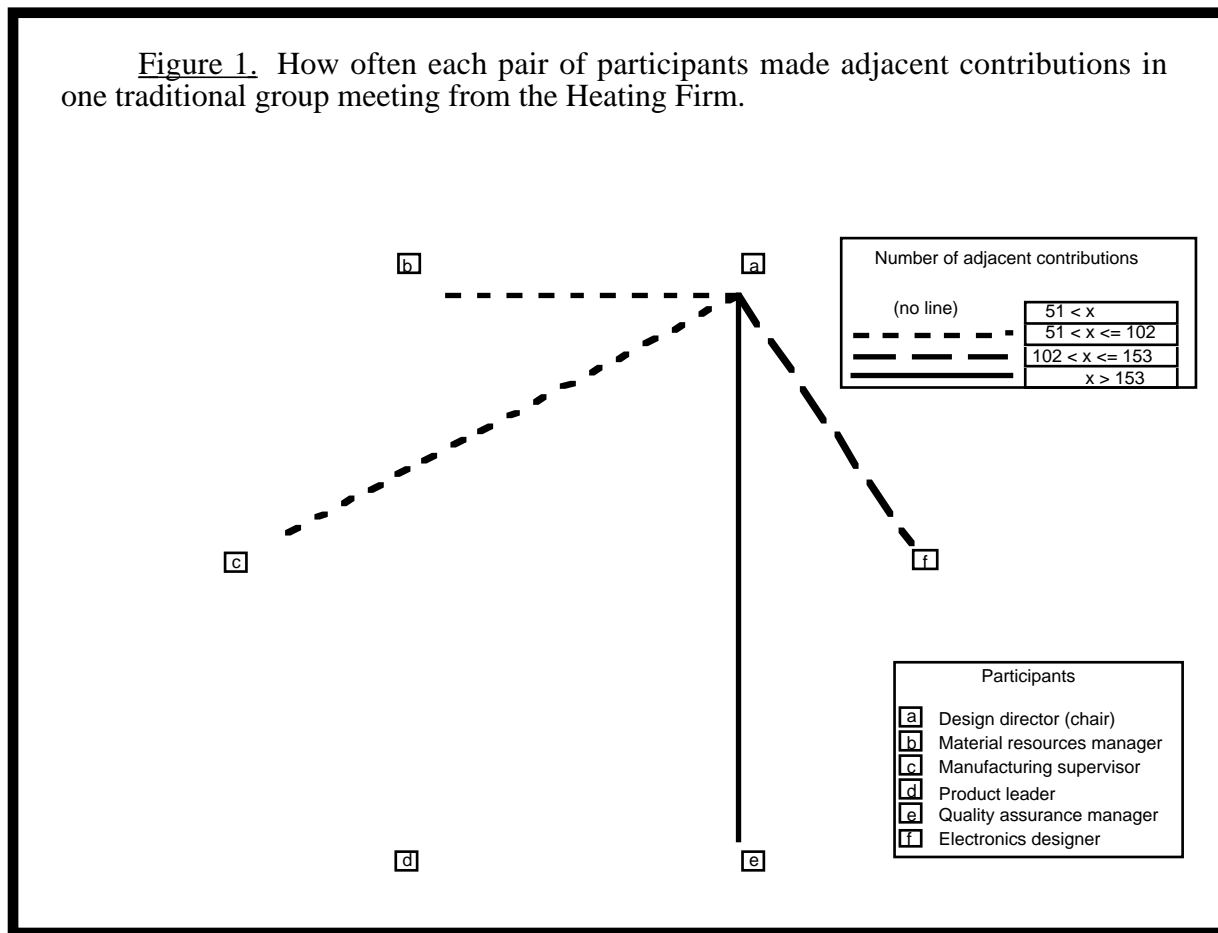
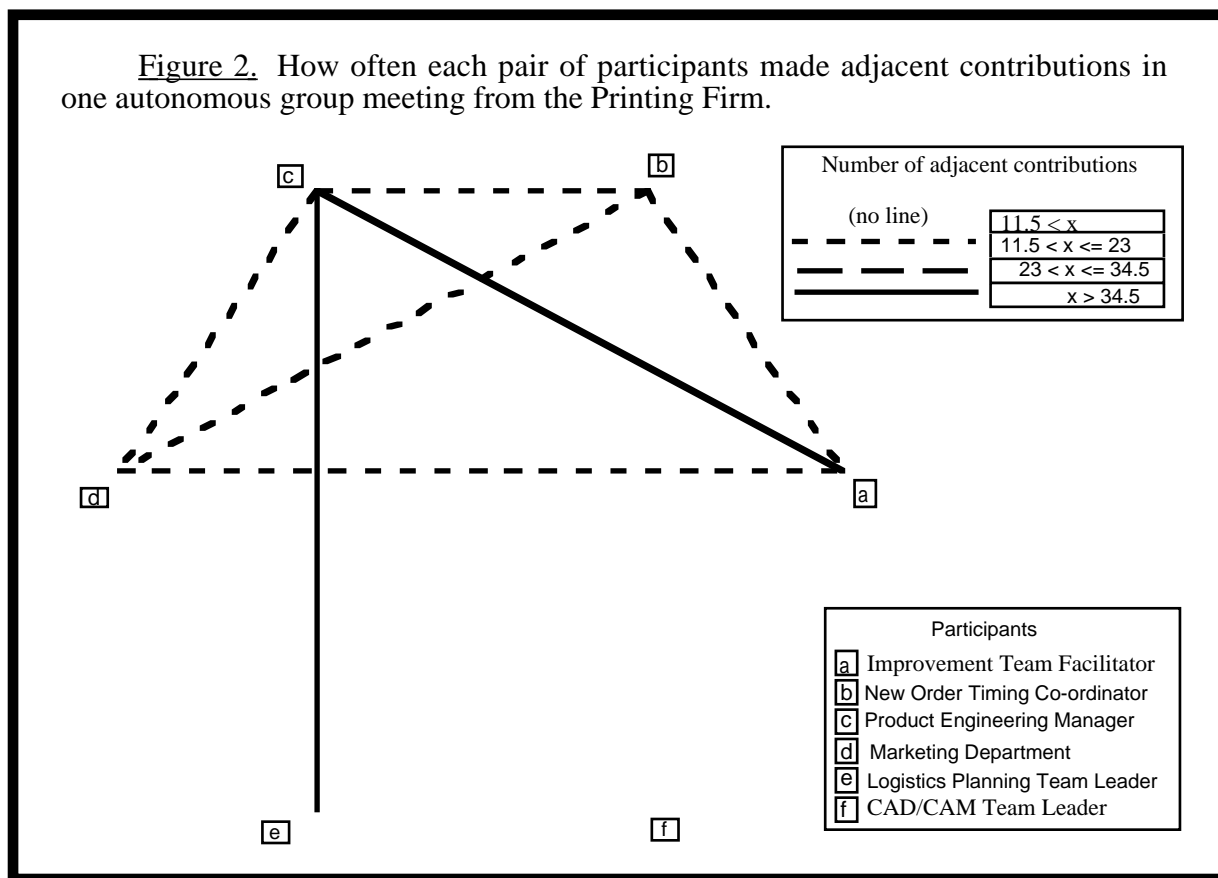


Figure 2. How often each pair of participants made adjacent contributions in one autonomous group meeting from the Printing Firm.



In general, the more equal the lines of the entire diagram, the more diverse the interactions that took place. In the first Printing Firm meeting, interaction was very free for a six person meeting except that speaker F was isolated. In the first Heating Firm meeting, most participants interacted with only one key person. Freedom of interaction can be scored using the inverse of the proportion of maximum entropy achieved in the pattern of who spoke after whom.⁵ Entropy is a central concept in information theory (Cherry, 1966) and has been applied to the analysis of participation in brainstorming groups (Ruback, Dabbs Jr, & Hopper, 1984). It measures predictability in a data sequence; less predictable sequences are said to be more informative and have higher entropy. The freer the pairwise interaction, the less easy it should be to predict who will speak given who spoke last plus the relative frequencies of all the possible two-person sequences of speakers in the data.

Finally, since the primary way in which autonomous and traditional group discussions differ is in whether authority belongs to the group or to an individual

⁵ If $S_{a,b}$ was the number of times that speaker b spoke immediately after speaker a, and T_b was the total number of times b spoke immediately after anyone in the meeting, then the entropy H of the meeting is given by $H = -\sum_{S_{a,b}} (S_{a,b}/T_b) \log_2(S_{a,b}/T_b)$. H is 0 if whenever some speaker has just spoken, the same person always speaks next, and is at its theoretical maximum if the interaction is at its most free --- that is, if whenever some speaker has just spoken, everyone else has an equal chance of speaking next. This maximum varies with the size of the meeting and is equal to $-n \log_2(1/(n-1))$, where n is the number of participants in the meeting. Therefore it was possible to score a meeting for freedom of interaction by subtracting H from the maximum possible for a meeting of that size and dividing by that maximum. This yielded a score between 0 and 1 where 0 is the most free interaction and 1, the most predictable. We then subtracted this score from 1 so that it reflected freedom and not predictability of interaction.

group manager, a natural question is whether the manager plays a special role in the group's communication. Relatively high status may lead managers to dominate the proceedings. One way of measuring the manager's dominance is to consider how much he speaks in comparison to the other participants; another is to count the proportion of pairwise conversations in which he is involved, since whoever predominates in conversations will have some degree of control over the proceedings. However, looking at who initiates communication provides two finer measures of control. Dabbs and Ruback (1987 p. 126) summarized a strand of Bales' work as concluding that "the group member who initiates the most communication acts as the central focus of the communications network in the group, receiving questions from other group members and communicating information and opinions to the group as a whole as well as to other specific individuals." In a pairwise conversation, the second person to speak is typically responding to something said by the first person. For instance, consider the following interaction from a traditional group meeting in the corpus:

Manager: [Firm B], [Production Planning Representative], this was last week where we asked for a sample order to be raised and put on the system.

Production Planning: I put it on this morning.

Manager: So that's on. They're to be moulded. OK, we'll get that on the system. That's the one that we just finished a large quantity of. Next item was [Firm O].

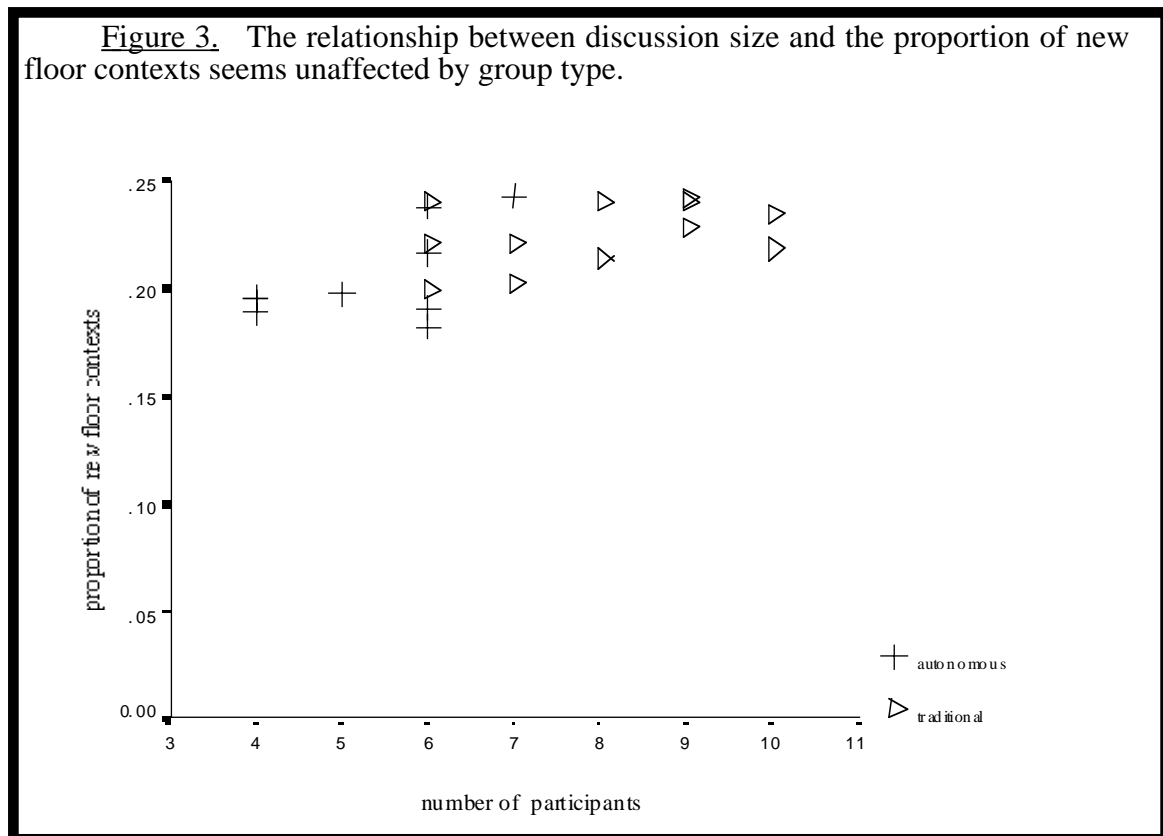
Here, the manager is explicitly controlling the flow of the meeting. However, control can also be subtler; for instance, the first person to speak may ask a question or make a suggestion which naturally leads to some immediate response on the part of the second person, and then to some follow-on reaction to that response from the initial speaker, or some further questions or suggestions. In such cases, the initial speaker controls the interaction by setting the goals which should be met by the communication (Carlson, 1983). Thus one measure of control is the proportion of the pairwise conversations in a meeting which were initiated by an individual. To allow for differences in underlying conversation rates, we also consider the proportion of one's own conversations which an individual initiates.

Results

There was no correlation in the data set between discussion size and either the proportion of contributions in pairwise conversations overall or the proportion of contributions in long conversations⁶ (Spearman $r_s=0.26$ and 0.08 , respectively, $n=21$, NS). However, discussion size was correlated with the proportion of new floor contexts (Spearman $r_s=.61$, $n=21$, $p<.005$ two-tailed). This correlation did not appear to come from discussions from one of the two types of groups, although sample sizes were rather small for this test (for autonomous group discussions, Spearman $r_s=.36$, $n=9$, NS; for traditional ones, Spearman $r_s=.47$, $n=12$, NS); see figure three.

⁶ We defined a long conversation to be one containing six turns or more. The meetings we recorded had median conversation lengths ranging between 3 and 5 contributions, with an average of 3.38. They had maximum conversation lengths ranging between 8 and 43 contributions, with an average of 15.38.

Figure 3. The relationship between discussion size and the proportion of new floor contexts seems unaffected by group type.



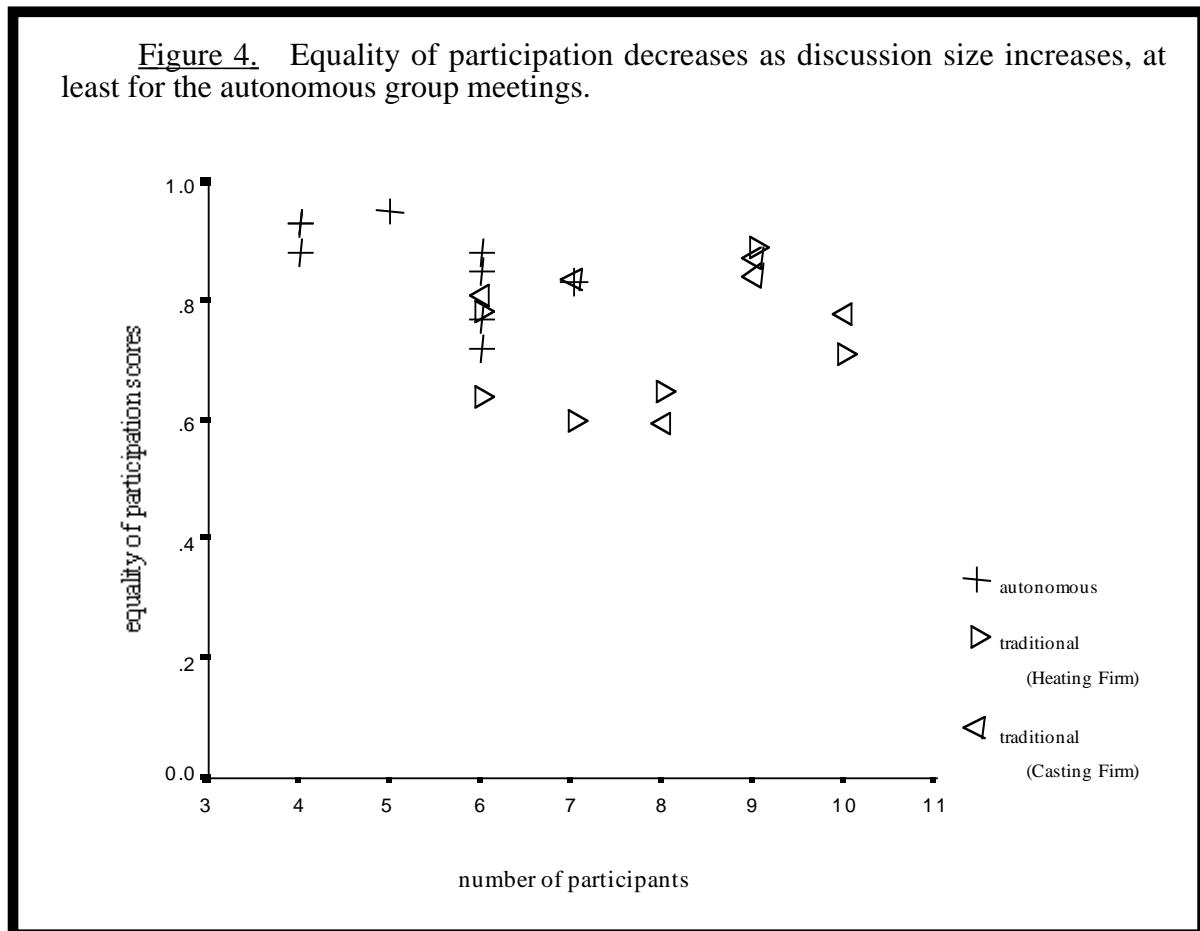
The proportion of contributions in pairwise conversations was no lower for autonomous group discussions than for traditional ones (median traditional group discussion rank was 12.5; median autonomous group discussion rank was 8; Wilcoxon-Mann-Whitney $W_x = 82$, $\underline{m}=9$, $\underline{n}=12$, $\underline{z}=-1.17$, NS). This was true even if we only considered long pairwise conversations (median traditional group discussion rank was 12.5; median autonomous group discussion rank was 8; Wilcoxon-Mann-Whitney $W_x = 82$, $\underline{m}=9$, $\underline{n}=12$, $\underline{z}=-1.17$, NS). Although the rank sums and medians were the same for these two tests, the two scoring systems did not rank the group discussions in the same orders.

The proportion of new floors was different between autonomous and traditional groups, but the autonomous group discussions had a *lower* proportion of new floors than the traditional ones (median traditional group discussion rank was 13.5; median autonomous group discussion rank was 5; Wilcoxon-Mann-Whitney $W_x = 68$, $\underline{m}=9$, $\underline{n}=12$, $\underline{z}=-2.20$, $p<.03$ two-tailed).

Discussion size was mildly negatively correlated with our equality of participation scores (Spearman $\underline{r}_s=-0.43$, $n=21$, $.05<p<.10$ two-tailed), although this correlation appeared to stem from the autonomous group discussions (Spearman $\underline{r}_s=-0.71$, $n=9$, $p<.02$ two-tailed) and not the traditional ones (Spearman $\underline{r}_s=0.21$, $n=12$, NS; see figure four). Note that given our sample sizes, one might be willing to accept such marginal significances, pending further data collection. Discussions from autonomous groups showed more equal participation using our scoring system than discussions from traditional ones (median autonomous rank was 15; median traditional rank was 8.5; Wilcoxon-Mann-Whitney $W_x=131$, $\underline{m}=9$, $\underline{n}=12$, $\underline{z}=2.24$, $p<.01$ one-tailed). Participants in autonomous group discussions varied the percentage

of words they contributed to two meetings with comparable attendance⁷ more than participants in traditional group discussions did (median autonomous participant rank was 33.75; median traditional participant rank was 17.5; Wilcoxon-Mann-Whitney $W_x=670$, $\underline{m}=22$, $\underline{n}=24$, $\underline{z}=3.4$, $\underline{p}<.001$ one-tailed). These variances were not related to the number of speakers common to the two meetings (Spearman $\underline{r}_S=-0.03$, $\underline{z}=-0.21$, $n=46$, NS) or to the percentage of words spoken by participants who attended only one of the two meetings (Spearman $\underline{r}_S=-0.11$, $\underline{z}=-0.66$, $n=46$, NS).

Figure 4. Equality of participation decreases as discussion size increases, at least for the autonomous group meetings.



There was the same confusion with discussion size for freedom of interaction scores as for equality of participation. Similar to the results for equality of participation, discussion size was negatively correlated with our freedom of interaction scores (Spearman $\underline{r}_S=-0.62$, $n=21$, $\underline{p}<.005$ two-tailed), although again this correlation appeared to stem from the autonomous group discussions (Spearman $\underline{r}_S=-0.69$, $n=9$, $\underline{p}<.10$ two-tailed) and not the traditional ones (Spearman $\underline{r}_S=-0.26$, $n=12$, NS). Note again the small sample sizes. Using this scoring, the autonomous group discussions did in fact exhibit more diverse interactions than the traditional ones (median autonomous rank was 17; median traditional rank was 8.5; Wilcoxon-Mann-Whitney $W_x=126$, $\underline{m}=9$, $\underline{n}=12$, $\underline{z}=1.88$, $\underline{p}<.05$ one-tailed).

For each of our four measures of individual control over the meeting, traditional group managers contributed more than would have been expected if all group members had contributed equally. Table two summarizes the statistical results and gives a sense of the magnitude of the differences by describing the population of ratios between the manager's contribution and the average individual contribution, in

⁷ Meetings were considered to have comparable attendance if participants who attended only one of the two meetings accounted for less than ten percent of the total words spoken.

terms of words said, pairwise conversations engaged in, pairwise conversations initiated, and the proportion of one's own conversations initiated. For instance, on average group managers spoke 3.9 times as many words as the mean number of words spoken by anyone in their groups.

Table Two: Four measures of managerial dominance.

	sign test			ratio of manager to average for meeting	
	\bar{x}	N	α	mean	std. dev.
words	0	12	.001	3.9	1.1
conversations engaged in	0	12	.001	2.9	0.6
conversations initiated	0	12	.001	4.3	1.5
proportion of own conversations initiated	0	12	.001	2.3	1.2

Although group managers exert more control over group discussions than the average participant, this does not preclude there being other members who exert even more control than the managers. There is one traditional group meeting in the corpus for which the group manager did not participate in and initiate more pairwise conversations than everyone else; he was bettered by the managing director of the company, who was sitting in on a meeting he would not ordinarily have attended.

Discussion

The fact that neither discussion size nor autonomy related to the predominance of pairwise conversations concords with what is known about how people take turns. In dyads, the mechanism for ceding the turn to the conversational partner is highly visual. The gaps between adjoining utterances are too short for it to be the case that people start talking when they notice that their partners have finished speaking (Sacks, Schegloff, & Jefferson, 1974). Speakers look away while they plan an utterance, and then towards the end of an utterance look at the partner to make sure the utterance is having the desired effect (Kendon, 1967). Hearers resort to gross movements such as balance shifting or gestures to try to obtain the turn early (Beattie, 1980), and speakers use different kinds of gestures to signal that they wish to retain or yield the floor (Duncan, 1972). Since people learn to communicate in dyads, it seems likely that a speaker in a discussion will tend to look at the last person to speak. In a competition for the floor, the first person to start speaking usually obtains it (Sacks et al., 1974), so that the person at whom the speaker is looking has the advantage. Similarly, there is an advantage to people who can see the main speakers clearly; hence the people at the head of a table or across from talkative people speak more (Dabbs Jr & Ruback, 1987; Lobb, 1982; Steinzor, 1950). This turn-taking mechanism is so basic that, despite the rhetoric behind teamworking, it is not surprising that discussion size and placement of authority have no effect on how many contributions occur in pairwise conversations.

Our autonomous group discussions were small and small discussions have a smaller proportion of new floor contexts, but our autonomous group discussions did not contain more long conversations than our traditional ones. Intuitively, it always seems harder to break into a conversation the longer one waits to do so once the desire to speak arises. One possible explanation of this result is that if the participants in a discussion have all decided not to interrupt a conversation in the initial stages, that conversation is likely to go on until some natural break ends it.

The correlation between group type and the proportion of new floor contexts could be accounted for by the confusion of discussion size with group type, since the autonomous groups were smaller and had fewer new floor contexts. Stasser and Taylor (1991) suggested that the larger the set of participants, the more fragmented the conversations will be because of increased competition to gain the floor. If we recall that one of the points of implementing autonomous work groups is supposed to be more active discussion, and that fragmentation of conversations is one measure of how active the discussion is, then the fact that it increases with discussion size regardless of group type suggests at least that group type is not a major determiner for it.

The degree of control that the managers of traditional groups exercised explains the lack of a relationship between discussion size and either equality of participation or freedom of interaction for traditional groups. Group managers have the authority to bring their own preconceived notion of order to a discussion no matter how many people are present. The observed relationship between discussion size and the number of new floor patterns in traditional groups can be explained by the fact that the more people present, the more people the group manager feels the urge to talk to in the allotted time. No relationship is observed between discussion size and either equality of participation or freedom of interaction in traditional groups because strong leaders impose centralized communication networks (Hare, 1981), even in relatively small groups. Group managers naturally control discussion because their authority gives them relatively high status; as a result they talk more, make more task-oriented utterances, and are asked to make more task-oriented utterances (Berger et al., 1980). People of high social rank, such as group managers are likely to be, initiate interaction for others more often than they have it initiated for them (Chapple & Arensberg, 1940; Homans, 1951 p. 145). On the other hand, if authority is not placed in any one person, the ensuing free-for-all should work well for small discussions but deteriorate as discussion size rises, since this will tend to degrade sight lines and increase competition for the floor. It has previously been observed in discussion groups that the larger the group, the more likely it is to form a centralized communication network (Hare, 1981), the higher the number of nonparticipants (Bray, Kerr, & Atkin, 1978) and the more one person will dominate the discussion (Bales, Strodtbeck, Mills, & Roseborough, 1951). Thus larger autonomous groups will begin to behave more like traditional groups even though an authority has not been designated externally. For these reasons, we accept that equality of participation and freedom of interaction are related not just to size but also to where authority is placed. It appears that autonomous groups can break away from the kind of centralized communications that group managers impose, but only if they are kept relatively small.

Implications for Innovation in Workplace Groups

The assumption implicit in the organizational psychology literature is that active discussion within autonomous work groups leads to innovative behaviour. We have suggested that small autonomous groups show different patterns of communication than large autonomous groups or traditional groups of any size. We now propose the theory of output/input co-ordination as a mechanism for how the pattern observed in small autonomous groups could lead to better innovation after all and outline some practical implications for the implementation of innovative work groups which arise from our theoretical argument.

Output/input co-ordination

Garrod and Anderson (1987) used a corpus of experimentally-elicited task-oriented two-person games to demonstrate that the participants collaborated in order to establish schemes for describing the concepts needed for the task which they both understood and used. In establishing this description language, the participants did

not just stick to the first reasonable scheme which emerged, but explored different schemes in order to determine which was most appropriate. Pairs of participants eventually settled on a mutually agreeable scheme. Garrod and Anderson argued that this convergence occurred because of "output/input co-ordination"; unless there are good reasons for choosing otherwise, people choose the same sorts of descriptions which they have just heard from their partner. This co-ordination occurs because comprehension and generation are linked. Interpreting an utterance in a certain way predisposes one's next utterance to use the same formulation. Co-ordination benefits conversants by reducing the overall collaborative effort required (Clark & Wilkes-Gibb, 1986).

Garrod and Doherty (1994) went on to show that when pairs of participants were arranged so as to form a community in which each participant played with (and therefore had an opportunity to co-ordinate with) every other one, the outcomes were very different from when the trials were arranged so that there was one "key player" who played with all of the other participants. In the communities where interaction was equally distributed, each participant was initially exposed to a wide range of description schemes, but the entire community quickly converged on one scheme. This scheme was the one which predominated in the early games once the different schemes had been explored; again, this convergence is explained by output/input co-ordination. Note that the community arrangement allows a wide range of possible schemes to affect the final community choice. In addition, the community arrangement ensures that new partners will understand descriptions which use the community choice of scheme because they will have been exposed to them before, reducing communicative effort. On the other hand, in "key player" trials the participants are not exposed to a wide range of schemes early on, and they do not converge on one scheme but become increasingly disco-ordinated as the "key player" is exposed to more fresh partners.

The introduction of new description schemes in one of Garrod and Doherty's trials is similar to the introduction of a new idea in a work group meeting --- in both cases an individual comes up with a different way of looking at a problem which he or she thinks best fits the current situation and proposes it for adoption by his or her communicative partners. However, there is one major difference between Garrod and Doherty's experimental set-up and face-to-face communication in groups: Garrod and Doherty's participants communicated in isolated pairs. As we have argued, most face-to-face group discussion, including that in our autonomous and traditional groups, consists of pairwise conversations which are overheard by the rest of the group participants. However, overhearers do not understand as much of a conversation as the actual conversants because they are unable to affect a speaker's behaviour by, for instance, looking puzzled or interested (Schober & Clark, 1989). Although overhearers in face-to-face groups do have some opportunity to affect the speaker, competition for the floor within a group discussion makes it quite difficult to exercise it. Thus the difference between Garrod and Doherty's isolated pairs and group discussions is smaller than it might seem. Given that autonomous groups show the same patterns as Garrod and Doherty's communities, the principle of output/input co-ordination predicts that autonomous groups will innovate more simply on the basis of how communication works when an individual with final authority is and is not present.

There are a few previous studies which give some support to our suggestion that output/input co-ordination operates not just in Garrod and Doherty's limited setting but within the workplace for problem-solving in general and for the introduction of new ideas in particular. Work on group discussions has suggested that positions which are supported early and often are likely to be accepted by the group (Stasser & Taylor, 1991). Structured discussion leads to worse decisions than unstructured discussion, with less of the relevant information being included (Stasser, Taylor, & Hanna, 1989). Groups working on complex problems make fewer errors and reach a solution faster if they are decentralized (Shaw, 1964). Centralized groups are like

Garrod and Doherty's "key player" communities, which encountered new description schemes slowly and therefore gave each less of a chance to influence the final choice of scheme. These results suggest that we are correct in attributing the same communication difficulties for group discussion as were found in Garrod and Doherty's "key player" communities despite the fact that the latter involved communication between isolated pairs only. Moscovici and Doise (1994) distinguished between "passive" and "active" communication, where passive communication involves observing, informing oneself about the opinions of others, and overhearing conversations, and active communication makes every individual both the source and target for opinions and information. In their terms, our autonomous groups are more active. Moscovici and Doise suggested that in active communication, "tensions and dissonances are continuously modifying ideas and perceptions, until they converge (p. 80)," while passive communication does little to modify the participants' opinions.

There is also some support for our position from within the organizational psychology literature. Haleblan and Finkelstein (1993) found that in turbulent environments, groups perform better when the CEO of the company is less dominant. Although having a dominant CEO can affect the dynamics of a company in many ways, dominant CEOs are exactly those who are likely to centralize communication and disallow the kind of pairwise communication which might bring about good proposals for change. Haleblan and Finkelstein remark that dominant CEOs restrict the flow of information and that their teams spend a disproportionate amount of time supporting or rejecting the CEOs ideas. Guest (1962) showed that increasing lateral and upward communication in a factory and devolving authority downwards can raise productivity by allowing workers at the lower levels to determine how to improve production processes and to have these changes implemented. Rogelberg et al. (1992) showed that the quality of decision-making and agreement on the final outcome is better when using the "stepladder" technique, a structured problem-solving method, than when using conventional groups. Although there are several possible explanations for its benefits, the stepladder technique enforces better pairwise interaction by introducing members to the group one at a time, with each member presenting ideas to the group before hearing a summary of the discussion so far. In addition, West (1990) argued that good teams foster free information sharing in which the members are safe to participate actively, and that they end up with a more shared and more valued vision of their goals and plans. Output/input co-ordination suggests that the former leads naturally to the latter.

Practical Implications

It is unlikely that output/input co-ordination is the only factor at work in making autonomous groups more innovative. Although the evidence is somewhat tentative, relatively young, cohesive, and equal status groups are expected both to have less predictable speaking patterns (Dabbs Jr & Ruback, 1987) and to perform better on the sorts of tasks involved here (Berger et al., 1980; Guzzo & Dickson, 1996; Moscovici & Doise, 1994 p. 61; Silver et al., 1994). Groups are also thought to be more effective if they are heterogeneous, have a large pool of members, are well-informed, believe they will be effective, and set shared group goals on which they receive feedback (Guzzo & Dickson, 1996). On the whole, these factors encourage interaction among people with differing opinions. We propose co-ordination as the mechanism by which these factors bring about their benefits. However, if co-ordination operates in work groups as we have suggested, this raises two important questions about the implementation of work groups.

The first question comes about from the suggestion that innovation arises out of pairwise interaction and that pairings are more diverse in small, leaderless discussions. In this case, is it necessary for work groups to meet together as a whole? Many work groups go to great lengths to find acceptable meeting times. However,

ethnomethodological studies have suggested that most real discussion takes place in impromptu "doorway" chats (Boden, 1994; Schwartzman, 1988). The importance of this kind of interaction was acknowledged by (Katzenbach & Smith, 1993), who said, "creative insights as well as personal bonding require impromptu and casual interactions just as much as analyzing spreadsheets and interviewing customers (p. 119)." One way to foster innovation might be simply to ensure that people have the opportunity to bump into each other. In some cases, this can be done by rearranging office space to place group members near each other or by providing a common room. However, this is impractical for the sort of cross-disciplinary manufacturing team which draws participants from different roles across the factory. 3M, the company which invented yellow Post-it notes and views product innovation as the key to its success, overcomes these problems by having multi-disciplinary technical forums and dedicated cross-divisional research facilities --- and by encouraging their technical staff to communicate by allowing them to use 15% of their time pursuing their own ideas (Pullin, 1997). New technologies such as internet-based "chat rooms" or desktop communication software might also have a role to play as organizations become more disparate or even when they could come together; a study with older computer-based communication technology found that such technologies foster more equal participation, overcoming status differences, but unfortunately also overlooking expertise (Dubrovsky, Kiesler, & Sethna, 1991). Apart from the suggested improvements in innovation, simply the overall cost of meetings makes it worthwhile to consider how informal modes of communication can best be used.

The second question is whether or not organizations which are unwilling to vest authority in groups as a whole can still improve their innovation somewhat by improving their pairwise communication patterns. It can be difficult for organizations to give up traditional power structures. Perhaps one of the reasons that the relationship between autonomy and performance is so murky (Guzzo & Dickson, 1996) is not just that organizations mean different things by "teams" but also that different organizations have different amounts of pairwise interaction as part of their group cultures to begin with. If the authoritative figure is willing to listen to other people's ideas at all, fostering impromptu communication might help traditional groups just as it does autonomous ones --- as long as the boss is not always in the corridor or coffee room talking to people.

References

- Argyle, M. (1969). Social Interaction. London: Methuen and Co.
- Bales, R. F. (1951). Interaction Process Analysis: A method for the study of small groups. Cambridge, MA: Addison-Wesley.
- Bales, R. F., Strodtbeck, F. L., Mills, T. M., & Roseborough, M. E. (1951). Channels of communication in small groups. American Sociological Review, 16, 461-468.
- Beattie, G. W. (1980). The role of language production processes in the organization of behaviour in face-to-face interaction. In B. Butterworth (Ed.), Language Production. London: Academic Press.
- Berger, J., Rosenholtz, S. J., & Zelditch Jr., M. (1980). Status organizing processes. Annual Review of Sociology, 6, 479-508.
- Berkowitz, L. (1955). Sharing leadership in small decision-making groups. In A. P. Hare, E. F. Borgatta, & R. F. Bales (Eds.), Small Groups: Studies in Social Interaction (pp. 543-555). NY: Alfred A. Knopf.
- Boden, D. (1994). The Business of Talk: Organizations in Action. Oxford, England: Blackwell.

Bowles, B. A. (1994). Collaborative working and integrated communications services in the UK manufacturing sector. BT Technology Journal, *12*(3), 12-28.

Bray, R. M., Kerr, N. L., & Atkin, R. S. (1978). Effects of group size, problem difficulty, and sex on group performance and member reactions. Journal of Personality and Social Psychology, *36*, 1224-1240.

Burns, T., & Stalker, G. M. (1966). The Management of Innovation. London: Tavistock Publications.

Carletta, J. C., Isard, A., Isard, S., Kowtko, J., Doherty-Sneddon, G., & Anderson, A. (1997). The reliability of a dialogue structure coding scheme. Computational Linguistics, *23*(1), 13-31.

Carlson, L. (1983). Dialogue Games: An Approach to Discourse Analysis. Dordrecht: D. Reidel.

Chapple, E. D., & Arensberg, C. M. (1940). Measuring human relations: An introduction to the study of the interaction of individuals. Genetic Psychology Monographs, *22*(1), 3-147.

Cherry, C. (1966). On Human Communication: A Review, a Survey, and a Criticism. (Second ed.). Cambridge, MA: MIT Press.

Clark, H., & Schaefer, E. (1989). Contributing to discourse. Cognitive Science, *13*, 259-294.

Clark, H. H., & Wilkes-Gibb, D. (1986). Referring as a collaborative process. Cognition, *22*, 1-39.

Dabbs Jr, J. M., & Ruback, R. B. (1987). Dimensions of group process: Amount and structure of vocal interaction. Advances in Experimental Social Psychology, *20*, 123-169.

Damanpour, F., & Evan, W. M. (1984). Organizational innovation and performance: The problem of organizational lag. Administrative Science Quarterly, *29*, 392-409.

Dubrovsky, V. J., Kiesler, S., & Sethna, B. N. (1991). The equalization phenomenon: Status effects in computer-mediated and face-to-face decision-making groups. Human-Computer Interaction, *6*(2), 119-146.

Dunbar, K. (1996). How scientists really reason: Scientific reasoning in real-world laboratories. In R. J. Sternberg & J. E. Davidson (Eds.), The Nature of Insight (pp. 365-395). Cambridge, MA: MIT Press.

Duncan, S. D. (1972). Some signals and rules for taking turns in conversations. Journal of Personality and Social Psychology, *23*, 283-292.

Garrod, S. C., & Anderson, A. (1987). Saying what you mean in dialogue: A study in conceptual and semantic co-ordination. Cognition, *27*(2), 181-218.

Garrod, S. C., & Doherty, G. M. (1994). Conversation, co-ordination and convention: an empirical investigation of how groups establish linguistic conventions. Cognition, *53*(3), 181-215.

Guest, R. H. (1962). Organizational Change: The Effect of Successful Leadership. London: Tavistock Publications.

Guzzo, R. A., & Dickson, M. W. (1996). Teams in organizations: Recent research on performance and effectiveness. Annual Review of Psychology, *47*, 307-338.

Haleblian, J., & Finkelstein, S. (1993). Top management team size, CEO dominance, and firm performance: The moderating roles of environmental turbulence and discretion. Academy of Management Journal, *36*, 844-863.

- Hare, A. P. (1952). A study of interaction and consensus in different sized groups. American Sociological Review, *17*, 261-267.
- Hare, A. P. (1981). Group size. American Behavioral Scientist, *24*, 695-708.
- Homans, G. C. (1951). The Human Group. London: Routledge & Kegan Paul.
- Jaffe, J., & Feldstein, S. (1970). Rhythms of Dialogue. New York: Academic Press.
- Katzenbach, J. R., & Smith, D. K. (1993). The discipline of teams. Harvard Business Review, *71*(2), 111-120.
- Kendon, A. (1967). Some functions of gaze direction in social interaction. Acta Psychologica, *26*, 22-63.
- Lobb, M. O. H. (1982). Seating arrangement as a predictor of small group interaction. Journal of Advanced Nursing, *7*, 163-166.
- Mahoney, T. A., & Weitzel, W. (1969). Managerial modes of organizational effectiveness. Administrative Science Quarterly, *14*, 357-365.
- McGrath, J. E. (1984). Groups: Interaction and Performance. Englewood Cliffs, NJ: Prentice-Hall.
- Moscovici, S., & Doise, W. (1994). Conflict and Consensus: A General Theory of Collective Decisions. London: Sage.
- Oreström, B. (1983). Turn-taking in English Conversation. Lund, Sweden: Gleerup.
- Parker, K. C. H. (1988). Speaking turns in small group interaction: A context-sensitive event sequence model. Journal of Personality and Social Psychology, *54*(6), 965-971.
- Pullin, J. (1997). Precision ad infinitum. Professional Engineering, *10*(18), 32-33.
- Rogelberg, S. G., Barnes-Farrell, J. L., & Lowe, C. A. (1992). The Stepladder Technique: An alternative group structure facilitating effective group decision making. Journal of Applied Psychology, *77*(3), 730-737.
- Ruback, R. B., Dabbs Jr, J. M., & Hopper, C. H. (1984). The process of brainstorming: An analysis with individual and group vocal parameters. Journal of Personality and Social Psychology, *47*(3), 558-567.
- Sacks, H., Schegloff, E., & Jefferson, G. (1974). A simplest systematics for the organization of turn-taking for conversation. Language, *50*(4), 696-735.
- Schegloff, E. A. (1982). Discourse as an interactional achievement: Some uses of 'uh huh' and other things that come between sentences. In D. Tannen (Ed.), Analyzing discourse: Text and talk. 32nd Georgetown University Roundtable on Languages and Linguistics 1981. Washington, DC: Georgetown University Press.
- Schober, M. F., & Clark, H. H. (1989). Understanding by addressees and overhearers. Cognitive Psychology, *21*, 211-232.
- Schwartzman, H. (1988). The Meeting. NY: Plenum.
- Shaw, M. E. (1964). Communication networks. Advances in experimental social psychology, *1*, 111-147.
- Silver, S. D., Cohen, B. P., & Crutchfield, J. H. (1994). Status differentiation and information exchange in face-to-face and computer-mediated idea generation. Social Psychology Quarterly, *57*(2), 108-123.
- Slater, P. E. (1958). Contrasting correlates of group size. Sociometry, *21*, 129-139.

Stasser, G. (1988). Computer simulation as a research tool: The DISCUSS model of group decision making. Journal of Experimental Social Psychology, 24, 393-422.

Stasser, G., & Taylor, L. A. (1991). Speaking turns in face-to-face discussions. Journal of Personality and Social Psychology, 60(5), 675-684.

Stasser, G., Taylor, L. A., & Hanna, C. (1989). Information sampling In structured and unstructured discussions Of 3-person and 6-person groups. Journal of Personality and Social Psychology, 57(1), 67-78.

Steinzor, B. (1950). The spatial factor in face to face discussion groups. Journal of Abnormal and Social Psychology, 45, 552-555.

Stephan, F. F., & Mishler, E. G. (1952). The distribution of participation in small groups: An exponential approximation. American Sociological Review, 17, 598-608.

West, M. A. (1990). The social psychology of innovation in groups. In M. A. West & J. L. Farr (Eds.), Innovation and Creativity at Work: Psychological and Organizational Strategies. Chichester: John Wiley.

West, M. A. (1994). Effective Teamwork. Leicester: The British Psychological Society.

Appendix: Company and Group Descriptions

Printing Firm

Five meetings were recorded from a cross-functional group whose remit is to improve the speed with which new orders are processed. These meetings were professionally facilitated by someone with no technical expertise in the area, with team members trained in problem-solving techniques. Decisions were consensual. Who attended depended on the business being discussed. This group was classified as autonomous, since they had the power to make decisions affecting people outside the group, and this power was vested in the group as a whole. One remaining meeting was of a different group whose remit was to review the progress of individual new orders, pending the improvements to be introduced by the former group. This group was also classified as autonomous because the group as a whole was responsible for any changes in the existing schedule.

Heating Firm

Six meetings were recorded from a cross-functional group whose remit is to design a new caravan fan heater. Meetings were chaired by the "design director", who had ultimate responsibility for decisions but often invited contributions and suggestions from the floor. The entire group always attended meetings no matter what business was discussed. This group was classified as traditional.

Casting Firm

Six meetings were recorded from a cross-functional group from a manufacturer of industrial valves. The group's remit was to review progress on orders, with an emphasis on cash flow. Meetings were chaired by the "methods and development manager", with the managing director occasionally taking part. Meetings discussed the same topics using the same agenda at the same time every week, and decisions were imposed on the team by the chair. This group was classified as traditional.

Lighting Firm

Two meetings were recorded from the board of directors and chaired by the managing director. The company made light sources for scientific instruments and was formed by a management buy-out led by the current managing director. The directors had individual job functions relating to operations, sales and marketing, and finance and in conversation with us complained that the pressure in their daily jobs was such that rarely had the opportunity to talk to each other outside of meetings. Although the company claimed to be committed to team-working, this group explicitly discussed their unease with allowing other teams in the company to take on responsibilities. However, the board of directors itself shared responsibility, and thus was classified as an autonomous group. In one additional meeting, an accountant external to the firm facilitated a discussion in which the participants considered whether or not to float the company on the stock exchange. Here, the same people from within the firm were present, but were acting as a different group --- the group of people with a financial stake in the company. Since any decision about whether or not to float the company required the entire group to agree, this group was also classified as autonomous.