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G P I R

Maintaining Interpersonal Continuity in Groups: The Role of Collective Memory Processes in Redistributing Information

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Maintaining interpersonal continuity of experience is a process by which groups ensure that new information is available to members who require it. Groups and organizations continuously encounter new information. Sometimes this information is encountered by a single member (or subset of the group), who may have to redistribute it to other members for it to be useful to the group as a whole. Redistribution is conceptualized as a collaborative activity where members recall past episodes during group discussion, thereby creating shared knowledge. Discourse data from an observational study of groups managing a simulation show that redistribution takes place mainly at the outset of meetings. Members with different perspectives on new information participate differently in the redistribution process. Outgoing members (the possessors of new information) initiate a majority of references to the preceding meeting, and contribute the most memories. Incoming (previously inactive) members also participate in redistribution by focusing recall and contributing information of their own from earlier meetings. Redistribution is a dynamic process that evolves in the course of interaction.

keywords continuity, discourse, group memory, redistributing information, socially shared cognition

CONSIDER the reunion of two friends who have not seen each other for some time. They catch up on what has happened since their last meeting, telling each other about relevant new developments in their lives. They are bridging the discontinuity between their last encounter and the current one. They end the encounter by wishing each other well and committing to see each other again soon. Here too, they are bridging a discontinuity by projecting their relationship into the future. The continuity that

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they experience as an essential part of their relationship is not something given, but rather something *constructed* during interaction (Albert & Kessler, 1976; Goffman, 1971).

Continuity is also an essential function of group life. I define *maintaining interpersonal continuity of experience* as a collaborative activity by which groups ensure that new information is available to those members who need it to work at group tasks. There is an important connection between continuity and sharing knowledge. I propose that all real social systems organize a part of their activities to accomodate continuity demands, either in a routine or an ad hoc fashion. Continuity can be considered a component of what Arrow, McGrath, and Berdahl (2000) term system integrity. The question of continuity is at the heart of research on the relationship between individual and group phenomena (Cranach, Ochsenbein, & Valach, 1986), socially shared cognition (Resnick, Levine, & Teasley, 1991; Thompson & Fine, 1999) and groups as information-processing units (Hinsz, Tindale, & Vollrath, 1997; Larson & Christensen, 1993). However, it has generated little interest (none of it recent, and none of it in small group psychology).

The focus of this article is task continuity: How do groups with specialized roles redistribute information to ensure that everyone is in a position to perform the group task? In the next section, I discuss two threats to continuity: member fluctuation and new information. Focusing on the latter, I then discuss how continuity is maintained by redistributing new information and how this is a communicative process. I provide discourse data from an observational study of situated group action to show how the redistribution of information affects group discussion, and how participants collaborate in the redistribution process.

Threats to continuity: member fluctuation and new information

Member fluctuation

Continuity can be threatened by member fluctuation. Groups whose members interact regularly often develop a transactive memory system (Moreland, 1999). In such a system, members take responsibility for remembering information about topics for which they are experts, and rely on other group members to remember information about topics for which they are not experts. This makes the group more efficient, but it also makes it sensitive to member fluctuation. Members who leave take their expertise with them, which may be disruptive. Fluctuation also occurs when new members enter the group. Newcomers may disrupt established beliefs or practices. Indirect support for the claim that fluctuation can threaten continuity comes from research on the impact of turnover on organizations. Turnover increases administrative workload (e.g. the recruitment and training of new employees), decreases the stability of interactions among individuals, and weakens consensus. These effects lead in turn to a growth in administrative costs, a decline in integration, and a greater need for formalization (Price, 1989). Other research (Carley, 1992) suggests that the impact of turnover may be moderated by organizational structure, with centralized hierarchies less vulnerable to high turnover rates than teams, because the former are more likely to use routines or archives, which can buffer against the loss of knowledge produced by turnover.

The need for continuity may also explain why socialization forces in groups tend toward assimilation (Levine & Moreland, 1999), and why many groups have routines for ensuring the adequate socialization of new members. For example, in psychotherapy groups, new members are sometimes admitted as vacancies are created by therapy terminations. This can impede progress, because therapeutic goals are sidetracked while the group assimilates the newcomer (see Moreland & Levine, 1988). Sometimes, pretherapy training is used to minimize acclimatization periods for newcomers (Gauron & Rawlings, 1975).

To summarize, member fluctuation can affect group and organizational functioning in several ways, many of which threaten continuity of experience. Different kinds of routines can counteract these effects. Again, these can be seen as means of maintaining continuity.

New information

Comparatively speaking, member fluctuation threatens continuity on a larger time scale. A potential threat on a smaller scale is new information. Groups encounter new information continuously. However, only rarely will all members do so simultaneously. New information is often encountered by a single member acting for the group. New information must be communicated to other group members or rerouted to a specific person in order for the group to act upon it (Huber, 1991).

One way of circulating new information is when the person who acquired it recounts it at a later group meeting. Unshared, 'new' information can thus be integrated with 'old', shared information. The question is how this is done. There has been little research on this in small group psychology, although the problem has been characterized as 'directory updating' (Wegner, 1995). The problem has also been recognized in research on organizational learning (Huber, 1991). There is considerable research on the use of shared and unshared information in group discussion and decision-making (Wittenbaum & Stasser, 1996), but it focuses on 'static' tasks, where there are many discrete facts that are invariant over time. In contrast, I will focus on how groups deal with an ongoing flow of new information (e.g. continuously monitoring the state of task-relevant external variables). In the following sections, I first argue that the redistribution of new information is an important group activity. I then discuss how redistribution is accomplished as a communicative process.

Routines for redistributing new information

Redistributing new information is a problem for all social systems. It is especially important in organizations characterized by shift work, and so routines for dealing with the problem are common in such organizations. For example, hospital shift transitions are marked by meetings (rounds) to transfer patient information from one caregiver to another (Cicourel, 1990; Middleton, 1997). At these meetings, the outgoing caregiver typically briefs the incoming one on new developments in a patient's condition. An alternative to this serial transfer of information is centralization, whereby relevant information about ongoing conditions is periodically archived, as in patient records (Engeström, Brown, Engeström, & Koistinen, 1990) or log books. Another example, in the military, is patrolling, the purpose of which is to gather new information or update existing knowledge about the surroundings of a unit. When a patrol reports back, the ensuing debriefing can also be characterized as redistributing new information. A similar point could be made about briefings in flight crews. Scientific meetings, which also serve to redistribute new information (cutting-edge research), are yet another example. All of these routines ensure that new information encountered or generated by group members becomes available to the organization as a whole.

Small groups also have ways of maintaining continuity. Group meetings often begin with the minutes of preceding meetings. Couples regularly update each other about new developments in their lives (e.g. 'how was your day' sequences). As noted earlier, long-lost friends try to 'catch up' with each other when meeting again. Reunions are also interesting in this respect. A reunion is a periodical meeting of past members of a group (e.g. former classmates) that has ceased to exist (Seltzer, 1988). Reunions also emphasize continuity over time and provide a yardstick for measuring personal change. These examples illustrate that continuity can be maintained by filling in the period of time between the current encounter and the preceding one. They suggest that a common way of doing this is to redistribute unshared information encountered during that period. In the next section, I analyze this as a communicative process.

Redistributing information as a joint activity: conversational roles and perspectives

Understanding how new information is integrated into shared knowledge requires analyzing communication processes. The present

work is based on a view of discourse as joint action applied to conversational remembering. The joint action view of discourse (Clark, 1996; Clark & Brennan, 1991) considers communication to be collaborative in nature. To talk together is to engage in a minutely coordinated process. Each new utterance produced by a speaker must be accepted as understood ('grounded') by a hearer in order to constitute a contribution. Each new contribution to conversation adds to the common ground between speaker and hearer—the knowledge they believe to be mutually shared (Clark & Schaefer, 1989).

A growing body of research on conversational remembering (e.g. Bangerter, 2000; Edwards & Middleton, 1986; Hirst & Manier, 1996; Middleton, 1997) is based on this view. The focus of joint remembering is constructing a *version* of the past by organizing participants' experiences into the form of a narrative. Participants can contribute to the emerging narrative through different moves, including acts of remembering, requests for mnemonic assistance (Goodwin, 1987), or eliciting questions and evaluative comments (Hollingshead, 1998). Different perspectives on an event can be articulated, discussed, disputed, and integrated into the narrative. There may also be a division of labor in conversational remembering. For example, family members who are reminiscing together may spontaneously adopt different conversational roles (Hirst & Manier, 1996). Some become narrators and produce the bulk of the memories, others become 'monitors' and assess the accuracy of those memories, and still others become 'mentors' and direct the narrative. These roles also incorporate different perspectives on the emerging narrative.

To summarize, conversational remembering is a collaborative activity to which group members can contribute in several ways. Different members may have different perspectives on the same event. And members who did not experience an event may be interested in hearing a particular aspect of it that does not correspond to what group members who did experience the event have narrated. They can then redirect the narrative, by asking (for example) pertinent questions. Thus, discussing different perspectives leads to an integration of the information and is qualitatively different from merely reporting it. The point is that shared experience is not shared just because more than one group member experienced it. It only becomes truly shared when it is discussed, for only then is *mutual* knowledge created (Clark, 1996).

The present study

Redistributing new information can be conceptualized most simply as a collaborative activity where one group member (an *outgoing* member in a shift-type situation) recounts a past episode to another group member (an *incoming* member). The situation is characterized by an asymmetry of knowledge. The main outcome of the activity is a reduction of that asymmetry.

How is this activity related to other activities in the same group meeting? What effect does it have on group communication during the meeting? From the examples I have offered, the effect could be substantial. Indeed, in the closing moments of an encounter, communication is often dominated by expressions of well-wishing, regret at separation, and hopes for meeting again soon (Albert & Kessler, 1978; Schegloff & Sacks, 1973). Such acts create what can be termed *prospective* continuity—bridging an imminent separation by projecting a future encounter. In contrast, the present work deals with *retrospective* continuity—bridging a separation between the unfolding present encounter and the previous one. Therefore, talk in the opening moments of an encounter should be directed toward creating continuity through the communicative remembering of relevant past episodes.

How do group members collaborate to produce continuity? Incoming and outgoing members have different perspectives on new information. Their efforts should be influenced by the temporary knowledge asymmetry, which determines what they can or cannot contribute. The main burden of recall should fall on outgoing members, at least in the opening moments of the encounter, because they possess the new

information. But incoming members could also contribute, for example by directing the course of recall (Hirst & Manier, 1996). As the knowledge asymmetry is reduced, incoming members should participate more, leading to shifts in collaboration patterns.

This study explores these issues using observational data from a study of memory use in task-related communication (Bangerter, 2000; Bangerter, Cranach, & Arn, 1997). I wanted to document the creation of continuity in its generic form, and to generate hypotheses for further study. I relied on a combination of discourse analysis and quantitative measures. The study follows a middle line between fieldwork and experimentation, combining a high degree of ecological validity with statistical analysis. An open-ended methodology seemed most appropriate for a topic that has seldom been studied (see Fine & Elsbach, 2000; Gersick, 1988). In the following section, the study is described in detail.

Method

Simulation

Nine four-person groups with a formal role structure managed a complex computer simulation of a modern city over four days. The study consisted of two main phases. In the *training phase* (days 1 and 2), participants learned the basic functioning of the computer simulation and acquired specialized knowledge according to their different roles. Participants worked for an hour each day. In the *simulation phase* (days 3 and 4), participants managed the computer simulation together. This work lasted 90 minutes each day.

The computer simulation used was the game Sim City (Maxis Software, 1993). In that game, players build and manage a city, manipulating different game variables and administering transport networks, police departments, commercial, industrial, and residential zones, and so on. Players must take into account such factors as environmental problems, crime, and public opinion.

Each group was composed of two, two-person subgroups: the *City Council* and the *Traffic and Environmental Commission*. Each subgroup included two roles, a group leader and a subordinate. The leader of the group is the *Mayor*, who heads the City Council. The leader of the Commission is the *Chairperson*. The two subordinate roles in each subgroup are *Analyst 1* and *Analyst 2*. Participants were asked if they had a preference for any particular role. If so, then they were assigned that role. If not, then they were randomly assigned to a role. During the training phase, each person received a booklet detailing his or her responsibilities. Leaders were responsible for long-term planning and decision-making, and analysts were responsible for implementing plans and dealing with emerging problems. The booklets also contained information about the responsibilities of other group members.

The structure of these groups corresponded to a specific set of tasks. The city was designed so that several problems were salient at the beginning of the simulation phase. Participants had to solve these problems. The group as a whole worked toward achieving and maintaining a high public approval rating. To do this, it was necessary to work simultaneously toward the goals of *reducing crime*, *managing finances*, *reducing traffic*, and *reducing pollution*. The City Council was responsible for crime and finances; the Commission was responsible for traffic and pollution. Each task could be decomposed into several subtasks (actions consisting of manipulating particular game variables, such as building police departments). Leaders received detailed information about the tasks for which their group was responsible, including information about the causal relations among game variables, whereas analysts received practical training on the manipulation of the game system.

Interaction among group members took place in a sequence of meetings (see Figure 1) called a *discussion cycle*. This cycle was enacted twice on each day of the simulation phase, four times in all. A discussion cycle lasted around 40 minutes and consisted of six dyadic meetings, or *sessions*. During the first session (planning), leaders met and planned what to do during the coming cycle. They had access to the computer

system for consultative purposes only (the simulation was set on 'pause'). Analysts were inactive during this session, which lasted 10 minutes. They were told to take a 'break', which they could spend in a lounge area adjacent to the rooms where the experiment took place. During the next two sessions (subgroup discussion), each subgroup simultaneously met in separate rooms for 6 minutes to discuss subgroup-specific aspects of the tasks in more detail. During the third session (execution), analysts implemented the plans together on the computer. During this session, which lasted for 15 minutes, leaders were inactive, and the simulation was running. During the last two sessions (subgroup evaluation), both subgroups met again separately for 6 minutes to discuss results and feedback from the game system, and to initiate new plans for the next cycle (the simulation was saved after the first day, so that on the next day, players continued where they left off). In this way, the group managed an ongoing task implemented in a series of repeated dyadic interactions (24 in all).

This setting was purposely designed to approximate the complex environment of a real work group. It was ideal for studying redistribution of information. In the subgroup discussion and evaluation sessions, both members of each subgroup met. The subgroup discussion session occurred immediately after the planning session. Therefore, outgoing members from the planning session (Mayor and Chairperson) reported on new developments from that session to incoming members (Analysts 1 and 2), who had been inactive during that time. For the subgroup evaluation sessions, the roles were reversed. This time Analysts 1 and 2 came straight from the execution session as outgoing members and reported on new developments from that session to the incoming members (the Mayor and Chairperson). So, redistribution processes could be compared with both group

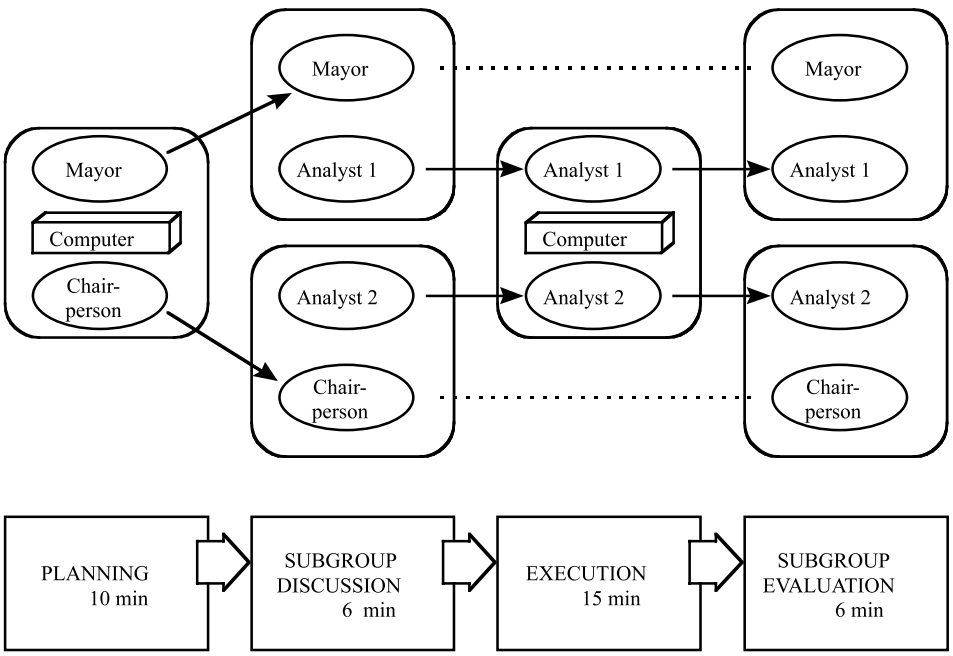

Figure 1. The different sessions of a discussion cycle. Rounded rectangles indicate the different sessions and the ovals indicate the participants. The sequence of participation in the sessions is indicated by full arrows. The dotted lines indicate transition of participants between sessions where they are inactive.

leaders and analysts in incoming and outgoing roles, controlling for possible effects of hierarchy on participation in redistribution. These sessions could also be compared with the planning and execution sessions, where there was no clear distinction between incoming and outgoing members (and no unequivocal asymmetry of knowledge between participants). Furthermore, in the planning and execution sessions, participants were from different subgroups, and probably less motivated to redistribute information than in the subgroup discussion and evaluation sessions. So there was reason to expect different patterns of participation across these two session types.

Data collection and transcription

Nine groups completed the study. Participants (22 females and 14 males) were recruited among students of the University of Berne, who participated for a combination of course credit and money. Interactions were videotaped and transcribed. All excerpts shown here are English translations of the original German transcripts. Utterances and actions are transcribed on separate lines, numbered, and preceded by an abbreviation of the speaker's or actor's role (M: Mayor; C: Chairperson; A1: Analyst 1; A2: Analyst 2). Acts are transcribed in italics. The onset of simultaneous speech (or simultaneous speech and action) is indicated by asterisks. Short pauses within turns are marked by a full stop. Transcriptionist comments are in brackets.

Coding: collective memory processes

Redistribution of information was investigated by analyzing *collective memory processes* (CMPs), defined as sequences of utterances comprising at least one reference to the past (a memory utterance, henceforth abbreviated 'MU') and related to a unitary theme. An MU was an isolated memory utterance produced by a single person, whereas a CMP was the sequence of interrelated utterances of which the MU was a part. A CMP was thus a relatively complex analytical unit. CMPs typically comprised between two and five utterances, about half of which were MUs. The rest were related acknowledgments or comments. Every session transcript was coded for MUs and CMPs. Interrater agreement was assessed with Cohen's kappa statistic on the basis of double-coded data from two sessions chosen randomly from each discussion cycle (eight sessions per group, or approximately a third of the data set). Kappa values for identification of MUs varied between .71 and .79 by session type (all kappa values were significant at $p < .05$). Because CMPs were sequences of utterances, interrater agreement was assessed by examining agreement on the identification of their opening and closing utterances. This conservative procedure led to kappa values varying between .60 and .74 (all ps $< .05$). According to Fleiss (1981), these values indicate agreement ranging from adequate to excellent.

Groups produced between 247 and 354 CMPs ($M = 304$) over the entire simulation. Excerpt 1 shows four successive CMPs from the opening moments of a subgroup evaluation session, where Analyst 2 was reporting back to the Chairperson on measures undertaken in the preceding execution session. (In all excerpts, memory utterances are marked with the abbreviation 'MU'. The past session to which an MU refers is indicated as: EX = Execution; PL = Planning.)

Excerpt 1 (Group 1, first discussion cycle, Commission subgroup evaluation session)

1	A2:	well and bridges the tram and the train I couldn't do that$_{EX}$	MU
2	C:	mhm mhm	
3		and up there did you do something?	
4		*points to sketch*	
5	A2:	yeah just also. also fixed$_{EX}$	MU
6	C:	but not APPs [Atomic Power Plants] *well power plants	
7	A2:	*but no APPs built uh-huh$_{EX}$	MU
8	C:	and the budget did you raise it?	
9	A2:	yes. yes we raised that$_{EX}$	MU
10	C:	yes you did all of that	

Four successive CMPs were coded here. The first CMP (utterances 1 and 2; theme: *railways*) contains one MU (1) that was acknowledged by a back-channel (2). The second CMP includes

utterances 3–5 (theme: *roads*). The MU (5) was an answer to an eliciting question on the part of the Chairperson (3). In the third CMP (utterances 6–7; theme: power plants), the MU (7) was also elicited (6). The fourth CMP (utterances 8–10; theme: transport budget) consists of an elicitor (8)-MU (9)-acknowledgment (10) sequence.

Participation in CMPs: Initiating and informing

In this paper, two features of CMPs will be analyzed in detail: (1) the *initiator*, and (2) the *informant*. The initiator is the speaker of the opening utterance of a CMP. In the fourth CMP in Excerpt 1, the opening utterance is (8), which was produced by the Chairperson. An informant is any person who produces an MU—anyone engaging in an act of remembering. In the fourth CMP in Excerpt 1, this was Analyst 2. Note that a given utterance can initiate a CMP and constitute an MU at the same time, as in (1).

These variables tap two important dimensions of memory use. By initiating a CMP, a member begins to shape the course of discussion by focusing recall on a certain theme. And by contributing an MU (informing), a member can redistribute new information. These two variables are thus useful indicators of the conversational roles taken in redistributing new information. They were coded for each CMP.

Statistical analyses

One tradeoff involved in a complex setting like this one is the difficulty of applying statistical analyses to the data. Fewer groups can be 'run' than in a typical experimental study. Nor can one simply aggregate data from the many sessions produced by a given group, because they are not statistically independent data (Kenny & La Voie, 1984). For many of the following analyses, I will thus compare data from group members who did not interact with each other. For example, the Mayor interacted with both the Chairperson and Analyst 1, but not with Analyst 2. Likewise, the Chairperson interacted with both the Mayor and Analyst 2, but not with Analyst 1. Comparing the behavior of, say the Mayor and Analyst 2, or the Chairperson and Analyst 1, thus allowed me to investigate several questions (e.g. differences related to hierarchical status) using inferential statistics, without violating independence assumptions.

Results

First, I will look at when CMPs occurred within sessions. Then, the effects of incoming versus outgoing status on participation in CMPs (initiating and informing) will be analyzed. Finally, I will look at how participation in CMPs varied within sessions, using quantitative but also qualitative analyses.

Distribution of CMPs within sessions

The redistribution of new information should affect discussion primarily in the opening moments of sessions, so CMPs should occur most often then. This was the case, as Figure 2 shows. Sessions were divided into deciles on the basis of the total number of utterances, then the number of CMPs produced in each decile was computed. A 10 (decile) by 4 (discussion cycle) repeated-measures analysis of variance (ANOVA) was conducted for each session type separately, treating each group as one case. There was a significant main effect of decile for each session type (Planning: $F(9,72) = 4.3$; City Council subgroup discussion: $F(9,72) = 12$; Commission subgroup discussion: $F(9,72) = 9.4$; Execution: $F(9,72) = 54$; City Council subgroup evaluation: $F(9,72) = 11.1$; Commission subgroup evaluation: $F(9,63) = 15.6$; all $ps < .001$). Repeated-measures contrasts revealed that for all session types except the City Council subgroup evaluation session, the average number of CMPs decreased significantly between the first and second deciles. For the planning sessions, there was also a main effect of cycle ($F(3,24) = 14$, $p < .001$). Although a few other differences emerged between other successive deciles for some session types, the decrease in CMP production between the first and the second deciles of a session seemed to be the only pattern consistent across most session types.

CMPs were thus produced most often in the opening decile of a session, independently of session type. Participants began discussions by

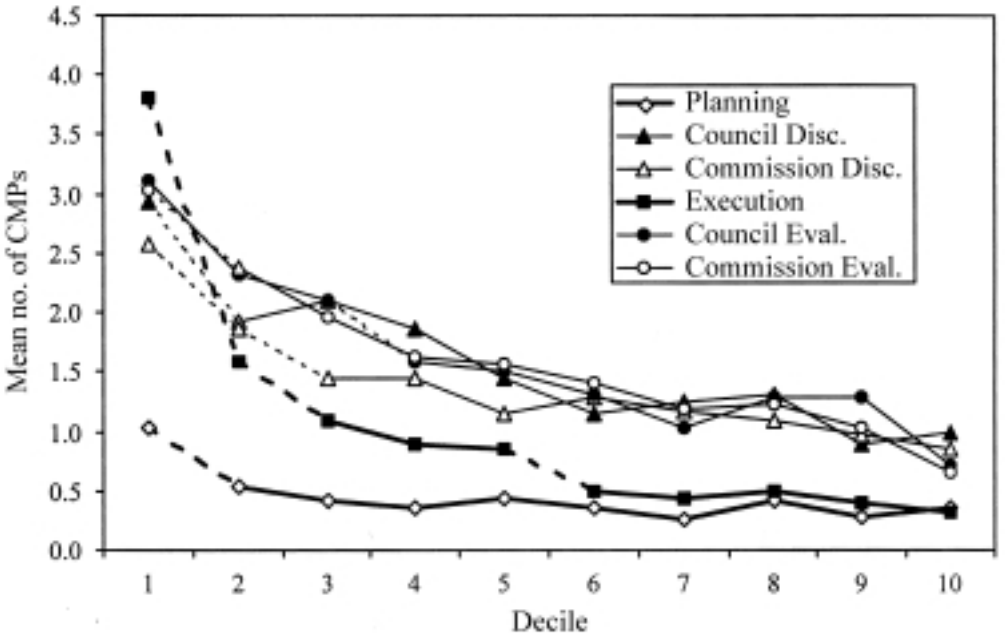

Figure 2. Mean number of CMPs per decile for each session type. Dotted lines indicate differences between deciles which are significant at $p < .05$.

reporting events from the preceding session. Because CMPs are segmented on the basis of thematic focus, the fact that CMPs were most frequent at the outset of a session indicates that discussion tended to focus on a number of topics. This suggests in turn that information was processed superficially, with participants switching rapidly from one topic to the next. They may have been trying to establish an overview of new events (for an example, see Excerpt 1, which comes from the first minute of a subgroup evaluation meeting). As I will show, this differed markedly from discussion later on in the sessions.

Initiating CMPs

To find out whether roles, sessions, or incoming or outgoing status influenced CMP initiation, the percentage of CMPs initiated in discussion and evaluation sessions by the Chairperson and Analyst 1 were compared. The Chairperson was the outgoing member in discussion sessions and the incoming member in evaluation sessions. Analyst 1 was the incoming member in discussion sessions and the outgoing member in evaluation sessions. A 2 (session: discussion or evaluation) by 2 (role: Chairperson or Analyst 1) by 4 (discussion cycle) mixed-model ANOVA with session and discussion cycle as repeated measures revealed a main effect of role ($F(1,15) = 6.4$, $p = .023$), and a role by session interaction ($F(1,15) = 457$, $p < .001$). There were no other significant main effects or interactions. Means and standard deviations are shown in Table 1. The significant interaction indicates that the Chairperson initiated more CMPs than Analyst 1 in discussion sessions and vice versa in evaluation sessions. This suggests that incoming versus outgoing status was the main factor influencing CMP initiation. Indeed, outgoing members initiated approximately three out of four CMPs in these sessions. The main effect of role shows that leader status (e.g. the Chairperson) increased CMP initiation, suggesting that leaders played a more active role than analysts in directing the course of remembering and

therefore affected the redistribution of information more strongly as well. These findings parallel those of Larson, Christensen, Franz, and Abbott (1998), who found that group leaders repeated unshared information more often and asked more questions. Likewise, initiating CMPs was done here by either asking an eliciting question or recalling some information.

Table 1. Mean percentage of CMPs initiated by Chairperson and Analyst 1 in the subgroup discussion and evaluation sessions

	Chairperson	Analyst 1
Discussion	77.8 (10.6)	17.8 (12.4)
Evaluation	30.2 (13.8)	72.1 (13.8)

Note: Standard deviations are shown in parentheses.

A similar analysis was performed for the planning and execution sessions. These sessions contrast with the discussion and evaluation sessions in that Chairperson and Analyst 2 interacted with their hierarchical counterparts from the other subgroup (the Chairperson interacted with the Mayor and Analyst 1 interacted with Analyst 2). Both members had new information to report, so there was no unequivocal distinction between incoming and outgoing members. And there were no hierarchical differences. So if these two factors influence CMP initiation, as suggested by the earlier analysis, then there should be no differences in initiation between the planning and execution sessions. This conjecture was supported: a 2 (role: Chairperson or Analyst 1) by 4 (discussion cycle) mixed-model ANOVA revealed no significant effects. Chairperson and Analyst 1 initiated approximately half of all CMPs in these sessions (45.4% and 47.7%).

Informing CMPs

To investigate who produces the memories in CMPs, the percentages of CMPs with Chairperson and Analyst 1 as informants in the discussion and evaluation sessions were compared. As for CMP initiation, a 2 (session: discussion or evaluation) by 2 (role: Chairperson or Analyst 1) by 4 (discussion cycle) mixed-model ANOVA was performed. It revealed a role by session interaction ($F(1,15) = 1327.6$, $p < .001$), and a discussion cycle by role by session interaction ($F(3,13) = 16.4$, $p < .001$). There were no other significant main effects or interactions. Means and standard deviations are shown in Table 2. Again, the role by session interaction suggests that incoming versus outgoing status was the main factor influencing CMP informing. Indeed, outgoing members were informants for over 90 percent of the CMPs in these sessions. The cycle by role by session interaction indicates that this pattern varied by discussion cycle. Repeated-measures contrasts revealed that incoming members recalled more information in discussion cycles 2, 3, and 4 than in cycle 1. In doing so, they must have referred to sessions earlier than the immediately preceding one, where they were not present. Thus, in later discussion cycles, there may have been a more extended 'past' (i.e. a larger pool of memories) to integrate. However, that should have led to a progressive increase over cycles, rather than a difference between the first cycle and the others. An alternative explanation for this finding is that redistributing information is an interactive routine (Gersick & Hackman, 1990) that takes time to establish. During the first cycle, participants were getting used to working together as a group. Referring to the more distant past (removed from the immediate and pressing demands of the task situation) takes time, which participants may not have had. They may have discussed the more distant past only after having become more familiar with the task situation (Tschan, Semmer, Nägele, & Gurtner, 2000).

As for CMP initiation, a similar analysis was performed for the planning and execution sessions, where there were no differences related to incoming/outgoing status or hierarchy. A 2 (role: Chairperson or Analyst 1) by 4 (discussion cycle) mixed-model ANOVA revealed no significant effects. The Chairperson and Analyst 1 initiated 66.8 percent and 65.6 percent of CMPs in these sessions, approximately as often as their counterparts (the percentages were higher than 50%; but that was because they also included CMPs in which both members were informants).

Table 2. Mean percentage of CMPs with Chairperson and Analyst 1 as informants in the subgroup discussion and evaluation sessions, for discussion cycles 1–4

	Chairperson	Analyst 1
Subgroup discussion, Cycle 1	98.4 (3.2)	1.4 (2.7)
Subgroup evaluation, Cycle 1	11.6 (10.7)	98.7 (2.6)
Subgroup discussion, Cycle 2	88.9 (23.8)	17.8 (13.3)
Subgroup evaluation, Cycle 2	15.7 (17.3)	96.8 (4)
Subgroup discussion, Cycle 3	96.6 (5.2)	15.6 (10.7)
Subgroup evaluation, Cycle 3	21.8 (13.4)	96.2 (6.8)
Subgroup discussion, Cycle 4	98.9 (3.3)	14 (12.6)
Subgroup evaluation, Cycle 4	24.2 (13.4)	93.7 (6.7)

Note: Standard deviations are shown in parentheses.

Changes in CMP initiation within sessions

The results so far suggest that incoming versus outgoing status was the main factor influencing CMP initiating and informing. Outgoing members initiated most CMPs, and were informants more often than were incoming members. Did these patterns vary over the course of a session? To investigate this, the percentage of CMPs initiated by both members was computed for the first and second halves of each session. This time, data from the Mayor and Analyst 2 were compared. The percentage of CMPs initiated in the first half of a session was subtracted from the percentage of CMPs initiated in the second half, yielding a measure of increase in CMP initiation by each member. A 2 (session: discussion or evaluation) by 2 (role: Mayor or Analyst 2) by 4 (discussion cycle) mixed-model ANOVA was run, revealing a main effect of session ($F(1,15) = 7.9$, $p = .013$), and a role by session interaction ($F(1,15) = 96.8$, $p < .001$). There were no other significant main effects or interactions. Means and standard deviations are shown in Table 3. The role by session interaction suggests again that the main factor influencing the change in CMP initiation was incoming versus outgoing status, with incoming members initiating more CMPs in the second half of a session than in the first half, and vice versa for outgoing members.

Table 3. Mean percentage change of CMPs initiated by Mayor and Analyst 2 between first and second halves of the subgroup discussion and evaluation sessions

	Mayor	Analyst 2
Discussion	−13.7 (19.6)	27.7 (28.3)
Evaluation	20 (24.9)	−32.6 (28.2)

Notes: Positive values indicate increases from first to second half; negative values indicate decreases. Standard deviations are shown in parentheses.

Changes in CMP informants within sessions

To see whether patterns of informing also varied over the course of a session, the percentage of CMPs with each member as an informant was computed for the first and second halves of each session (using data from the Mayor and Analyst 2 again). The percentage of CMPs informed in the first half was subtracted from the percentage of CMPs informed in the second half, yielding a measure of increase in CMP informing by each member. A 2 (session: discussion or evaluation) by 2 (role: Mayor or Analyst 2) by 4 (discussion cycle) mixed-model ANOVA was run, revealing another role by session interaction ($F(1,15) = 12.1$, $p = .003$). There were no other significant main effects or interactions. Means and standard deviations are shown in Table 4. The role by session interaction suggests that the main factor influencing the change in CMP informing was incoming versus outgoing status, with incoming members informing more CMPs in the second half of a session. The decrease in outgoing members' informing percentages was small (2.2% for the Mayor and 3.6% for Analyst 2), so the difference was mainly due to the fact

Table 4. Mean percentage change of CMPs with Mayor and Analyst 2 as informants between first and second halves of the subgroup discussion and evaluation sessions

	Mayor	Analyst 2
Discussion	−2.2 (12.6)	10.8 (26.5)
Evaluation	12 (24.6)	−3.6 (17.5)

Notes: Positive values indicate increases from first to second half; negative values indicate decreases. Standard deviations are shown in parentheses.

that incoming members increasingly participated as informants.

Using CMPs to integrate information and create shared knowledge

The analyses presented so far show that the redistribution of information had a substantial impact on group discussion, especially at the beginning of a session, when outgoing members played an important role in reporting events from the preceding session. The participation of incoming members gradually increased between the first and second half of sessions. Incoming members initiated more CMPs, thereby influencing the redistribution process indirectly. They also produced more memories referring to sessions earlier than the immediately preceding one, thereby focusing discussion on earlier events. What was the purpose of this, and how did it influence the quality of discussions later in a session? To answer these questions, it was necessary to examine the discourse among participants. This is done in Excerpts 2–4, which all occurred late in their respective sessions (deciles 5, 10, and 8, respectively). The purpose of presenting these excerpts is to analyze in detail exactly how members referred in their CMPs to multiple points in the past.

Excerpt 2 (Group 3, third discussion cycle, City Council subgroup evaluation session)

1	M:	how is it with the other problems?	
2		*points to sketch*	
3		is crime 24 and and no more?$_{PL}$	MU
4	A1:	24$_{EX}$	MU
5	M:	yes	
6		like how are the others	
7		pollution and	
8	A1:	pollution is I think 11$_{EX}$	MU
9	M:	yes	

Excerpt 2 is a CMP initiated by the incoming member (the Mayor). She focused talk on 'other' problems (1), apparently considering aspects not discussed by the Analyst. She asked for two specific items of information, the crime rate (3) and the pollution rate (6, 7). For the crime rate, she recalled the last data available to her (from the planning session) and sought confirmation from the Analyst that it had not changed. The Analyst confirmed this by recalling the crime rate in the execution session. Thus, in this exchange, members created an informational continuity that bridged their experiences of the sessions they participated in since their last meeting, achieving a shared awareness of the ongoing state of a situational variable (the crime rate) that spanned the sessions of the past discussion cycle.

Excerpt 3 (Group 1, second discussion cycle, Commission subgroup discussion session)

1	C:	you can go fix stuff there and put in a railway	
2	A2:	yeah. did the warning come again high traffic?$_{EX}$	MU
3	C:	mmh no$_{PL}$	MU
4		did it come for you?	
5	A2:	yes$_{EX}$	MU
6	C:	mhm no not at all$_{PL}$	MU
7		crime is the highest problem otherwise$_{PL}$	MU

In Excerpt 3, the incoming member (Analyst 2) initiated a CMP (2–6) by asking the outgoing member (Chairperson) whether the computer generated a warning in the planning session that city traffic was too high. The Chairperson replied in the negative, and then asked the Analyst if that was the case for him, to which he replied affirmatively. Talk in this CMP was narrow in focus, establishing for both participants that the traffic

warning only occurred for the Analyst. With utterances 2 and 3, participants established that the Chairperson did not experience the traffic warning. With utterances 4 and 5, they established what was already implied in the Analyst's opening question ('did the warning come *again*'), namely that he experienced the warning. And with utterance 6, they reconfirmed what was established in utterances 2 and 3. The redundancy of this exchange is typical of grounding processes where participants have a high criterion for understanding (Clark & Schaefer, 1989). Here too, participants were bridging discontinuities in experience by exchanging accounts. In doing so, they redistributed previously unshared knowledge. Participants often did this at the end of sessions, after they had taken care of more urgent business. This kind of redundant, focused exchange was quite different from the more superficial reporting that occurred at the outset of a session (see Excerpt 1).

Excerpt 4 (Group 2, third discussion cycle, subgroup discussion session City Council)

1	M:	and concerning financing well police is fully financed$_{PL}$	MU
2		and traffic as well and$_{PL}$	MU
3	A1:	fire is on minimum$_{EX}$	MU
4	M:	fire is rather low$_{PL}$	MU
5	A1:	30 percent I think$_{EX}$	MU
6	M:	yes I believe$_{PL}$	MU
7		yes there isn't much more	

In Excerpt 4, discussion focused on police, road and fire department funding levels. The excerpt is similar to Excerpt 3 in its redundancy. What was especially interesting here is that both members start the exchange with different construals of the level of fire department funding ('on minimum' for A1 versus 'rather low' for M). These differences were resolved when the members shared their own experience, drawn from different points in time, of funding level values.

Taken together, the qualitative analyses of Excerpts 1–4 show a sharp contrast between redistribution activity at the beginning of a session and later on in the session. Redistribution at the beginning of sessions focused almost exclusively on reporting information from the immediately preceding session in a broad, superficial way. Later in the sessions, redistribution became more narrow in thematic focus. Participants seemed to concentrate more on explicitly integrating more specific information from multiple points in time.

Discussion

Maintaining interpersonal continuity of experience over time is an essential function of group life. I have focused on the redistribution of new information as one way of maintaining continuity. Redistributing information is a collaborative activity in which some group members recount previously unshared experiences to other members. In a complex group setting, I analyzed this activity by examining CMPs in task-related communication. Two parameters were analyzed in this respect—who initiated CMPs and who informed CMPs.

Members produced CMPs most often in the opening moments of sessions, suggesting that continuity demands are especially important then. Redistribution was broad in scope, suggesting that members tried to achieve an overview of the preceding session's events. Group members with two different perspectives on new information can participate in its redistribution in complementary ways. Outgoing members participated in the immediately previous session, so they had exclusive access to the most recent developments in the game system. In contrast, incoming members did not take part in that session and had no access to what transpired then. However, they were about to participate in the next session and thus needed updated information that was more recent than their own.

This combination led outgoing members to initiate more CMPs and act as informants more often. They took a primary role steering the course of discussion and recounting past experience. However, incoming members increased their participation between the first and second

halves of sessions, initiating more CMPs and contributing more memories of their own from sessions before the immediately preceding one. This shifted the focus of discussion to those earlier sessions. CMPs produced later on in sessions were narrower in focus than those produced at the beginning. They often incorporated memories from several points in time, suggesting that participants were trying to integrate discontinuous information.

There are several possible reasons for this shift from the immediate to a more distant past. Participants may have had more leisure at the end of a session to discuss matters in detail, because they had already taken care of their most urgent business. Alternatively, the sheer amount of information introduced over the course of the session may have generated a greater need for integration. Or, incoming members (who represented the subgroup in the next session) may have contributed to this shift to prepare themselves for the next session.

Finally, there was some evidence that patterns of participation in redistribution also changed over a larger time scale. Incoming members were more often informants in the second, third, and fourth discussion cycles than in the first one. This could reflect their increasing familiarity with the demands of the task and the simulation as a whole. As familiarity increases, many actions require less discussion, and participants can devote more effort to integrating information. Thus, this change seems akin to the emergence of a routine (Gersick & Hackman, 1990).

Redistributing information was a tacitly organized activity in this study, an activity to which participants contributed according to different conversational roles. It was a dynamic process, with shifts in patterns of participation. This is the case for all forms of conversation. Because conversation can be seen as a cumulative process of enlarging common ground (Clark, 1996), what is discussed at one point shapes later contributions. Will the results from this study generalize to discourse in other task settings? Although an answer is impossible without research, redistributing information (like other collaborative activities) should depend on the specific continuity needs it serves, as well as on other factors, such as the communication medium (Clark & Brennan, 1991). One factor likely to shape information redistribution is formalization. As noted earlier, information redistribution is often organized as a formal routine. But in this study, it was an ad hoc, emergent routine. Formal routines differ from ad hoc ones in several ways, such as how roles and role-related behavior are fixed. In a formal redistribution routine such as debriefing, participants' conversational roles are likely to be determined by their roles in the group. There are also concrete guidelines as to what information is relevant and what is not. Formalization can make the redistribution process more efficient, but it can also lead to the loss of potentially relevant information.

Nevertheless, certain aspects of information redistribution should remain invariant. Consider a talk at a scientific meeting as a way of redistributing new information. It is an institutionalized routine, differing in many ways from the present case. For example, there are officially designated roles (speaker, audience, chair) that constrain participation. However, the same basic patterns can be observed: first comes the talk itself, which is given exclusively by the speaker, who reports on his or her latest research. This resembles discussion in the opening moments of the sessions studied here. After the talk is over, questions are asked. At this point, other people can focus on certain parts of the presentation. They may bring to discussion another perspective on the topic, perhaps referring to other, related research. This resembles discussion in the later moments of the sessions studied here. The main point is that in this study, there was a *gradual* and *tacit shift* in participation patterns. In the scientific talk example, there is an *explicit compartmentalization* between an initial phase where the speaker is the main actor, redistributing new information, and a later phase where others contribute to the process, integrating that information with what they know. Despite this difference, basic aspects of the redistribution process are the same.

The present study illustrates how continuity is created and maintained in task-related communication by redistributing information. It

also highlights the role of communication that is less oriented to the immediate demands of task resolution or problem solving, and more focused on the 'system integrity' function identified by Arrow et al. (2000). In real groups, new information is something that must be dealt with continuously. It must be redistributed, centralized, archived, and transformed in various ways, many of which are not directly relevant to a specific task. Such efforts can take up a significant portion of discussion in group meetings, especially at the beginning. More than that, they can transform the very course of group discussion. This point seems worth emphasizing, for despite the importance of continuity demands as a global organizing factor of ongoing task-related communication, they are something that cannot (by nature) be observed easily in most laboratory experiments, where a group is assembled for just one session to complete a single task. Thus, the present study adds to a growing body of research (e.g. Arrow et al., 2000; Gersick, 1988; Tschan et al., 2000) that emphasizes the importance of studying groups over longer periods of time.

Despite its strengths, this study has a number of limitations. It was exploratory and focused on documenting the redistribution process and how it serves interpersonal continuity of experience. Thus, continuity was analyzed as a phenomenon, neglecting its possible impact as an independent variable. Further research should address this issue, especially by investigating the relationship between continuity and task performance. That relationship is likely to be complex. The effects of continuity on performance may be mediated by other variables, such as information loss. And continuity may itself mediate the impact of variables like turnover or group structure on performance. Indeed, some research (e.g. Carley, 1992; Huber, 1991) suggests that continuity affects long-term performance rather than performance over the short term. If so, then further research should involve more prolonged observation in field studies as well as laboratory experiments. Another limitation of this study was its focus on the redistribution of information. Continuity can be implemented in other ways, such as archiving information. What factors influence decisions to archive information or to redistribute it? This question may be amenable to experimental research.

Conclusion

Small group psychology has come a long way since the reality of groups was denied and group-level theorizing was considered a 'fallacy' (Allport, 1961). There is now an abundance of theoretical work affirming the reality of groups as active, information-processing units (Cranach et al., 1986; Hinsz et al., 1997; Larson & Christensen, 1993; Thompson & Fine, 1999). Group-level properties, such as entitativity, integrative complexity (Gruenfeld & Hollingshead, 1993), and reflexivity (Carter & West, 1998), are being explored empirically. Yet an important precondition for these properties is interpersonal continuity over time. For individuals, research has shown that continuity is not something given, but rather a construction that is created and maintained in the face of change over the life course (Habermas & Bluck, 2000). So it is with groups, too. If one accepts the reality of group life, then the problem of interpersonal continuity must be addressed.

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