

Chapter 5

Micro Foundation of Organizational Learning: Group Learning

5.1 Introduction

Cisco Systems, Inc. successfully acquired many software firms with 50–100 employees (Wysocki, 1997). Cisco paid a premium for the firms—on the order of two million dollars per employee. Why is Cisco paying so much for these firms? According to Wysocki,

In today's economy, building work teams from scratch can be yesterday's luxury. So when you can't build fast enough, you buy...Cisco is buying new product teams on the open market because it takes too long to assemble them from the ground up (1997, p. A1).

Thus, Cisco paid a premium for teams that had already learned how to work effectively together. These teams had learned who is good at what, which approaches to the tasks are effective, and how to coordinate their activities. Teams that have learned to work effectively together are worth much more than their individual components.

Understanding how groups or teams learn to work effectively together provides micro foundations for understanding organizational learning because groups are the building blocks of most organizations. Much of the learning that takes place in organizations occurs in work groups. The chapter begins with definitions of the concepts of "groups" and "group learning." A discussion of why understanding how groups learn helps us understand how organizations learn follows. Critical processes of group information processing are then presented. These include how groups share, generate, evaluate, and combine knowledge to arrive at a collective product.

5.2 Definitions

What is a group? Guzzo and Dickson (1996) defined a group as "made up of individuals who see themselves and who are seen by others as a social entity, who are interdependent because of the tasks they perform as members of a group, who are

embedded in one or more larger social systems (e.g., an organization), and who perform tasks that affect others (such as customers or coworkers)" (pp. 308–309). Similarly, Cohen and Bailey (1997) defined a team in an organizational setting as a collection of individuals who are interdependent in their tasks, who see themselves and are seen by others as an intact social entity, and who are embedded in a larger social system (see also Hackman, 1990).

Dimensions of definitions of groups that are particularly important are as follows: task interdependence (what one group member does affects and is affected by another group member); social–psychological awareness (members perceive themselves as a group and are perceived by others as a group); and social embeddedness (the group exists in a larger social system). Thus, while group members may be geographically dispersed, they should have some degree of awareness of one another and some sense of belonging to a group. McGrath (1984) further noted that a distinguishing feature of groups relative to other social aggregates such as communities or organizations is their relatively small size (see also Shaw, 1981). A new product development team, a self-managed work group, and a strategic planning committee are a few examples of the many groups found in organizations today.

Analogous to the definition of organizational learning, group learning is a change in the group's knowledge that occurs as it gains experience. Group learning manifests itself through changes in cognitions or behavior of group members. For example, as groups gain experience, they might acquire information about which group members are good at which tasks or about how to use a new piece of technology more effectively. They also might develop routines for coordinating their activities.

Groups can "learn" without evidencing performance changes. For example, a team that develops new software might learn that consumers are not willing to pay for the capabilities built into the software (e.g., Rhodes, 1986). The team might not be given opportunities, however, to produce other software products that manifest the knowledge it acquired. Hence, there might not be an apparent effect on performance of the knowledge the team acquired. Conversely, performance can change without any corresponding change in the group's knowledge. For example, a group's competitor might experience a strike or a materials shortage that prevents the competitor from producing products. The dearth of competition could result in an increase in the demand for the focal group's product, which in turn could lower the cost of producing each unit because the group has more units over which to spread its fixed costs such as equipment. In this example, although the group did not "learn" anything, its performance improved.

Understanding how group knowledge changes as a function of experience can be challenging. In studying group knowledge, it is important to be sensitive to the tacit nature of a significant component of the knowledge groups acquire as they gain experience. It is also important to be aware that knowledge can be distributed in groups in various repositories (see the discussion of knowledge repositories in Chap. 4).

When assessing group learning by measuring characteristics of group performance, it is imperative to control for factors in addition to changes in experience

that may affect performance. For example, consider the scenario described earlier where a competitor temporarily stopped production and the focal group was able to sell more units of its product and, thus, had lower unit costs. The lower unit costs in this example might not have been a function of experience, a prerequisite for learning to occur, but rather a function of the changing scale of operation. Thus, in order to demonstrate that learning occurred, it is important to demonstrate that the performance gains observed are a function of experience and not a function of other factors such as the scale of production. Chapters 1 and 3 discussed how one might control for these alternative explanations to determine whether performance changes are in fact indicative of “learning.”

5.3 Why Study Group Learning?

Research on group learning is relevant for understanding organizational learning for two reasons. First, groups are increasingly being used as a form of organizing—both in the executive suite (Ancona & Nadler, 1989) and on the factory floor (Hoerr, 1989). Understanding how groups learn helps us understand how the organizations they constitute learn.

The second reason why understanding group learning helps us understand organizational learning is that many of the social processes such as coordination, communication, and influence that transpire in organizations also occur in groups—only on a smaller scale. The smaller scale of groups makes it easier to capture and understand these processes. Additional processes such as managing relationships across groups come into play in organizations. And there are issues about how well the processes “scale up” as one moves from the group to the organizational level of analysis. These complexities notwithstanding, the important information about social processes gleaned from studies of group learning helps us understand the processes of organizational learning more fully.

Research on group learning has increased dramatically in recent years (see Edmondson, Dillon, & Rolloff, 2007, for a review). Theoretical pieces on groups as problem-solving and information-processing systems have appeared at an increasing rate (e.g., Argote, Gruenfeld, & Naquin, 2001; Hinsz, Tindale, & Vollrath, 1997; Klimoski & Mohammed, 1994; Larson & Christensen, 1993; Levine & Moreland, 1991; Sandelands & Stablein, 1987; Wegner, 1986; Wilson, Goodman, & Cronin, 2007; Wittenbaum & Stasser, 1996). Empirical studies examining how groups recall, share, and combine information to create a collective product are also more common (Gruenfeld, Martorana, & Fan, 2000; Phillips, Mannix, Neale, & Gruenfeld, 2004; Stasser, Vaughn, & Stewart, 2000; Thomas-Hunt, Ogden, & Neale, 2003). Group cognition has been found to contribute to effective teamwork (De Church & Mesmer-Magnus, 2010) and is included in current models of team performance (Ilgen, Hollenbeck, Johnson, & Jundt, 2005; Kozlowski & Ilgen, 2006).

Many studies of group learning have been conducted in the laboratory where groups are asked to solve a problem or perform a collective task. By observing

group processes and performance or videotaping them for subsequent analysis, researchers are able to capture and analyze group processes. These studies have provided rigorous theoretical models and empirical evidence on the processes of group “remembering,” knowledge sharing, social influence, and the like. The studies have increased our understanding about the mechanisms through which one variable affects another—about why variables have the effects that they do.

Another strength of laboratory studies of group learning is that researchers can design experiments to disentangle various theoretical models. The control afforded by the laboratory enables one to construct experimental conditions for which different theories would predict different outcomes. By observing the outcomes of the experiment and assessing their correspondence to various theoretical predictions, one can determine the degree of empirical support for various theories. For example, Turner, Pratkanis, Probasco, and Leve (1992) tested social identity theory as an explanation of a form of flawed group decision making, “groupthink” (Janis, 1972). According to social identity theory, groupthink occurs only under certain conditions. By observing whether groupthink occurs under the conditions predicted by the theory and not under others, one can determine whether social identity is a viable explanation for groupthink. Further, because laboratory studies enjoy the benefits of random assignment to condition, researchers can more readily determine the effect of variables of interest than one can in studies that do not have the benefits of randomization.

Field research, of course, has its own strengths, especially that of external validity. When conducting field research, one can study groups that exist in an organizational and temporal context. Thus, field research facilitates analyzing external group processes (how groups learn from other groups) and studying how group processes change over extended time periods. Laboratory and field methods each have much to offer our understanding of group and organizational learning. By incorporating information obtained from each method, one arrives at a deeper understanding of the phenomenon.

This chapter focuses on internal information processing by groups. Information processing is involved when groups perform cognitive tasks such as making a decision, solving a problem, or generating ideas. Information processing is also involved when groups perform a production task such as building a product or assembling its components. Thus, the chapter focuses on how groups develop knowledge. How groups retain and transfer knowledge are discussed in Chaps. 4 and 6.

5.4 Processes of Group Learning

Groups develop knowledge through several processes. Groups can elicit or share knowledge that one of their members already possesses or generate new knowledge through collaboration and interaction. Another process of group learning involves a “weighting” or evaluating of information that has been shared or generated. This involves influence attempts on the part of those who provide information and

attempts to determine the information's accuracy and appropriateness on the part of those who receive the information. The last process of group learning is combining knowledge: once knowledge has been shared and evaluated, it must be combined into a collective product. Thus, group learning involves the processes through which members (1) share, (2) generate, (3) evaluate, and (4) combine knowledge. Although these processes emphasize different aspects of group learning and help us organize relevant empirical findings, there is considerable overlap and feedback among them. A process might not occur. Some might occur very explicitly, while others might be more implicit. Findings relevant for each of these internal processes of group learning are now discussed.

5.4.1 *Sharing Knowledge*

Individual group members possess expertise and information that is relevant, to varying degrees, to the group's task. Just because an individual possesses information, however, does not mean that he or she will necessarily share it with the group. The individual must recall the information, perceive it as relevant, and be motivated to share it. This section discusses the sharing of information in groups. It begins with an example of a distributed group that did not share a particular piece of knowledge. A discussion of how groups compare to individuals on particular knowledge-sharing tasks follows. The next part of the section is devoted to reviewing what we know about factors affecting information sharing in groups. The section concludes with a discussion of the effect of group composition on knowledge sharing in groups.

5.4.1.1 *A Case Example*

A case study of a new product development team illustrates the importance of knowledge sharing in groups and the negative consequences that can result from the failure to share critical knowledge (Olivera & Argote, 1999). The task of the product development team was to design a new computer. A critical feature of the new computer was that it should have a small "footprint" so that it did not occupy too much desk space and would thus be attractive to customers such as banks and hospitals where desk surfaces were very limited. Aspects of the design of the computer were assigned to various subgroups. The subgroup that was responsible for designing the power supply missed the critical design feature that the computer should be small in size. The subgroup designed a power supply to sit next to the computer on the desk surface and thereby defeated the design feature of a small footprint. The problem with the power supply did not become apparent until all the subgroups designing the computer met the night before the computer was to be introduced at a computer fair. By then, it was too late to make fundamental changes in the system. The product was shipped with the power supply that was inconsistent with a key design feature.

• This example illustrates how the failure to share knowledge can have negative consequences for a group. The lack of knowledge sharing compromised a critical design feature of the computer. Prospective sales for the computer did not materialize. After a year or so of disappointing demand, production of the computer was discontinued. Although several factors contributed to the computer's disappointing sales, the incongruity between the power supply and desired design features was cited as a major contributor.

• Knowledge sharing in this example was complicated by the distributed nature of the design team (see Kush, Williamson, & Argote, 2012, for a review of research on learning in geographically distributed teams). Geographically distributed teams designed subcomponents of the system. We have argued for the importance of having these teams interact face-to-face for at least some time to provide more opportunities to share tacit and taken-for-granted knowledge (Olivera & Argote, 1999). Although face-to-face groups provide more opportunity for knowledge sharing, knowledge sharing does not happen automatically in these groups either. The next sections of this chapter describe the conditions that enhance knowledge sharing in groups. The first of these sections examines group remembering—whether groups are better (or worse) than individuals at recalling information to which group members were exposed. The second section examines whether group members share information that they uniquely hold. The remaining section examines the effect of group composition on knowledge sharing.

5.4.1.2 Group Remembering

Research on group or collaborative remembering examines how groups remember or recall information. For example, members of a jury deliberating on a verdict might try to reconstruct what they heard in the courtroom. Or members of a work team might try to recall the training they received on a new piece of technology.

• The general finding of research on group or collaborative remembering is that although groups typically do not perform as well as their “best” member, they perform better than individuals, on average, on memory recognition tasks (Clark & Stephenson, 1989; Hartwick, Sheppard, & Davis, 1982; Hinsz, 1990). Hinsz (1990) identified several processes that contributed to the superior recall of groups. First, groups have access to a wider pool of information than individuals. Second, groups make fewer errors than individuals. Third, groups are better than individuals at determining what they could and could not recognize correctly. These latter two benefits seem to depend on groups being required to reach agreement or consensus (Weldon & Bellinger, 1997).

• Weldon and Bellinger (1997) found that when groups were compared to the best individuals, groups performed significantly better than the best individuals on recall of random items but not of organized stories. When the performance of a collaborative group was compared to the performance of a nominal group formed by pooling the nonredundant responses of the same number of individuals working alone as were in the groups, however, nominal groups recalled more than

collaborative groups. Thus, although collaborative groups recalled more than even the best-performing individuals, collaborative groups did not achieve their maximum potential. Further, previous experience in a group consistently improved subsequent individual performance and improved group performance for meaningful tasks.

In these studies of collaborative remembering, group members are typically exposed to information together and then asked to recall it. Often, however, group members possess information that they acquired individually that may or may not overlap with information other group members possess. Through training and past experiences, certain group members may acquire information that others do not possess. The next section examines the conditions under which individual members share information that they uniquely possess.

5.4.1.3 Factors Affecting Knowledge Sharing

Information sharing in groups often takes place in the context of a meeting or face-to-face discussion. Stasser and his colleagues have conducted an important stream of research on the conditions under which group members share knowledge in these discussions. The basic finding of this line of research is that group members are more likely to share ideas that members already have in common than to discuss unshared ideas that are unique to individual members (see Lu, Yuan, & McLeod, 2012; Wittenbaum, Hollingshead, & Botero, 2004; and Wittenbaum & Stasser, 1996, for reviews). For example, if a group meets to evaluate a candidate for a job, the group is more likely to focus on information all members share than to surface information about the candidate that only one member possesses. This tendency to focus on already shared information is unfortunate from the perspective of group performance because it suggests that groups might not realize a major benefit of having multiple members—pooling their different information and viewpoints.

Stasser and his colleagues provided an explanation of why groups do not discuss unshared information. Stasser and Titus (1985, 1987) proposed an information-sampling model that predicts that the probability that a piece of information will be mentioned during group discussion increases as the number of members who already possess the information increases. Thus, “shared information” is said to have a sampling advantage over unshared information because it is more likely to be mentioned and discussed. Further, mistakes in recalling shared information are likely to be corrected whereas mistakes in recalling unshared information cannot be corrected (Lightle, Kagel, & Arkes, 2009). Gigone and Hastie (1993) provided a different interpretation for the tendency of groups to be more influenced by shared than unshared information. They argued that the greater influence of shared information derives from its effect on group member pre-discussion preferences rather than its effect on what is mentioned during group discussion. Wittenbaum and Bowman (2004) provided a third explanation. They argued that the validation members receive when they mention shared information increases the tendency to repeat it. This last explanation does not explain the tendency for shared information to be

mentioned more initially than unshared information but rather explains the tendency for shared information to be repeated more frequently than unshared information.

A "hidden profile" approach was developed by Stasser (1988) to evaluate the effectiveness of a group in integrating information. Information is distributed in a hidden profile such that group members have different pieces of information, yet if all the information is pooled together, a superior solution can be achieved. Stasser and Titus (1987) found that providing groups with small amounts of information to remember and a high percentage of unshared information facilitated the recall of unshared information during group discussion. The latter finding suggests that diverse groups whose members possess different information may be more likely to discuss uniquely held information than groups composed of similar members because members of diverse groups are likely to have less information in common.

Many factors affect whether groups share information and discover the hidden profile. Knowledge of how information is distributed among group members affects the retrieval and integration of information. A group's awareness of the distribution of expertise within the group increases the likelihood that unshared knowledge uniquely held by members is shared (Stasser, Stewart, & Wittenbaum, 1995; Stewart & Stasser, 1995). Further, expert roles within a group validate the credibility of uniquely held information. Group members are likely to accept and remember information contributed by a recognized expert (Stewart & Stasser, 1995). This finding also relates to the "weighting" or evaluation process of group learning discussed later in this chapter. Information provided by a recognized expert receives more weight in determining the group output than information provided by someone not perceived as having special expertise.

Leadership also affects the sharing of unshared information. Larson, Christensen, Abbott, and Franz (1996) found that medical residents who had more experience and expertise as well as higher status repeated *both* more shared and unshared information than interns or medical students who focused more on shared information that all members possessed. This finding is consistent with results previously described on the effect of expert roles on information sharing because medical residents have more expertise than interns or medical students.

Group size also affects the sampling advantage of shared over unshared information. Stasser, Taylor, and Hanna (1989) found that large groups were more likely to focus only on shared information than small groups were. In a related vein, studies of social loafing have found that the extent of social loafing increased as group size increased (Karau & Williams, 1993). Thus, members of large groups contributed less information per person than members of small groups. Similarly, members of large groups contributed fewer pieces of unique information than members of small groups.

The nature of the task has also been found to affect information sharing in groups. The extent to which a task has an answer that can be shown to be correct, such as solving a math problem, affects group information sharing. Stasser and Stewart (1992) found that the perception of a demonstrably correct answer promoted the sharing of unshared information. Conversely, the lack of a demonstrable answer promoted consensus building and inhibited the sharing of information members uniquely possess.

The temporal phase of a discussion also affects the mix of shared versus unshared information that is discussed. Larson, Foster-Fishman, and Keys (1994) argued that the sampling advantage of shared information dissipates as discussion develops because the pool of shared items would be depleted and only unshared items would remain. Consistent with their predictions, the researchers found that sharing of unshared information increased over time (at least for groups who did not receive any special training). This finding suggests that the tendency for groups to focus on shared rather than unshared information may be more characteristic of short than of long meetings.

The sharing of unshared information is also affected by the extent to which group members have experience with the task and the training they receive. Wittenbaum (1996) found that while inexperienced group members mentioned more shared than unshared information, experienced members repeated more unshared than shared information. Thus, experience with the task increased the amount of unshared information that surfaced during group discussion. Similarly, Larson et al. (1994) found that group decision training increased the amount of *both* shared and unshared information discussed. While discussion in untrained groups focused first on shared and then on unshared information, discussion in trained groups was more balanced over time.

This line of research suggests the conditions under which information will be shared during a group discussion. Information is most likely to be shared when: group members are not overloaded with information; diversity of views exists in the group (i.e., the percentage of "shared" information is low); some group members are recognized for having special expertise; leaders are present in the group; groups are small in size; tasks are seen as having some answers that are better than others; group members are given experience or training with the task; and group meetings last long enough to get past the initial tendency to focus on information members hold in common.

Although several of these factors are beyond the control of an organization, others are more amenable to organizational design choices. For example, groups can be kept reasonably small in size with some diversity in membership and relevant expertise. Information loads can be managed to some degree to prevent excessive overload (Kahn, Wolfe, Quinn, Snoek, & Rosenthal, 1964). Groups can also be given appropriate training and experience working together. Promoting finding the best solution rather than voting or other more political solutions is likely to lead to higher-quality decisions.

Let us return to the example of the computer design team discussed previously to determine whether these factors that have been found to increase information sharing in groups existed in that case. Group members were clearly perceived as having special expertise. This factor favored the sharing of information in the computer design group.

Most of the characteristics of the group, however, were not conducive to sharing information. For example, when one took into account all the individuals involved in designing subsystems for the computer, the group was large in size. The failure to share information did not occur on a decision for which some solutions were

perceived as technically better than others; rather it surfaced at the level of the overall design of the system. The decision to have a small footprint was a design choice made on the basis of judgments about sales opportunities rather than dictated by technical exigencies. Thus, at this level, the task was not perceived as having a "correct" answer.

A point on which the computer design team clearly diverged from the conditions that promote the sharing of unshared information in groups is the team's experience working together. The subgroup that designed the power system did not meet the other group members face-to-face until the night before the computer was to be unveiled at a computer fair! Thus, the group did not have much opportunity to develop common understandings and shared conceptions of the task. What one subgroup took for granted as a key feature of the task was not transmitted to another subgroup. Face-to-face opportunities to interact with and observe one another are better mechanisms for transferring tacit knowledge and taken-for-granted understandings than the electronic media often relied on so heavily to coordinate geographically dispersed teams (Nonaka, 1991).

5.4.1.4 Group Composition

Another issue to consider in the development of knowledge by groups is their composition, especially the diversity or heterogeneity of their membership. As noted previously, results of a study by Stasser and Titus (1987) suggested that diverse groups whose members possess different information due to variation in their backgrounds, training, or experiences are more likely to share their unshared information than homogeneous groups composed of similar members. Considerable research has been conducted regarding the effect of group composition (especially the heterogeneity of group membership) on dimensions of group performance (see Jackson, May, & Whitney, 1995; Mannix & Neale, 2005; Moreland & Levine, 1992; Shaw, 1981; and Williams & O'Reilly, 1998, for reviews).

Research on group composition has yielded contradictory findings. In a review of the literature concerning the effect of group composition on group performance, Bettenhausen (1991) concluded that most studies have found that homogeneous groups composed of similar members performed better than groups composed of dissimilar members. For example, Ophir, Ingram, and Argote (1998) found that homogeneous kibbutzim composed of similar members learned more from their experience than their counterparts composed of more heterogeneous members. By contrast, in their review, Jackson et al. (1995) emphasized the beneficial effects of group member heterogeneity for group decision quality. Jackson et al. (1995) concluded that heterogeneous groups were more innovative and creative than homogeneous groups (e.g., see Bantel & Jackson, 1989).

After carefully reviewing 40 years of empirical findings on the effects of group heterogeneity or diversity, Williams and O'Reilly (1998) concluded that diversity is more likely to have negative than positive effects on group performance. An exception to this pattern was found for the effects of functional diversity or diversity in backgrounds:

functional diversity generally had a positive effect on group performance. Williams and O'Reilly (1998) emphasized that a critical issue in managing diversity is balancing the benefits of the increased information diverse members provide with the costs associated with communicating in diverse groups.

The computer design example discussed previously illustrates the difficulties heterogeneous groups composed of members with different "thought worlds" (Dougherty, 1992) have working together. The design team for the computer consisted of members from different functional areas. Members of these different functions tend to have different values, preferences, and orientations (Dearborn & Simon, 1958; Lawrence & Lorsch, 1967). In the computer case, designers had specified that a key feature of the computer was to be its silent operation. Given this specification, the product planners did not want a fan to be installed on the computer because the fan would generate noise that conflicted with the desire for silent operation. Further, the product planners had conducted many tests that indicated that the computer would not overheat without a fan. Thus, planners felt strongly that a fan was not needed on this particular model. By contrast, manufacturing engineers were adamant that a fan was needed to prevent overheating. Manufacturing is the department that is responsible for any equipment that is returned due to malfunctioning. If a computer overheated, manufacturing would bear the cost of its repair. Manufacturing was not persuaded by the results of tests indicating that the computer would not overheat without a fan. The department finally agreed to ship computers without fans as long as space was provided to install fans if they were needed!

None of the machines has ever been returned because of overheating. Unfortunately, costs were associated with the compromise of leaving room for a fan. The extra space required by leaving room for the fan compromised the design feature of a small-sized computer. This example illustrates the difficulties members of different functional areas can have when they work together.

The disparate research findings and examples about the effects of member heterogeneity can be reconciled in part by considering the particular dimension of heterogeneity focused on, the performance measured used, the nature of the task, and the time span of the study (see Argote & McGrath, 1993). Concerning the dimension of heterogeneity, Williams and O'Reilly (1998) found different effects for different dimensions of diversity. As noted previously, functional diversity generally had more positive effects on performance than other dimensions of diversity.

The performance measure used also matters. For example, Hambrick, Cho, and Chen (1996) found that heterogeneous top management teams were more likely to launch a greater number of initiatives but were slower in responding to competitors' initiatives than homogeneous teams. In their review of the literature, Williams and O'Reilly (1998) concluded that heterogeneous groups were generally more creative but had more difficulty implementing ideas than homogeneous groups.

Heterogeneous groups seem most beneficial on creative tasks that involve innovation while homogeneous groups are more beneficial for tasks requiring considerable coordination. For example, Eisenhardt and Tabrizi (1995) found that team member heterogeneity (in terms of functional background) fostered product innovation in the computer industry. Similarly, Moorman and Miner (1997) found that

heterogeneity of views among product development team members enhanced new product creativity during turbulent periods of changes in technology or customer preferences. By contrast, Murnighan and Conlon (1991) found that string quartets whose members were homogeneous (with respect to gender, age, and skill backgrounds) performed better than those composed of heterogeneous members. Studies finding a positive effect of heterogeneity examined tasks that involved creativity: product innovation. By contrast, the study finding a negative effect of heterogeneity examined a task where precise coordination of interdependent activities was critical: the performance of a string quartet.

The point in time at which the effects of heterogeneity are assessed is also likely to make a difference in determining its consequences. Watson, Kumar, and Michaelson (1993) found that although the performance of homogeneous groups was initially superior to that of heterogeneous groups, the performance of culturally heterogeneous groups improved at a faster rate than that of homogeneous groups. At the conclusion of the several month-long study, heterogeneous groups were more effective than homogeneous groups at identifying problems and generating solutions. The overall performance of the heterogeneous and homogeneous groups was roughly the same at the end of the study. Thus, although it may take heterogeneous groups longer to work through process difficulties (Steiner, 1972) and develop effective task performance strategies, with experience, the performance of heterogeneous groups can equal (or exceed in certain dimensions) the performance of homogeneous groups.

A relatively new and exciting area of research on diversity differentiates between surface-level characteristics such as race or gender, which are readily apparent, and deep-level characteristic such as expertise, which require interaction to discern (Harrison, Price, & Bell, 1998). Phillips and Loyd (2006) found that groups with surface-level diversity fostered more sharing of dissenting views, an example of deep-level diversity, than groups with surface-level similarity.

Much of the advantage of heterogeneous groups stems from the diverse pool of information their members have access to and share during group discussion. Heterogeneous groups, however, are also better than homogeneous groups at developing new knowledge. Their advantage along this dimension is discussed in the following section.

5.4.2 Generating New Knowledge

In addition to developing knowledge by sharing knowledge that members already possess, groups also develop knowledge by generating new or “emergent” knowledge. The term “emergent” refers to knowledge that no individual group member possessed before group discussion, but comes out or “emerges” in the discussion. For example, one group member might make a comment that stimulates another to form a new idea. Or members might present conflicting views that lead to the creation of new knowledge (Lovelace, Shapiro, & Weingart, 2001), especially when

cooperative mental states are activated (De Dreu, 2010). Thus, new or emergent knowledge that no member possessed before the discussion can develop through group discussion and interaction. The development of emergent knowledge is particularly important for groups engaged in tasks that involve creativity and innovation (see Paulus & Coskun, in press, for a review). Past work on the generation of emergent knowledge has generally focused on procedural changes that increase the likelihood of new knowledge emerging or compositions that foster the generation of new knowledge.

5.4.2.1 Procedural Approaches to Knowledge Generation

Brainstorming is a popular procedural technique designed to increase the number of new ideas generated by groups. Brainstorming involves encouraging group members to come up with as many ideas as possible, forbidding members from criticizing each others' ideas, and fostering members' building on ideas to generate new ones (Osborn, 1957). Thus, this technique involves sharing knowledge that group members already possess (see previous section) as well as generating new knowledge through group discussion.

Although brainstorming is intuitively appealing, the evidence on its effectiveness at generating new ideas is disappointing. Compared to individuals who work alone, groups who use brainstorming generate fewer nonoverlapping ideas per person (see Mullen, Johnson, & Salas, 1991, for a review). That is, four individuals working alone would generate more unique ideas in total than a four-person brainstorming group would. Further, productivity losses in brainstorming groups are greatest when (a) the group is large in size, (b) an authority figure is present, (c) group members vocalize their ideas (rather than write them down), and (d) the result is compared with individuals who perform truly alone rather than individuals who perform in the presence of others (Mullen et al., 1991).

Several mechanisms have been proposed to explain why brainstorming groups do not realize their "potential" productivity. Mullen et al. (1991) organized these mechanisms into three categories (1) procedural mechanisms such as production blocking whereby idea generation is "blocked" while group members wait for their turns to talk (e.g., Stroebe & Diehl, 1994); (2) social-psychological mechanisms such as social influence processes whereby group members attempt to match their performance to that of other group members (Paulus & Dzindolet, 1993); and (3) mechanisms such as social loafing (Latane, Williams, & Harkins, 1979) that represent an intentional decrease in effort on the part of group members. Mullen et al. (1991) concluded that research findings provide the most support for social-psychological mechanisms, moderate support for procedural mechanisms, and little support for social loafing as explanations of the failure of brainstorming groups.

Sutton and Hargadon (1996) challenged research documenting the disappointing performance of brainstorming groups by noting that there are many benefits to brainstorming besides idea generation. Based on evidence from a qualitative study of a product design firm that used brainstorming, Sutton and Hargadon (1996)

concluded that brainstorming had many benefits for the firm such as supporting the organization's collective memory.

The conclusion described previously that it is primarily social-psychological mechanisms that explain the poorer performance of brainstorming groups (relative to individuals working alone) suggests that knowledge of these processes can be used to design conditions that minimize productivity losses. For example, having brainstorming groups consist of members who know each other rather than strangers (and this seems likely in real organizations in contrast to laboratory studies) might minimize productivity losses by reducing evaluation apprehension and the like. Providing brainstorming groups with high external standards or comparison norms may also increase their performance (Paulus & Dzindolet, 1993). Further, there is evidence that the gap in the output of brainstorming groups and the pooled output of the same number of noninteracting individuals decreases over time to the point where the productivity of brainstorming groups may even surpass that of noninteracting individuals (Paulus & Dzindolet, 1993). Procedures in which brainstorming groups write rather than speak their ideas have also been found to result in more ideas relative to nominal groups (Paulus & Yang, 2000).

Taken together, these arguments suggest that one-shot laboratory studies of brainstorming groups of strangers may significantly overstate the losses in productivity brainstorming groups experience. When brainstorming groups are composed of individuals who know each other and are given time to work through social-psychological processes such as evaluation apprehension, their productivity may approach and even surpass individuals. These are the conditions one is more likely to find in ongoing organizations rather than in laboratory studies. This may explain the apparent popularity of brainstorming in organizations.

5.4.2.2 Compositional Approaches to Knowledge Generation

Having individuals with different views in a group often leads to conflict that can create new knowledge. For example, Nemeth and her colleagues have examined the effect of conflict on the stimulation of divergent thinking in groups (Nemeth, 1992). "Divergent thinking" refers to the process of considering an issue from multiple perspectives (see Argote et al., 2001, for a review). Divergent thinking is stimulated by the presentation of minority views during group discussion. Groups that considered alternative solutions presented by a minority have been found to outperform groups that lacked a minority view. Such groups formulated more appropriate solutions and produced more creative and original arguments than groups lacking minority input (Nemeth & Kwan, 1987; Nemeth & Wachtler, 1983). The divergent thinking of these groups results from their consideration of unusual alternatives without the pressure to accept them (Nemeth, 1986). Groups with a minority influence therefore have advantages in generating new knowledge over groups without minorities. These advantages apply to subsequent tasks (Smith, Tindale, & Dugoni, 1996).

Similarly, the presence of conflict coupled with the absence of pressure to conform has been found to increase "integrative complexity" in groups. Dimensions of

integrative complexity are (1) a group's ability to identify and differentiate between multiple dimensions of an issue and (2) a group's ability to identify and integrate connections among those dimensions (Gruenfeld & Hollingshead, 1993). A group with high integrative complexity accepts multiple viewpoints and the trade-offs associated with them. A group with low integrative complexity, for example, might believe that full participation is unconditionally productive in making group decisions; conversely, a group with high integrative complexity might foresee certain instances where full participation would not improve group outcomes.

Examining Supreme Court decisions, Gruenfeld (1995b) found that majority opinions written on behalf of a nonunanimous court exhibited greater integrative complexity than those written on behalf of a minority or unanimous court. Furthermore, assigning participants to majority factions in nonunanimous laboratory groups fostered an increase in integrative complexity, whereas assigning subjects to minority factions and unanimous groups fostered a decrease in integrative complexity (Gruenfeld, 1995a).

Groups display an increase in integrative complexity as members gain experience working together. During a semester-long course involving a variety of tasks, group essays initially exhibited similar integrative complexity to the average individual essay, but significantly lower integrative complexity than that exhibited by the best individual essay (Gruenfeld & Hollingshead, 1993). With experience in collaboration, however, the level of group integrative complexity increased: during the second half of the semester, group complexity was significantly higher than average individual complexity and even comparable to that of the best individual. The Gruenfeld and Hollingshead (1993) study therefore contests the assertion that groups do not perform as well as their "best" members (e.g., see Hill, 1982), suggesting that, with experience working together, groups' integrative complexity can evolve to the level of their best members.

Do groups that are high in integrative complexity perform better than groups that are not? Gruenfeld and Hollingshead (1993) found that the relationship between group integrative complexity and task performance depended on the nature of the task. High levels of group integrative complexity were associated with superior performance on conceptual synthesis and problem-solving tasks, whereas low levels of integrative complexity were marginally associated with superior performance on mixed-motive negotiation tasks. No significant relationships were found between group integrative complexity and performance on judgmental decision-making tasks. These results suggest that integrative complexity is beneficial for tasks where group members are interdependent and coordination is required. Groups high in integrative complexity performed better on tasks that involved coordinated efforts to identify a single, optimal solution.

Taken together, these findings suggest the conditions under which new or emergent knowledge is likely to develop in groups as a result of their interaction. Emergent knowledge is most likely to develop when there is some diversity of opinion among group members; group norms favor learning rather than finding the "best" or the "fastest" solution; and groups have time to learn to interact effectively and develop appropriate task performance strategies. These are the conditions under which groups are most likely to create new knowledge.

5.4.3 *Evaluating Knowledge*

Once groups have developed knowledge (either by sharing it among members or by generating it themselves), they must evaluate it. Past research has shown that groups are better than individuals at evaluating one type of knowledge—knowledge embedded in hypotheses. Research on “collective induction” examines how groups perform on inductive tasks, which involve the search for rules and principles (Laughlin & Hollingshead, 1995). For example, a maintenance team in a factory might try to determine the conditions under which a machine breakdown occurs; a hospital emergency service unit might try to diagnose a patient’s condition; a team of medical researchers might try to specify the conditions under which a new drug has desired effects. The two basic processes of induction are hypothesis generation and hypothesis evaluation (see Laughlin & Hollingshead, 1995, for a fuller discussion). Hypothesis generation is the development of a tentative explanation or hypothesis for the observed phenomenon. Hypothesis evaluation is the testing of that hypothesis against data. Although groups are not better than individuals at generating hypotheses, they are better able than individuals to recognize a correct hypothesis once it is proposed (e.g., Laughlin & Futoran, 1985; Laughlin & Shippy, 1983). This superiority in the ability to evaluate hypotheses proposed by group members leads groups to be better than individuals on inductive tasks.

How do groups evaluate hypotheses or other information provided by their members? In order to evaluate hypotheses and other information, groups need to determine whether the information provided by a member is accurate or appropriate and whether it should figure in their final output. This involves both implicit and explicit judgments of the expertise, status, and role of the individual offering the information as well as political considerations of the implications of accepting it. Research on perceptions of expertise and on minority influence is relevant for understanding how groups evaluate the contributions of their members.

5.4.3.1 *Perceptions of Expertise*

Research discussed previously on expertise and knowledge sharing is relevant for determining the weight information receives during group discussion. Factors that affect whether an individual is likely to volunteer information also affect whether the information is likely to be accepted and acted upon. As noted previously, expertise can provide validation of information. Stewart and Stasser (1995) found that group members were more likely to accept and remember information contributed by a recognized expert.

This finding has important implications for real groups that exist in naturalistic settings. These groups, such as task forces or problem-solving teams, are often brought together precisely because members have different expertise. For example, a task force of members from different departments might be put together to solve a problem that cuts across the departments, such as being more responsive to customers

or reducing cycle time. Also a strategic planning committee might be composed of members with different functional expertise because high-level strategic problems do not fall neatly into one functional area but rather require input from many different ones. Stasser et al.'s (1995) results suggest that the differential in expertise that exists in these naturalistic groups increases the likelihood that information will be shared in them. Further, Stasser and Stewart's (1992) results suggest that information contributed by an expert is more likely to be recognized and accepted than information contributed by someone not perceived as having expertise.

Will these perceptions of expertise that group members develop be accurate? Empirical evidence on the ability of group members to identify the best performer in the group is somewhat mixed (see Littlepage, Robison, & Reddington, 1997, for a review). Although Miner (1984) found that groups identified their best performer only slightly better than random chance, Yetton and Bottger (1982) found that groups performed significantly better than chance in identifying their best performers. Henry (1995) found that groups identified their best member significantly more frequently than would be predicted by chance alone. In Henry's (1995) study, groups were still not able, however, to identify their most accurate member most of the time. Henry, Strickland, Yorges, and Ladd (1996) found that groups that were given outcome feedback were better at identifying their best member than groups that were not provided any feedback. The benefit of feedback occurred even though the same individual was rarely the most accurate across tasks.

Perceptions of the expertise of others have generally been found to become more accurate with increasing experience. Hollenbeck et al. (1995) found that as teams gained experience working together, their leaders became better at appropriately weighting group members' judgments in arriving at the group decision. That is, through experience with the task, leaders learned about the competence of team members and about which members could be relied upon for accurate judgments. Similarly, Moreland, Argote, and Krishnan (1998) found evidence that experience working together improved the complexity and accuracy of group members' judgments about each others' expertise. In a similar vein, Littlepage et al. (1997) found that experience working together improved members' ability to recognize expertise when it transfers to new performance situations.

Will having accurate perceptions of expertise improve group performance? Libby, Trotman, and Zimmer (1987) found that both variation in individual performance and the ability of groups to recognize expertise were associated with more accurate group performance. Liang, Moreland, and Argote (1995) found that knowledge of who was good at what in a group improved subsequent group performance. By contrast, Henry et al. (1996) found that although outcome feedback improved the ability of groups to identify who was best at a task, this ability did not improve group performance. The researchers suggested that participants in their laboratory study might have been more concerned with maintaining positive group relations by incorporating everyone's input than with increasing group accuracy by relying on the best member. It is also important to note that the task used in the study (estimating different items) was deliberately chosen so that the same individual would not be the most proficient at different performances of the task. Although this design

choice suited the researchers' purpose, the design made the task less representative of the types of tasks real groups encounter. Real groups are likely to experience more stability in who is good at which task. Littlepage et al. (1997) found that group performance was predicted by the recognition of the expertise of group members. In general, the evidence seems to suggest that accurate perceptions of expertise improve group performance.

It is interesting to return at this point to our earlier discussion of factors explaining organizational learning curves. An important factor identified by members of organizations we interviewed was learning who is good at what—that is, learning the expertise of organizational members. This knowledge enables organizations to match tasks with the most qualified people. Knowledge of who is good at what also speeds problem solving because members know whom to ask for assistance or needed information. Many organizations such as consulting firms invested considerable resources in developing databases or knowledge networks that catalog the expertise and past work products of their members (Moreland, 1999; Stewart, 1995a, 1995b) and make this knowledge available to the entire organization. Although the evidence on their effectiveness is mixed, the development of these systems suggests that firms view the knowledge of who knows what as important to firm success. Knowing who is good at what is an important contributor to group and organizational performance.

5.4.3.2 Influence of Minorities

Minority influence is an important factor in understanding the way in which groups weight information provided by their members (see Levine & Thompson, 1996; Martin & Hewstone, 2008, for reviews). A small percentage of group members may have minority viewpoints that conflict with the majority opinion. Research on minority influence reveals factors that affect the ability of minorities to persuade the group to accept their alternative ideas. Further, the analysis of minority influence provides information about the persistence of attitudes because attitudes formed following minority influence are stronger and more resistant to counter-persuasion than attitudes formed through majority influence (Martin & Hewstone, 2008). The overall influence of minorities is related to the previously discussed work concerning minority contributions to divergent thinking (e.g., see Nemeth, 1992).

A group's acceptance of minority views or accommodation of them is affected by characteristics of the minority. A characteristic that is very important in the minority's ability to influence the group is credibility (Wood, Lundgren, Ouellette, Busceme, & Blackstone, 1994). Several factors determine a minority's credibility, including consistency of opinion (Moscovici, Lage, & Naffrechoux, 1969), flexibility (Mugny, 1982), and gradual distancing from the majority view (Levine, Saxe, & Harris, 1976). A minority's credibility increases if the minority demonstrates concern for the welfare of the group rather than for his or her individual welfare. That is, a minority is influential if he or she advocates outcomes that are not guided by his or her personal interests (Eagly, Wood, & Chaiken, 1978). Support from other

group members bolsters a minority's credibility (Penrod & Hastie, 1980). The distinctiveness of the minority also encourages more elaboration of its message (Martin & Hewstone, 2008). Minority members who share a social identity with the majority are more likely to be influential than those who do not (Kane, Argote, & Levine, 2005).

Characteristics of the group's task or problem also affect a minority's ability to influence other members. "Demonstrably correct" suggestions, or those that seem to be logical answers, are more acceptable to the group than suggestions that do not seem as obviously appropriate for the problem (Laughlin, 1988). When the group's objective is to learn rather than to perform, members may be more open to minority ideas (Smith et al., 1996).

These findings help to identify conditions under which individually proposed information significantly influences the final group decision or product (Argote et al., 2001). The primary factors allowing information to be heavily weighted are the level of expertise of the information's contributor; the extent to which the contributor is perceived to be concerned primarily with the group's welfare rather than his or her personal interests; the consistency of the contributor's opinion; his or her openness to other input; the degree of support from other group members; and whether the information is conceived to be an appropriate, logical solution to the problem. Individuals who possess these characteristics or craft arguments characterized by these features are more influential during group discussions than those lacking such characteristics.

5.4.4 Combining Knowledge

Once group members have shared information and determined (either implicitly or explicitly) how much weight to place on various bits of information, the information must be combined into a collective product. Several lines of research are relevant for understanding how groups combine information: descriptive work on group social decision schemes, normative work on social decision themes, and models of persuasive argumentation.

5.4.4.1 Social Decision Schemes

A social decision scheme is a rule or procedure that converts individual preferences into a group product (Davis, 1973). Thus, a social decision scheme describes the social processes by which a group makes a decision. These processes can be explicit or implicit. Examples of social decision schemes include the following: "truth wins," in which a single correct member proposes a response that is then accepted by the group; "truth-supported wins," in which one member proposes and another supports a correct response that the group then accepts; majority, in which the group decision is the alternative preferred by the majority of members; and equiprobability,

in which the collective group decision is equally likely among the proposed alternatives regardless of the number of members favoring them.

The extent to which the task is perceived as having a demonstrably correct answer is a critical factor that affects the decision scheme groups employ (Laughlin & Ellis, 1986). Tasks can be classified upon a continuum from intellective to judgmental tasks. Intellective tasks have a demonstrably correct answer, such as a solution to a math problem. Judgmental tasks, such as selecting a job candidate, do not have demonstrably correct answers. Taken together, the results of several studies suggest that the number of group members necessary and sufficient for a collective group decision decreases as the demonstrability of the "answer" increases (Laughlin & Ellis, 1986).

For intellective tasks with an obvious demonstrably correct answer, a "truth wins" social decision scheme best characterizes the decision process groups use (Laughlin & Ellis, 1986; Lorge & Solomon, 1955). For intellective tasks with nonobvious demonstrably correct answers, such as tests of knowledge, a "truth supported wins" social decision scheme best describes the decision process typically employed (e.g., see Laughlin & Adamopoulos, 1980). For collective induction tasks in which answers are neither demonstrably correct nor demonstrably incorrect, a combination of majority and truth-supported wins characterizes the group decision process (Laughlin & Futoran, 1985; Laughlin & Shippey, 1983). For judgmental tasks without a demonstrably correct answer, a majority or equiprobability social decision scheme characterizes how groups make their decisions (e.g., see Davis, 1980, 1982; and Penrod & Hastie, 1979, for reviews).

Einhorn, Hogarth, and Klempner (1977) also analyzed how individual inputs are combined into a group output. Rather than describing the decision scheme groups actually used, the researchers analyzed whether using different decision schemes or models theoretically affected the quality of group judgment. Four models that characterize how groups form judgments were contrasted. The four models involved the following (1) randomly picking an individual's judgment as the group's judgment (random model); (2) taking the mean of the judgments of individual group members as the group's judgment (mean model); (3) using the judgment of the "best" group member, whom the group is able to identify with certainty (best member model); and (4) using the judgment of the best member, whom the group identifies with some probability (the proportion model). The researchers examined the four models under varying conditions of group size and individual member bias.

Theoretical results indicated that the random model generally led to the poorest decision accuracy while the best member model consistently led to the highest decision accuracy. The proportional model and the mean model were intermediate in accuracy. For low levels of bias, the mean model performed better than the proportional model, while the reverse was true for high levels of bias. As bias increased, the best member model improved relative to the other three models. As group size increased, the accuracy of group judgment increased. The increase in accuracy observed with increasing group size was particularly pronounced for the best member model and for the mean and proportional models under low levels of bias.

These results represent the theoretical baseline that could be achieved under various conditions of decision model, group size, and member bias. Thus, the results do not describe what groups do but rather prescribe the ideal level that could be achieved under various conditions. If one knows the best member with certainty, relying on the best member's judgment is clearly the best strategy. Under conditions of uncertainty about the best member, forming a mean of members' judgments is the best strategy when individual judgments are not very biased. For high levels of bias, relying on the person believed to be the best member is more effective than averaging the judgments of all group members. It is interesting to note that the importance of knowing who is best at what figures so prominently in this and other discussions of group learning and performance.

5.4.4.2 Persuasive Arguments

Another perspective on how groups combine knowledge to arrive at a collective decision can be found in "persuasive arguments" theory (Burnstein & Vinokur, 1977). This theory has received considerable support as an explanation of the risky shift or group polarization phenomenon (for reviews of the risky shift and related phenomena, see Cartwright, 1973; Dion, Baron, & Miller, 1970; Myers & Lamm, 1976). According to persuasive arguments theory, the greatest choice shifts found after group discussion occur when (1) the preponderance of arguments in the "population" of arguments favors one alternative; and (2) the probability that a given individual group member possesses the arguments is low. Group discussion exposes individuals to new arguments. Because there are many more arguments in favor of one alternative than the others, individuals' preferences shift to that alternative during group discussion.

In order for persuasive arguments to lead to a choice shift, individual group members must possess only a small subset of the arguments in favor of an alternative at the start of group interactions. This is one of the conditions that Stasser and Titus (1987) found increased the sharing of unshared information in groups. When the percentage of shared information is low, individuals were more likely to share "unshared" information. When they share their unshared information and when most of the information favors a particular alternative, individuals are exposed to a large number of arguments in favor of the alternative through group discussion. In persuasive arguments theory, the balance of arguments determines the group outcome. The alternative with more arguments in its favor is accepted.

The studies of group decision making reviewed in this section are largely laboratory studies where groups are convened for the purpose of forming a judgment or making a decision. Hence, the social decision schemes used by these groups might be more explicit and perhaps more collective than one finds in ongoing groups in organized settings. For those groups, a formal leader might make the decision, with or without consultation with group members. The influence processes described in the previous section are likely to come into play to affect whom a leader or manager consults and whether their opinion is incorporated in the final decision. Power and status also influence how knowledge is combined (Thomas-Hunt et al., 2003).

5.5 Limits of Group Learning

The general pattern found on a variety of tasks is one of groups being superior to individuals (certainly the “average” individual, and sometimes even the “best” individual—see Reagan-Cirincione, 1994; Weldon & Bellinger, 1997) and of groups improving with experience. Groups are better than individuals on recall (Hinsz, 1990) and induction tasks (Laughlin & Hollingshead, 1995). Groups become better at sharing information (Wittenbaum, 1996) and developing more complex understandings of phenomena (Gruenfeld & Hollingshead, 1993) as they gain experience. With experience, groups also become better at identifying expertise and who knows what (Liang et al., 1995) and at recognizing and accepting the correct solution proposed by a group member (Laughlin & Hollingshead, 1995). Group performance improves as groups gain experience (Argote, Insko, Yovetich, & Romero, 1995; Goodman & Leyden, 1991; Guetzkow & Simon, 1955; Shure, Rogers, Larsen, & Tassone, 1962).

Although the general pattern is one of group superiority to individuals, there are important examples where groups make very poor decisions. Janis (1972) vividly described examples of fundamentally flawed group decisions with disastrous consequences and attributed the flaws to the groupthink phenomenon. Controversy has swirled around the groupthink phenomenon, the conditions under which it occurs and whether it leads to defective outcomes (see Aldag & Fuller, 1993, for a review).

Several of the conditions hypothesized to lead to groupthink arguably prevent groups from learning. For example, a leader who actively promotes his or her opinions might prevent others from speaking up or voicing their views. Similarly, a lack of norms about the importance of incorporating all members' inputs in decisions could discourage members from sharing information they possess. Thus, groupthink may block the learning processes that generally occur in groups as members gain experience working together. In a related vein, Argyris (1992) demonstrated how the defensive routines organizations invoke to avoid embarrassment or threat can prevent organizational learning (see also Argyris & Schon, 1978).

Janis (1972) described how the same group of policy makers who made very poor decisions in the Bay of Pigs fiasco functioned much more effectively in the Cuban Missile Crisis after they had gained experience working together. By contrast, Kim (1997) found that groups with both experience on a similar task (task experience) and experience working together (team experience) performed more poorly than their counterparts lacking both types of experience in a laboratory study. The poor performance of groups with both task and team experience was due in part to their tendency to focus on information that members held in common rather than discuss unique information that different members possessed.

Katz (1982) found a non-monotonic inverted U-shaped relationship between group “longevity” (the average amount of time group members had worked together) and the performance of Research and Development (R&D) groups. Performance initially increased and then decreased with increases in the average group experience. Initially, performance improved as group members learned how to communicate

and coordinate their activities. The decrease observed in performance at high levels of experience was attributed to the groups becoming too inwardly focused and not interacting with or learning from external sources. These results underscore both the benefits and the costs of experience. Increases in experience can enhance group performance significantly by providing group members with opportunities to learn how to work together effectively. If increases with experience are also associated, however, with becoming isolated from external sources of knowledge, performance decrements can occur.

Although there is considerable evidence of individual performance improving with experience, there is also evidence that individuals have difficulties drawing appropriate inferences from their experience (Dawes, 1988; Einhorn & Hogarth, 1986; Tversky & Kahneman, 1974). Not only does the performance of most groups improve with experience, groups seem to improve in interpreting their experience (e.g., see Gruenfeld & Hollingshead, 1993).

How can these conflicting viewpoints of the role of experience in individual and group performance be reconciled? A possible reconciliation would be to demonstrate that groups are better than individuals at learning from experience. Comparing how individuals and groups learn from experience would extend previous comparisons of individual and group performance (Hill, 1982; Maier, 1967) in interesting ways. In their analysis of group versus individual accuracy, Gigone and Hastie (1997) concluded that "groups tend to outperform individuals when the judgment policies of their most accurate members are both more accurate than the judgment policy of the statisticized groups and discernible by other members" (p. 163). As noted earlier in this chapter, perceptions of the expertise of other group members have been found to become more accurate as groups gain experience. This may explain an advantage groups have relative to individuals at learning from experience.

Research has been done comparing individual and group biases that is also somewhat relevant for this issue (e.g., see Argote, Seabright, & Dyer, 1986; Kerr, MacCoun, & Kramer, 1996; Tindale, 1993). This work examines whether groups amplify or cancel decision-making biases observed at the individual level (see Kahneman, Slovic, & Tversky, 1982, for a discussion of biases at the individual level). Most of this work has been conducted at one point in time. Hence it does not directly address questions of learning but rather provides comparisons of group versus individual judgment.

Research comparing group and individual biases has yielded contradictory findings. Some studies have shown that groups eliminate biases observed at the individual level, whereas others have reported that groups amplify individual biases. Whether groups amplify or cancel biases depends on the nature of the bias. If the bias is not systematic, group discussion will serve to weaken the bias because members will be exposed to other points of view that are less biased or biased in a different direction (see also Gigone & Hastie, 1997). Conversely, if the bias is systematic and widely shared, group discussion is likely to amplify the bias by exposing members to others who hold the same bias and thereby, increasing confidence in its correctness. Thus, groups may be better than individuals at learning if group

members have diverse views that are utilized effectively. Even when individual biases are systematic, groups may be able to outperform their best member if their discussion is facilitated to ensure that all group members participate and if members are provided feedback as a group (Reagan-Cirincione, 1994).

The context in which learning occurs within groups also helps to explain variation in the extent to which groups learn from experience. A culture of “psychological safety,” where group members feel free to express their ideas, has been found to facilitate learning (Edmondson, 1999). A “learning” orientation, in which members emphasize learning, has been found to lead to better performance than a “performing” orientation, in which members compare their performance to that of other units (Bunderson & Sutcliffe, 2003). Team structures characterized by specialization, formalization, and hierarchy have been found to facilitate team learning because those bureaucratic structures increased information sharing and reduced conflict (Bunderson & Boumgarden, 2010). Research on how the context interacts with experience to affect learning processes and outcomes is very promising.

More research is needed on the question of how groups (and organizations) learn from experience and the conditions under which their performance improves with experience. Determining the answer to this question will require longitudinal studies that examine groups over time. It will also require studying many groups that differ in interesting ways. This research strategy will enable us to specify more fully the conditions under which group learning occurs. Characteristics of the context in which the group is embedded are likely to condition the extent to which group learning occurs.

5.6 Conclusion

Several key processes must occur in order for groups to learn. Groups develop knowledge by sharing knowledge members already possess or by generating new knowledge. Several important conditions increase the likelihood that knowledge will be shared by group members: having group members with different expertise, keeping groups small in size, creating the perception that some solutions to the problem are better than others, having leaders or facilitators present, refraining from overburdening the groups, and providing group members with experience or training and enough time in meetings to get past the initial tendency to focus on shared information.

Several of these conditions that increase the likelihood that group members share information are the same conditions that increase the likelihood that new or emergent knowledge is generated in groups. Having members with different backgrounds and views increases the likelihood that new or emergent knowledge develops as a result of their interactions. Groups with diverse members or minority views are more likely to experience conflict than homogeneous groups or groups lacking minority dissent. The presence of this conflict coupled with an absence of pressure to conform and a cooperative culture can lead to the development of new approaches

and alternatives. Thus, conflict can lead to the creation of new knowledge. Providing group members with experience working together also leads to the creation of new knowledge. Groups can also develop knowledge by importing it from outside the group. This mechanism for knowledge acquisition is discussed in Chap. 6 on knowledge transfer.

Once information has been shared or new information generated, groups must evaluate the information they have acquired and determine its weight in the final judgment. This involves judging the expertise, the status, and the role of the individual providing the information as well as considering the implications of accepting it. Groups are more likely to accept information contributed by a recognized expert than by someone not perceived as having relevant expertise. With experience working together, groups learn who the experts are in various areas. Individuals are also likely to persuade the group to accept their point of view when they take a consistent—but not rigid—stance, when they are not perceived as having a personal stake in the group's decision, and when other members support their positions.

Once group members have acquired information and determined (either implicitly or explicitly) the weight it receives, the various bits of information must be combined into a collective product. There are many strategies that groups can use to combine information. These strategies range on a continuum from relying on one person to make the decision to basing the decision on consensus of all group members. Several factors tip a group toward one versus the other end of the continuum. The more the task is perceived as having a demonstrably correct answer, the fewer the number of persons supporting the answer required for the group to accept that answer. By contrast, for judgmental tasks lacking a demonstrably correct answer, a majority of group members are required for a group to accept a point of view. The more member acceptance is viewed as critical for decision success, the greater the number of group members typically involved in a decision.

Although there are important examples of groups making disastrous decisions, on balance, groups are generally better than individuals (at least the average individual) on a variety of tasks. Further, group performance typically improves with experience. Groups become better at sharing information. They learn who knows what and whom they can rely upon. This meta knowledge of each other's expertise improves group performance. Members know whom to go to for information or advice. Tasks are assigned to the most qualified group member. Groups develop effective strategies for coordinating their activities. Thus, as groups acquire experience, they develop effective connections for getting their work done (Fang, 2011; Huberman, 2001).

Although this chapter acknowledged that heterogeneous groups composed of diverse members do not always outperform homogeneous groups, the chapter has emphasized the benefits of diversity in functional areas or members' backgrounds for developing new knowledge. Diverse groups are more likely to share "unshared" information and to generate new knowledge as a result of their interaction. Diversity causes group members to rethink their positions and to create new approaches and alternatives that accommodate different views. Diversity is particularly beneficial for the creation of new knowledge. Too much diversity, however, can impair the

generation of new knowledge, if there is not some overlap or base of common understanding (Owens & Neale, 1998). Too much diversity can also impair the transfer of knowledge across organizational units. This issue is discussed in the next chapter.

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