Intervening When the Time is Right:

How the Timing of Formal Interventions Affects Group Process and Outcomes

Colin M. Fisher

Boston University

WORKING PAPER (under review March 2014)

Author Note

Colin M. Fisher, Department of Organizational Behavior, School of Management, Boston University.

This research was supported in part by grants from the Intelligence Technology Innovation Center, Harvard University, and Boston University. I would like to thank J. Richard Hackman, Ruth Wageman, Teresa Amabile, Anita Woolley, GroupsGroup, and HBS OBLab for their assistance in developing this manuscript, as well as all of the superb research assistants involved in collecting and coding these data.

Correspondence concerning this article should be addressed to Colin M. Fisher, School of Management, Boston University, 595 Commonwealth Avenue, Boston, MA 02215.

Email: cofisher@bu.edu
Abstract

People helping groups improve their processes face tradeoffs between intervening earlier during group development when processes are flexible, and later when group members have more experience working together. This paper explores how the timing of formal interventions influences group processes and outcomes. In two laboratory experiments, I test the extent to which decision-making groups alter processes in response to interventions received at various times during their first task as a team. In Study 1 (n = 60 three-person groups), groups that received interventions during early stages of their discussions shared more information than groups that received interventions before beginning discussions, which influenced decision quality indirectly. In Study 2 (n = 105 three-person groups), I compared early, in-process interventions to interventions received at the temporal midpoint of the first task, finding that groups receiving interventions at the temporal midpoint of their first task improved initial processes and outcomes, and groups receiving earlier interventions did not. During a subsequent task, however, both early and midpoint interventions led to better decisions since groups receiving interventions decreased the extent to which members advocated for member preferences.

*Keywords*: group development, timing, intervention, group process, group decision-making
Intervening When the Time is Right:

How the Timing of Formal Interventions Influences Group Process and Outcomes

In contemporary organizations, groups rarely enjoy the benefit of stable membership (O’Leary, Mortensen, & Woolley, 2011; Valentine & Edmondson, 2014), and new teams perform many crucial organizational tasks. Unfortunately, new teams seldom hit the ground running; most initially adopt suboptimum strategies such that early work is inferior to later work (Akgün & Lynn, 2002; Rand, 1998). This liability of newness can have dire consequences. For example, Hackman (2002) reports that the National Transportation Safety Board’s (NTSB) database of commercial airline incidents reveals that “73 percent of the incidents in the NTSB database occurred on a crew’s first day of flying together, and 44 percent of those took place on a crew’s very first flight” (p. 55). Thus, helping leaders and team members create and leverage opportunities to develop and adopt appropriate strategies quickly is critical.

One way to help groups overcome initial struggles quickly is through formal intervention (Morgeson, 2005; Morgeson & DeRue, 2006; Okhuysen & Eisenhardt, 2002). Okhuysen (2001) defines a formal intervention as “instructions given to groups for members to follow as they work [which] give impetus to the incremental change process by providing legitimate points at which groups can stop and evaluate their work” (p. 795). Such efforts to improve group processes and performance produce mixed results (Kaplan, 1979; Salas, Rozell, Mullen, & Driskell, 1999), suggesting interventions are effective only under some conditions (Klein et al., 2009). Although scholars have explored the content of effort to improve group processes (Argyris, 1982; Mathieu & Rapp, 2009; Schein, 1987; Schwarz, 2002), less attention has been paid to the role of timing when leveraging and creating such opportunities (Hackman & Wageman, 2005; Weingart, 1992; Woolley, 1998). Since theories of group development suggest
temporal dynamics play a critical role in shaping the readiness of groups for change (Gersick, 1989; Ilgen, Hollenbeck, Johnson, & Jundt, 2005; Knight, 2014; Kozlowski & Bell, 2008; Marks, Mathieu, & Zaccaro, 2001; Waller, 1999; Weingart, 1992), it is surprising that intervention timing has not been explored further, making the timing of formal interventions a potentially important though little-researched area of theoretical and practical concern. I investigate how the timing of formal interventions influences a group’s capacity to improve initial strategies. I present two laboratory experiments in which groups performed two decision-making tasks, and received interventions at various times during initial tasks. In Study 1, groups received interventions at one of three time points during the beginning of their work. In Study 2, I investigate whether the way in which the intervention was delivered (i.e., directive versus participative style) moderates the effects of intervention timing. Analyses examined the extent to which interventions alter group processes, the degree to which those changes are sustained in a subsequent task, and the impact of those changes on decision quality.

**Theoretical Background**

Over time, group members alter the way they communicate and coordinate activities (Gersick, 1988; Ilgen et al., 2005), and two major approaches describe how group process changes predictably. First, many scholars posit that groups progress through several stages of development (Bales & Strodtbeck, 1951; Chang, Bordia, & Duck, 2003), the most well-known of which is Tuckman’s (1965) forming-storming-norming-performing model. These linear stage models suggest groups devote a smaller proportion of their time to task work early in their development, instead focusing on interpersonal and teamwork factors (Kozlowski & Bell, 2008) such as inclusion, norms, and trust. As these relational issues are addressed, groups devote more attention to the task. Thus, an implication of linear stage models is that groups increasingly
focus on task work as they become more temporally distant from their beginnings, and a group’s performance strategy develops and changes gradually throughout its work.

Second, inspired by Gersick’s (1988, 1989) punctuated equilibrium model of group development, other theorists reject the notion that groups pass through predictable stages during development. Instead, deadline-driven, task-performing groups establish norms (Bettenhausen & Murnighan, 1985; 1991) and work processes quickly in their earliest formative moments (Eriksen & Dyer, 2004; Gersick & Hackman, 1990). Groups increasingly resist altering these work processes (Ancona & Chong, 1999; Zellmer-Bruhn, Waller, & Ancona, 2004) until the temporal midpoint between the beginning and a deadline, at which point the group becomes more aware of temporal constraints, sparking rapid change that endures until the end of the task (Knight, 2014; Okhuysen & Waller, 2002). These models imply group performance strategies emerge rapidly at the beginning of a task, and are static for long periods.

More recently, scholars expanded the idea of punctuation and transition beyond beginning and temporal midpoints (Ilgen et al., 2005). In their model of group process, Marks et al. (2001) argue that groups alternate between action phases during which groups focus on completing tasks, and transition phases during which groups reflect on and plan for future action. During an action phase, groups follow the inertial patterns Gersick (1988, 1989) describes, and during a transition phase, groups lay groundwork for altering task strategies. There is consensus that group processes change over time, and earlier processes influence subsequent processes strongly (Eriksen & Dyer, 2004; Ilgen et al., 2005), but the nature and patterns of these changes are subjects of debate.

Timing and Formal Interventions
Formal interventions are important triggers of transitions, beyond those sparked by deadlines and awareness of clock time (Okhuysen, 2001; Okhuysen & Eisenhardt, 2002). Formal interventions such as instructions to focus on sharing information or questioning others lead members to shift attention away from a focal task, creating an opportunity for members to raise other issues about teamwork and task-work processes. The shift creates clusters of attention switches that facilitate incremental change (Okhuysen & Eisenhardt, 2002; Okhuysen & Waller, 2002). Most formal-intervention research focuses on the effects of interventions offered before groups interact (Okhuysen, 2001; Okhuysen & Eisenhardt, 2002; cf. Woolley, 1998). Offered during group task work, formal interventions are interruptions (Morgeson, 2005; Staudenmayer, Tyre, & Perlow, 2002) that alter a group’s focus. The effect of an in-process intervention depends on the state of group process at the time of the interruption (Morgeson & DeRue, 2006). To explain this phenomenon, Hackman and Wageman (2005) theorize that a team’s readiness for an intervention varies over time, and they define readiness as: “(1) the degree to which the issues to be addressed are among those naturally on team members’ minds at the time of the intervention, coupled with (2) the degree to which the team as a whole is not at that time preoccupied with more pressing or compelling matters” (p. 275). In their theory of team coaching, they focus on three key moments during group development—the beginning, midpoint, and end of group task work—as times during which teams are prepared most for certain types of intervention.

If group process is characterized by multiple cycles of transition and action phases within a task (Goh, Goodman, & Weingart, 2013), interventions can trigger transition phases, more disparities in intervention timing might also matter. For example, beginnings shape team trajectories (Eriksen & Dyer, 2004; Ginnett, 1993) and influence subsequent norms and
interpersonal processes (Bettenhausen & Murnighan, 1985), but conceptualizations of
“beginnings” vary considerably in the literature, with scholars operationalizing them as pre-task
instructions (Ginnett, 1993; Woolley, 1998), the first half of a single task (Lim & Murnighan,
1994; Okhuysen & Waller, 2002), and the entire first meeting of a project team (Gersick, 1988;
1989; Eriksen & Dyer, 2004). Since definitions vary broadly, it is difficult to theorize how and
why beginnings constitute times of high readiness for intervention.

To clarify why and how intervention early in a group’s existence is important, I
distinguish pre-task from in-progress interventions (see Weingart, 1992 for a similar distinction
regarding strategy discussions), and argue they influence group processes variously. Before the
task begins, members focus on understanding task demands, individual roles, and member
appraisal (Kozlowski & Bell, 2008). Group members might be anxious about interacting with
new people or participating in a new task. Since groups possess a great deal of cognitive load
during initial stages, they experience difficulty remembering and integrating strategic advice
offered before a task begins (Gellatly & Meyer, 1992). Several studies highlight the difficulty of
asking group members to think deeply about performance strategy before beginning work
although pre-task interventions to elicit strategy discussions (Hackman et al., 1976) improved
group performance, it was extremely difficult to get members to conduct such discussions at this
time. Since groups are naturally hesitant to engage in strategy discussions (Mathieu & Rapp,
2009) and are concerned with other matters, groups are less ready for interventions regarding
their performance strategies pre-task in comparison to in-process.

Because groups initially adopt suboptimum norms and performance strategies
(Bettenhausen & Murnighan, 1985; Gigone & Hastie, 1993), in-process interventions disrupt
existing processes and create a switch of attention that might lead to productive changes (Okhuysen & Eisenhardt, 2002). If there are no processes to disrupt, members might not fully understand the implications of a formal intervention, and might be less likely to self-correct during an interruption. The more collective experiences a group has, the more data it possesses regarding its task strategies and what aspects of strategy are relevant. Such experiences have long been proposed as antecedents to learning (Kolb, 1984). In the absence of collective experience, groups have difficulty applying strategic advice or learning from it. Since groups are less ready for strategic advice pre-task, and since in-process interventions both disrupt suboptimum patterns and offer members more experience with teamwork and task work (Marks et al., 2001), I predict:

_Hypothesis 1a_: Intervening after a group begins work leads to more effective group processes than intervening before it begins work.

_Hypothesis 1b_: Intervening after a group begins work leads to more effective group outcomes than intervening before it begins work.

**Temporal Distance and Group Readiness**

Although the beginning of group discussion represents readiness for intervention changes, the two primary theories of group development—punctuated equilibrium and linear stage models—lead to competing predictions about how time, elapsing during an initial task, influences intervention readiness. Punctuated models suggest radical change occurs in extremely small chunks of time, the results of which are difficult to dislodge for the majority of a group’s life. Beginnings are a particularly important punctuation (Gersick, 1989; Wageman, Fisher, & Hackman, 2009) because habitual routines (Gersick & Hackman, 1990) and vicious cycles (Eriksen & Dyer, 2004) are initiated very early during group development. Thus, receptivity to
INTERVENING WHEN THE TIME IS RIGHT

intervention wanes as a group gets further away from the very beginning of a task as routines, norms, and processes solidify (Ancona & Chong, 1999; Zellmer-Bruhn et al., 2004). Punctuated models predict narrow windows during which groups are receptive to altering task strategies (Hackman & Wageman, 2005), and groups are resistant to process changes between these windows.

Linear stage models predict gradual and iterative change over time; a group’s attention shifts gradually from relational activities to tasks as its work progresses. Thus, linear stage models imply that the more temporally distant the beginning (and thus the need for formative activities), the more groups shift attention to the task itself (Chang et al., 2003; Kozlowski & Bell, 2008), which by definition makes them more ready for a task-focused intervention. These two perspectives suggest competing hypotheses regarding the effects of temporal distance from the first moments of interaction. Punctuated theories suggest groups are uniquely receptive to change at the very beginning, but quickly develop resistance to change until the temporal midpoint. Linear stage models suggest temporal distance from the beginning makes groups more receptive to change since they are better able to focus on the task and the beginning is further in the past.

Hypothesis 2: Intervening at the very beginning of interaction leads to more effective group processes and outcomes than intervening later during a group's work.

Hypothesis 3: Intervening later during group interactions leads to more effective group processes and outcomes than intervening at the very beginning.

Study 1

Method
To test the hypotheses, I used a 1x3 experimental design in which newly formed groups made two decisions. Groups were assigned randomly to one of three intervention timings: a) just before the task started (i.e., pre-task), b) during the first few seconds of a group performing the task (i.e., minimal interaction), and c) five minutes into the first task (i.e., early stages). Groups completed two hidden-profile decision-making tasks in which the choice implied by members’ individual information was different from the preference implied by the pool of all members’ information (Stasser & Titus, 1985; Wittenbaum, Hollingshead, & Botero, 2004). Hidden-profile decision-making tasks were a good fit for this study because a) groups generally make poor decisions and their strategies are in need of correction, b) those poor decisions are attributable to group processes (i.e., the ways groups pool information), and c) the way information is pooled can be improved through simple interventions (Brodbeck, Kerschreiter, Mojzisch, & Schulz-Hardt, 2007; Wittenbaum et al., 2004). These characteristics accord with Cronin, Weingart, and Todorova’s (2011) call for temporal research in groups to build on well-established experimental tasks. Consistent with group decision-making literature, information pooling measured group process quality, and decision-quality measured outcomes (Wittenbaum et al., 2004).

Participants. Sixty three-person teams comprised of 180 English-speaking adults who were recruited through on-line, classified advertising were assigned to one of the three conditions. One-hundred one females and 79 males participated, aged 19 to 66 years ($M = 28.74, SD = 12.07$). Subjects were paid for participation.

Task and materials. Participants simulated a three-person group of investors who were opening a new, gourmet restaurant. Each group performed two hidden-profile, decision-making tasks (Stasser & Titus, 1985), choosing a) one of three finalists for the position of head chef and
b) one of three locations to rent. The sequence of chef and location tasks was counterbalanced within conditions.

Participants individually read a subset of the information concerning each of three potential chefs/locations (i.e., the decision options), and then discussed which of the options would be the best choice. Consistent with other studies that use hidden-profile, decision-making tasks (Wittenbaum et al., 2004), information favoring incorrect choices was held jointly by all three team members (i.e., shared information). Information favoring correct choices was distributed such that a subset was held uniquely by each team member (i.e., unshared information). Before discussion, each member held five positives, two neutrals, and two negatives about incorrect choices, and three positives, two neutrals, and four negatives about correct choices. The full profile consisted of five positives, four neutrals, and six negatives for incorrect choices, and nine positives, two neutrals, and four negatives for correct choices. To assess how groups perceived the intended correct and incorrect choices, a separate sample of 13 groups of three members each were given the complete profiles containing all information about all three decision options for each task. When given all information, 90% of 39 individuals preferred the intended correct answers before discussion. After group discussion, 100% of the 26 group decisions were in favor of intended correct answers.

**Procedure.** When all three team members arrived, participants were seated at a table and given information packets for the first task. An experimenter who was blind to hypotheses verbally explained the task instructions, asking participants not to show their packets to one another and indicating, “I may come in and offer some advice at some point.” Participants were instructed to read their individual information packets and indicate which option they felt was best, which option they felt was worst, and their confidence in those rankings, and to begin
discussion of which option to choose after making those ratings. All sessions were video recorded.

During the first task, the experimenter gave groups the following advice, designed to stimulate information pooling: “I’d like to give you one piece of advice about the process you use. We’ve found it helps groups to collect all the information before discussing its importance. This should be helpful in your discussion.” The intervention was delivered a) just before groups read their information packets (i.e., pre-task), b) when the first group member finished a speaking turn in which he/she revealed his preference (i.e., minimal interaction), or c) five-minutes into a group’s discussion (i.e., early stages). After 20 minutes, the experimenter collected the groups’ written decisions and distributed materials for the second decision task. All groups performed the second task without intervention. After completing the second task, participants completed a survey on their perceptions of the experiment and demographics. Participants were then debriefed and paid.

**Measures.** Videos of group discussions were coded for the degree to which groups pooled unshared information. Three research assistants (coders) who were unaware of the hypotheses independently watched a subset of video recordings. While they watched, they recorded every piece of information that was mentioned, by whom it was mentioned, and the sequence in which they were mentioned. All three coders coded 40 of the 60 videos such that two coders rated each video. Each coder coded an average of 1974 pieces of information, and inter-rater reliability was adequate (average Cohen’s $K = .94$). The third coder resolved disagreements between coder pairs. Unshared and shared information pooling variables were calculated as the sum of unique pieces of information the group pooled. For each task, groups had 27 unshared and 18 shared pieces of information available. Since patterns of shared and
unshared information pooling were nearly identical and were predicted by the same factors, but only unshared information pooling linked theoretically to decision quality (Brodbeck et al., 2007), only unshared information pooling is reported in the results. Including shared information pooling in the models did not change the patterns of results. Decision quality was coded as either correct (1) or incorrect (0). Pre-discussion preferences were measured as the number of members who preferred the correct answer before discussion. Descriptive statistics and correlations are shown in Table 1.

[Insert Table 1 here]

**Estimation procedures.** The data structure was pooled repeated measures (n = 120; 60 teams x 2 tasks). Following recommendations from Ballinger (2004), I used generalized estimating equations (GEEs) to test the effects of interventions on information pooling and outcomes. GEEs provide a flexible way to analyze clustered or longitudinal data with a variety of distributions in outcome variables (i.e., Poisson distributions for counts of information and binomial distributions for decision quality), while estimating robust standard errors (Huber, 1977), which allowed parallel analyses of information pooling and decision quality. Wald $\chi^2$ tests were used to test the null hypothesis that regression coefficients equaled zero. To test specific hypotheses of mean differences, planned comparisons of whether estimated marginal mean differences were greater than zero were used. When unshared information pooling was the dependent variable, a Poisson link function was specified, which is appropriate for count variables (Liang & Zeger, 1986). When decision quality was the DV, a binomial link function was specified. Following Preacher and Hayes’ (2008) recommendations, I also tested the indirect effects of timing on decision quality, modeling information pooling as the intervening variable and using a resampling procedure to bootstrap confidence intervals and the strength of
indirect effects. These analyses were conducted using Hayes (2013) PROCESS (v2.10) module for SPSS 20.

**Results**

Hypothesis 1a suggests pre-task interventions are less effective at stimulating better performance strategies such as information pooling than in-process interventions. The hypothesis was tested by comparing groups receiving pre-task interventions to groups in the other two conditions. This hypothesis was supported, \( \chi^2(1) = 4.84, p = .01. \) Groups receiving interventions before beginning discussions pooled an average of 12.40 pieces of unshared information (\( SE = .86 \)), and groups receiving in-process interventions pooled 14.83 (\( SE = .69 \)). Table 2 presents the GEE regression models for these tests.

[Insert Table 2 here]

Hypothesis 1b suggests groups receiving pre-task interventions make worse decisions than groups receiving in-process interventions. Differences between means were non-significant (\( \chi^2(1) = 1.36, p = .12 \)). Groups receiving interventions before beginning discussions chose the correct answer 54% of the time (\( SE = .05 \)), and groups receiving in-process interventions chose it 65% of the time (\( SE = .08 \)). Further analyses suggested an indirect effect of timing through information pooling (Mathieu & Taylor, 2006). As expected, unshared information pooling was a predictor of decision quality (\( \chi^2(1) = 14.23, p < .001 \)). Using Hayes’ (2013) approach to test mediation with categorical predictors, \(^3\) I found indirect effects of intervention timing on group decision quality through unshared information pooling; intervention before discussions resulted in less unshared information pooling, which resulted in inferior decisions (Effect = -.48, \( SE = .23; Z = -2.02, p = .04 \)) in comparison to in-process interventions. This finding offers indirect support of Hypothesis 1b.
Hypothesis 2 and Hypothesis 3 are competing hypotheses regarding the effects of temporal proximity to the beginning of interaction. These analyses are presented in Table 3.

The timing of intervention influenced the amount of unshared information pooled ($\chi^2(2) = 7.26, p = .03$); groups receiving later interventions shared more information ($M = 15.42, SE = .76$) than those given interventions before the task ($M = 12.40, SE = .89, p = .007$). In contrast, groups receiving interventions after minimal interaction did not pool different amounts of information than groups in either of the two other conditions ($M = 14.23, SE = 1.10, p > .20$).

Tests of the effects of interventions on decision quality had mixed results. GEEs showed no direct effect of timing on decision quality ($p = .38$). However, tests of indirect effects (Hayes, 2013) were used to compare the extent to which the two in-process interventions improved decision-quality indirectly through information sharing. These tests revealed different patterns, depending on the timing of the intervention. Groups receiving later interventions pooled more information, which led to marginally superior decisions (Effect = .44, $SE = .24$, $Z = 1.84, p = .06$), controlling for the effects of the other conditions. Groups receiving beginning interventions did not show an indirect effect, controlling for the effects of the other conditions (Effect = .06, $SE = .20$, $Z = .39, p = .75$). This lends further, though mixed, support for Hypothesis 3.

**Discussion**

These results suggest that the timing of an intervention influences its impact. Specifically, pre-task interventions were less effective than in-process interventions at stimulating information pooling, which indirectly led to worse group decisions. Later in-process interventions showed stronger differences with pre-task interventions than earlier in-process
interventions, suggesting new groups become progressively more ready for formal intervention as time elapses.

Study 1 has two primary theoretical implications. First, by finding support for Hypothesis 1, this study suggests the first moments of group interaction are a key beginning moment at the micro-level, at which point there is a change in group readiness for intervention. Second, these results support a linear rather than punctuated view of group development during these formative moments. The results imply that novice groups’ receptivity to strategic advice grows gradually during their first task since members acclimate to the task and other group members. No support was found for Hypothesis 2, which suggested a decline in the effectiveness of interventions as they became more temporally distant from group formation. Instead, a general pattern of results was consistent with Hypothesis 3. These results are inconsistent with a view of group process marked by rapid habituation and entrainment of the pattern and content of member interaction predicted by some theorists (Gersick & Hackman, 1990). Practically, these results suggest that pre-task strategic advice such as that used in most intervention studies is suboptimum relative to in-process advice, and readiness for intervention grows as the group increasingly interacts.

Study 1 included several limitations. First, the intervention and measurement in the study focused on one process relevant to group decision-making—information pooling. Group decision researchers also propose that preference negotiation—“group members focus on exchanging and negotiating opinions and preferences so that the dominant or majority position can be identified and settled within the group” (p. 463)—is a critical aspect of group decision-making (Brodbeck et al., 2007). High levels of preference negotiation drives out information pooling (Gigone & Hastie, 1993) and reduces the impact of new information on individual
member preferences (Brodbeck et al., 2007). Thus, intervention should target both information pooling and preference negotiation to ensure new information is both used and remembered.

Another limitation is that the intervention was subtle; absence of direct effects on decision quality might be due partially to intervention style. Additionally, this study did not employ a true control condition; since all groups received interventions, I could not compare the effects of non-intervention on groups. These limitations are addressed in Study 2. Finally, a study of timing on a short timescale might be qualitatively different than a study of long-term team members who together for weeks or months rather than minutes. I argue that showing effects over these short timescales is a conservative test of the importance of timing. If differences are observed over a five-minute period, larger differences in timing might be more consequential.

**Study 2**

An important implication of Study 1 is that groups become more ready for formal intervention as they accrue collective experience. Although the study suggests groups are more receptive to early, in-process intervention, it does not compare the impact of interventions at a key moment predicted by punctuated equilibrium theorists—the temporal midpoint. As Hackman and Wageman (2005) note in their theory of team coaching, “Beginnings are not a good time for strategy discussions, but…midpoints are” (p. 276). According to Gersick’s (1989) model, group awareness of and attention to time are heightened at the temporal midpoint, leading groups to reflect and alter work processes both suddenly and radically. At the temporal midpoint, novice groups possess significantly more knowledge of the interface between task demands and member knowledge than they do earlier in the task. Hackman and Wageman (2005) propose that groups are more receptive to interventions regarding task strategy at their
temporal midpoints than at the beginning. Supporting this notion, Woolley (1998) demonstrates that groups use an intervention better to elicit a group discussion of strategy at the temporal midpoint of a task than before the task begins, but the study does not address whether interventions work equally well at other points after interaction begins, or the extent to which those effects persist across tasks. Although some scholars question whether decision-making groups experience transitions at the temporal midpoint or at other times (Lim & Murnighan, 1994), current theory strongly suggests that midpoint interventions targeting strategy are more effective than earlier interventions. Therefore:

*Hypothesis 4a.* Intervening at the temporal midpoint of a group task leads to more effective group processes than intervening at earlier times.

*Hypothesis 4b.* Intervening at the temporal midpoint of a group task leads to more effective group outcomes than intervening at earlier times.

**The Moderating Effect of Intervention Style**

Another factor unexplored in Study 1 is how intervention style moderates intervention timing. Extant intervention studies vary to the extent they employ task instructions or advice (Klocke, 2007) versus giving a group a process designed to elicit planning, discussion, and reflection (Mathieu & Rapp, 2009; Villado & Arthur, 2013). Okhuysen and Eisenhardt’s (2002) formal interventions consisted of written instructions given pre-task such as, “Please share the information in your possession during your discussion” (p. 375), given before group discussion. In contrast, Woolley’s (1998) intervention instructed groups to discuss their strategies such as “different ways to succeed at the task and which approaches were best” (p. 35).

The contrast between formal interventions designed around advice and eliciting discussion parallels a distinction in the leadership literature between directive and participative
leader behaviors (Larson, Foster-Fishman, & Franz, 1998; Vroom & Jago, 1988, 1995; Yukl, 1989), a distinction I use to characterize formal intervention styles. Directive interventions tell group members what to do with a minimum of input from the group, and participative interventions invite member input. Historically, directive leadership was thought to be detrimental and participative leadership beneficial to group decision processes (Maier, 1950; Lippitt & White, 1952). More recently, scholars identified subtler distinctions regarding how leader styles influence group decisions (Cruz, Henningsen, & Smith, 1999; Larson et al., 1998). Peterson (1997) found that leaders who are directive about a process rather than a decision contribute to effective information sharing and decision-making. Thus, directive interventions have the potential to improve group decision-making.

Groups are less ready for formal interventions at the beginning of a task than at the temporal midpoint because earlier in a group’s work, members possess less experience with the task and each other than they do later. This lack of experience might lead to diminished understanding of an intervention, or how to apply it. Gersick (1988) argues that groups naturally discuss and reevaluate their strategies at the temporal midpoint by discussing task strategy among themselves, inconsistent with formal interventions that merely direct or instruct members without inviting participation. Thus, the way in which an intervention is delivered—and the degree to which it capitalizes on member readiness to participate in discussing how to proceed—influences its impact on group process and outcomes.

Directive interventions offer several advantages over participative ones. First, directive process interventions should be quicker than participative ones because directive interventions do not require group discussions, which diminish the time available to work on a task. In contrast, participative interventions offer more weight to less-expert team members (Vroom &
Jago, 1988), diluting the clarity of the intervention with a higher volume of ideas (Ford & Sullivan, 2004), especially in inexperienced groups. The benefits of directive interventions are most compatible with opportunities offered earlier in a new group’s life when members might welcome guidance of directive interventions. Similarly, since member attention focuses on orienting toward and understanding a task earlier during interactions (Kozlowski & Bell, 2008), the group might be less ready to contribute to a discussion of strategy early in the task. Intervening earlier when there is more time to apply it should help, and using a directive approach later in group process forfeits that advantage and targets stronger, more entrenched processes (Gersick & Hackman, 1990), without leveraging the experience members accrued. In decision-making groups, earlier, directive interventions should stimulate groups to develop productive processes for sharing and aggregating information, allowing ample time for group discussions, which improves information sharing (Parks & Cowlin, 1995). I argue that early in a group’s life, a directive approach to intervention is more effective than a participative one:

*Hypothesis 5a.* Early during an initial task, directive interventions lead to more effective group processes than participative interventions.

*Hypothesis 5b.* Early during an initial task, directive interventions lead to more effective group outcomes than participative interventions.

Participative interventions offer two clear advantages over directive ones: a) they leverage team members’ collective knowledge and experience (Vroom & Jago, 1988) and b) increase commitment to intervention (Durham, Knight, & Locke, 1997; Tyler & De Cremer, 2005). However, these advantages are more likely to be realized later in a group’s work. Participative interventions are most beneficial when a team holds idiosyncratic knowledge of the interface between member skills and task strategy. Such knowledge can only be gained through
experience, and is therefore likely to be more effective later rather than earlier in new groups. The reflective benefits of participation—discussing and evaluating the process to this point—is difficult to achieve early during interaction when there are fewer data on which to base evaluations. Thus, I predict groups are more ready for participative interventions at the temporal midpoint than early in the process.

*Hypothesis 6a.* At the temporal midpoint of an initial task, participative interventions lead to more effective group processes than directive interventions.

*Hypothesis 6b.* At the temporal midpoint of an initial task, participative interventions lead to more effective group outcomes than directive interventions.

**Method**

To test the hypotheses, this experiment used a 2×2 factorial design, crossing the timing of interventions (i.e., earlier versus midpoint) with intervention style (i.e., directive versus participative), including a control condition with no intervention.

**Participants.** One-hundred five three-person teams comprised of 315 individuals recruited through classified advertising and local study pools were assigned to one of five conditions, and completed the same tasks described in Study 1. Fifty-four-one groups received interventions during the early stages of interaction ($n_{Early\ Directive} = 18; n_{Early\ Participative} = 23$), thirty-six groups received interventions at the midpoint ($n_{Midpoint\ Directive} = 19; n_{Midpoint\ Participative} = 17$), and twenty-eight groups were assigned to a control condition and did not receive intervention. One-hundred sixty-one females and one-hundred fifty-two males participated, aged 18 to 66 years ($M = 29.1, SD = 11.9$), with zero to 45 years of full-time work experience ($M = 7.6, SD = 10.4$). Survey and demographic data for two individuals were unusable, and thus the sample size was 313 for all individual-level statistics of demographic and survey data.
**Procedure.** The same procedure from Study 1 was followed, with a few exceptions. The intervention addressed both preference negotiation and information pooling, and each task lasted 30 minutes. During the first task, experimental groups received either a directive or participative intervention from an experimenter. Both interventions offered advice designed to encourage group members to share all information and wait to evaluate the meaning of that information until after they were confident they had pooled all the information (see Appendix A for the full text). In the directive condition, the advice was framed as a best practice, and in the participative condition, the advice was framed as a possible strategy, which was given after a facilitated discussion of potential strategies.

An experimenter who was blind to the hypotheses intervened either five minutes (i.e., early condition) or fifteen minutes (i.e., midpoint condition) after groups began discussions. The directive intervention took approximately one minute, and the participative intervention took approximately five minutes. The time used for intervention did not count against the time groups had available to perform the task. If groups had not reached a decision after 25 minutes, the experimenter entered the room and stated the group had 5 minutes remaining. After 30 minutes passed, the experimenter collected the groups’ written decisions and distributed materials for the second decision task. All groups performed the second task without intervention, and after the second task, participants completed a survey on their perceptions of the experiment and demographics.

**Measures.** Decision quality, information pooling, and initial preferences were calculated as they were in Study 1. Two research assistants (i.e., coders) who were unaware of the hypotheses independently coded information pooling following the procedure from Study 1, and preference negotiation. Both coders watched 60 of the 105 videos, and coded an average of
9863 pieces of information; inter-rater reliability was calculated from 15 videos and 2465 pieces of information rated by both. Inter-rater reliability for information pooling was a Krippendorf’s α of .95. The author resolved disagreements between the two coders.

The same coders also rated groups on degree to which groups advocated individual member preferences. After each five-minute period of group discussion, the coders rated the group on four questions using five-point scales that assessed the degree to which a group negotiated preferences during that period. Examples questions included: “How much did members evaluate or interpret information as it was being shared for the first time?” and “How much of the group’s discussion during this time period was based on arguing for or against a specific group member’s preferences?” Inter-rater reliability was calculated from 15 videos and 99 five-minute periods, rated by both coders. The inter-rater reliability was an ICC(1, 3) of .88, and the scale showed sufficiently high internal reliability (Cronbach’s α = .88). During analyses below, preference negotiation refers to the mean of the scale described above; 5 indicates high and 1 indicates low preference negotiation.

Results

**Manipulation checks.** Across both tasks, interventions had their intended effects on information sharing and preference negotiation, with groups receiving interventions sharing more information (t(103) = -5.68, p < .001) and engaging in less preference negotiation (t(103) = 2.90, p = .003) than control groups. Two post-task survey questions assessed the extent to which interventions were perceived as directive and participative. Participants indicated on a seven-point, agree-disagree scale the extent to which they agreed with the statement: “The experimenter told us what strategy to use.” Independent-sample t-tests suggest participants who received the directive intervention agreed more with this statement than participants in all other
INTERVENING WHEN THE TIME IS RIGHT

groups \((t(324) = -2.96, p = .001)\). Likewise, participants who received participative interventions \((M = 5.67, SD = 1.30)\) agreed with the statement: “Team members contributed to the strategy that was suggested during the intervention” more than participants that did not \((M = 5.10, SD = 1.67; t(324) = -3.29, p = .001)\). Descriptive statistics and correlations are shown in Table 4.

Hypothesis tests. Hypothesis 4a suggests interventions received at the temporal midpoint of the first task produce greater process changes than in-process interventions at earlier stages. This hypothesis was tested in two GEEs, presented in Table 5, with unshared information pooling and preference negotiation as dependent variables, and timing of intervention as a predictor and initial preferences as a control. These analyses suggest all interventions improved information pooling, relative to control \((\chi^2(2) = 30.16, p < .001)\).

Groups receiving midpoint interventions pooled about the same amount of information \((M^p = 19.81, SE = .61)\) as groups receiving early interventions \((M = 19.60, SE = .60, p = .80)\). Both experimental conditions pooled more unshared information than control groups \((M = 13.90, SE = 1.00, p < .001)\). Similarly, I found no differences in average preference negotiation between groups receiving midpoint interventions \((M = 3.05, SE = .10)\) and those receiving early interventions \((M = 2.98, SE = .11, p = .60)\). All groups receiving interventions showed less preference negotiation than control groups \((M = 3.54, SE = .16, p < .01)\). Thus, Hypothesis 4a was not supported.

Hypothesis 4b suggests the timing of intervention influences quality of group decisions. I conducted a repeated-measures, logistic regression using GEEs as in Study 1. Overall,
intervention timing influenced group decision quality ($\chi^2(2) = 8.13, p = .02$). Planned comparisons showed that groups receiving midpoint interventions ($M = .78, SE = .06$) made marginally better decisions than groups receiving early interventions ($M = .67, SE = .07, p = .07$), and better decisions than control groups ($M = .49, SE = .10, p = .002$). Groups receiving early interventions also made better decisions than control groups ($p = .04$). This pattern of results provides marginal support for Hypothesis 4b. However, these findings are surprising given that intervention timing seemingly did not influence group processes. I explored reasons for these results by examining processes and outcomes within each task, which are reported in supplementary analyses.

Following Preacher and Hayes’ (2008) approach of testing multiple intervening variables simultaneously, I tested the extent to which group processes (i.e., unshared information pooling and preference negotiation) explained the effects of intervention timing on group outcomes (i.e., decision quality). As expected, unshared information pooling and preference negotiations were powerful predictors of decision quality. Both unshared information pooling ($\chi^2(1) = 12.75, p < .001, B = .15, SE = .04$) and preference negotiation ($\chi^2(1) = 6.20, B = -.70, SE = .28, p = .01$) were predictors of decision quality, controlling for initial preferences ($B = 1.64, SE = .39, \chi^2 (1) = 17.90, p < .001$). Following Hayes’s (2013) bootstrapping approach, I found that early interventions had an indirect effect on decision quality through preference negotiation (Effect = .41, $SE = .20, Z = 2.03, p = .04$) and unshared information pooling (Effect = .82, $SE = .29, Z = 2.84, p = .004$), controlling for initial preferences and late interventions. Midpoint interventions had similar indirect effects, with preference negotiation (Effect = .35, $SE = .18, Z = 1.93, p = .05$) and unshared information pooling (Effect = .84, $SE = .30, Z = 2.84, p = .005$) mediating the effects of interventions on decision quality. Thus, the effect of interventions on decision quality
can be explained indirectly by changes in group processes. However, since the magnitudes of the indirect effects of early and midpoint interventions were similar, these results do not explain the effect of intervention timing on decision quality.

Hypothesis 5 and Hypothesis 6 suggest that the effects of intervention timing are moderated by intervention style, such that (Hypothesis 5) early interventions are more effective when they are directive, and (Hypothesis 6) midpoint interventions are more effective when they are participative. I tested this hypothesis by adding dummy variables for the style of intervention and the interaction between style and timing to the GEE model. The interaction between style and timing was not a predictor of unshared information pooling ($\chi^2(1) = 1.78, p = .18$), preference negotiation ($\chi^2(1) = .55, p = .46$), or decision quality ($\chi^2(1) = .05, p = .82$).

Thus, Hypothesis 5 and Hypothesis 6 were not supported. However, the main effect of intervention style influenced decision quality ($\chi^2(2) = 9.07, p = .01$) and preference negotiation ($\chi^2(1) = 4.67, p = .03$), but not unshared information pooling ($\chi^2(1) = .19, p = .66$). Post hoc, pairwise comparisons showed that groups receiving directive interventions made marginally better decisions ($M = .79, SE = .06$) than those receiving participative interventions ($M = .66, SE = .07, p = .09$), and better decisions than control groups ($M = .49, SE = .10, p = .002$). Groups receiving participative interventions also made better decisions than control groups ($p = .05$).

**Supplementary analyses.** To assess findings further—that intervention timing predicts decision quality, but not group processes—I investigated the pattern of process changes within each task. I tested whether variables changed between tasks overall. Overall, decision quality did not improve between tasks ($\chi^2(1) = .46, p = .50$); groups chose the correct answer 64% of the time for task 1 ($SE = .06$) and 68% for task 2 ($SE = .07$), controlling for initial preferences.

Figure 1 shows the effects of condition on decision quality across tasks. Similarly, groups
pooled roughly the same amount of unshared information during the two tasks ($M_{\text{Task 1}} = 17.87, SE_{\text{Task 1}} = .51; M_{\text{Task 2}} = 18.42, SE_{\text{Task 2}} = .54; \chi^2(1) = 1.74, p = .19$). Figure 2 shows the effects of condition on unshared information pooling across tasks.

[Insert Figures 1 and 2 here]

In contrast, groups negotiated preferences less during task 2 ($M = 3.02, SE = .09$) than during task 1 ($M = 3.29, SE = .08; \chi^2(1) = 24.76, p < .001$). This effect was moderated by receiving intervention such that groups receiving interventions reduced their preference negotiation from task 1 to task 2, and control groups did not. This pattern is shown in Figure 3.

[Insert Figure 3]

I examined Hypothesis 4 further within each task. For task 1, intervention timing functioned consistently with Hypothesis 4b; groups receiving midpoint interventions ($M = .77, SE = .08$) made better decisions than control groups ($M = .50, SE = .10; p = .02$), and marginally better decisions than groups receiving early interventions ($M = .63, SE = .08, p = .09$). Early interventions did not result in better decisions than control groups ($p = .30$). A similar pattern was present for task 1 effects of intervention style; during task 1, directive interventions ($M = .79, SE = .07$) led to improved decisions relative to control groups ($p = .02$), and marginally relative to participative interventions ($M = .60, SE = .09; p = .06$). Shown in Table 6, these two effects were additive such that early participative interventions were ineffective at improving decision quality during task 1, and midpoint, directive interventions were more effective ($p = .01$). The interaction between timing and style was not significant ($\chi^2(1) = .29, p = .59$), meaning timing and style had independent rather than multiplicative effects, which explains between-cell differences.

[Insert Table 6 here]
For task 2, I found little evidence of differences in decision quality based on timing and intervention style. Although groups receiving midpoint interventions ($M = .79, SE = .08$) continued to make better decisions than control groups ($p = .02$), early interventions also made better decisions than control groups ($M = .73, SE = .09, p = .04$), and there were no differences between midpoint and early interventions ($p = .86$). Similarly, both directive ($M = .79, SE = .07$) and participative ($M = .72, SE = .10$) interventions led to improved decisions ($p = .02$ and $p = .09$, respectively). Information pooling did not mirror this pattern. As shown in Figure 2 and Table 6, although interventions stimulated more information sharing during both tasks, there were no differences based on timing or intervention style, nor were there differences for information pooled from task 1 to task 2 within each condition. All treatment groups declined regarding preference negotiation from task 1 to task 2.

Discussion

Like Study 1, Study 2 demonstrates that the timing of an intervention influences its effectiveness. Study 2 suggests groups are more receptive to strategic intervention at temporal midpoints, even relative to interventions that occurred a few minutes earlier. However, the relative success of midpoint interventions was driven largely by how unreceptive groups were to early participative interventions, which had little effect on initial decisions. The advantage of midpoint interventions was found only for task 1; during task 2, all interventions led to better performance than control groups.

Although I found no support for Hypothesis 5 and Hypothesis 6, the style of an intervention influenced its effectiveness, and this effect was clearer at some times than others. While there was no interaction between intervention timing and style, the entire study lasted sixty minutes. Thus, the notion that newer groups are less able to leverage the advantages of
participation and reflection accords with the result that directive interventions were more effective. Thus, the extent to which early participative interventions were ineffective is broadly consistent with extant research that suggests novice or inexpert groups struggle to derive benefits from participation (Vroom & Jago, 1988), and might reflect limitations of temporary groups in a laboratory context.

Study 2 elucidates the nature and conditions under which the liability of newness manifests. Control groups showed little change across tasks, and did not appear to suffer in their initial task. They maintained their initial processes and performance from task to task. Groups receiving interventions continued improving across tasks in the degree to which they avoided preference negotiation. These results help recast the nature of liability of newness in groups; groups’ initial performance was inferior to subsequent performance only under limited conditions. Among low-performing control groups of Study 2, there was little change in processes or outcomes. Only groups that received interventions showed between-task improvement, and only then in one aspect of group process. The primary evidence for outcome improvement across tasks appeared when groups received the least effective intervention. Otherwise, groups showed inertia between tasks.

The two group-process variables did not respond similarly to intervention. Information pooling improved immediately following intervention, but the pattern and amount of information pooled was similar across the two tasks. In contrast, although preference negotiation responded immediately to intervention, it continued to improve in the subsequent task. This may be due partially to the more demonstrative (Laughlin & Ellis, 1986) nature of information pooling in hidden-profile tasks; group members know and can alert each other when information is unshared among members, and inform members’ thinking about their options.
Reducing preference negotiation did not offer these short-term rewards, and might require more self-awareness and self-control than introducing information to a discussion.

These results do not support two alternative explanations for improvement of early interventions during task 2. One explanation is that groups that solved task 1 learned the structure of hidden-profile tasks and guessed (or intuited) that the correct choice was the one that seemed worst initially. However, the effect of interventions on task 2 decision quality was significant when controlling for task 1 decision quality, failing to support this view. Another explanation is that individuals formed weaker pre-discussion preferences during task 2, and were thus more easily persuaded by unshared information. Although task 2 pre-discussion preferences were weaker than those in task 1, the strength of these preferences did not predict decision quality, even when controlling for pre-discussion preferences.

**General Discussion**

As scholars of group process turn their attention to temporality, questions about improving group performance shift from “what” to “when.” The key finding of these two studies is that timing is a determinant of intervention success, one that should be integrated into future scholarship on formal intervention, group development, and group decision-making. In Study 1, the difference between the first and last intervention was only five minutes, but this was sufficient to produce disparities in information pooling. In Study 2, groups were more receptive to intervention at the temporal midpoint than during earlier times, though the advantage was present only for performance of the first task.

This study raises two important questions about extant theory on formal intervention and group development. First, this study suggests group processes are more malleable than punctuated models predict (Gersick, 1989; Gersick & Hackman, 1990), casting doubt on
Hackman and Wageman’s (2005) assertion that “teams are remarkably impervious to intervention, made during times of low readiness, that seek to alter their established trajectories” (p. 287). This study suggests decision-making groups do not form intransigent processes quickly, which can be altered substantially only at the beginning or temporal midpoint. Instead, groups were receptive to interventions shortly after they began interactions. However, the later the intervention occurred, the more likely the group was to show improved processes and outcomes. Thus, these results suggest that rather than readiness changing rapidly at the beginning and temporal midpoint, groups undergo rapid changes in readiness at the beginning of interactions, which gradually increases until the temporal midpoint.

Second, this study raises the question of whether a single model of group development explains several concurrent group processes adequately; the two processes measured in Study 2 (i.e., information pooling and preference negotiation) responded differently to interventions. Rather than regarding group process as unitary, scholars should study how processes change over time. Members might be more aware of and able to regulate demonstrable processes like information pooling, but require more practice to regulate less demonstrable processes such as preference negotiation.

Walton (2014) argues that the most effective interventions in psychology target processes that “contribute to recursive dynamics that compound with time”, and consider “how interventions change not a moment in time (‘a snapshot’) but a process that unfolds over time (‘a movie’)” (p. 76). This study shows the benefits of considering how the effects of interventions unfold over time. Extant research seldom explores either the effects of interventions in groups across tasks, or that aspects of group processes respond disparately to interventions. Echoing Cronin et al.’s (2011) emphasis on recursion as a lever of change in groups, the experiments
presented here highlight a difference between how change occurs for cumulative constructs such as information pooling, and emergent processes such as preference negotiation. Future research should explore what determines the recursive capacity of process changes.

This study supports the view that simple interventions induce groups to improve their processes quickly and effectively (Okhuysen, 2001; Okhuysen & Eisenhardt, 2002). Although these studies paint a much more optimistic picture of group readiness for intervention between the beginning and midpoint, they recast formal interventions given before interaction as too early. The effects of interventions might increase over time, and group readiness appears lower before interactions versus during. However, it also suggests an alternative interpretation of null findings of the impact of pre-task interventions on decision quality (Dennis, 1996; Klocke, 2007; Van Swol & Ludutsky, 2007). Since they rely on single tasks and pre-task interventions, some or all of these studies dismiss effective interventions that build groups’ capacities for future decisions. Future research should examine the effects of interventions across multiple decisions in both laboratory and field settings to assess how a group’s capabilities change over time.

These studies have several limitations that future research should address. First, the laboratory context and group decision-making task raise questions about the generalizability of findings to other tasks and organizational contexts. Future research should assess the boundary conditions of the effects described here. Second, several proposed mechanisms for development—such as task understanding and increased attention to a process—were not assessed in this study. Understanding these mechanisms are important to craft interventions appropriate to the developmental state of a group. Next, the comparison of participative and directive interventions might be driven partially by the protocol used here; the motivational
benefits of ownership and autonomy over time might not manifest when an experimenter who is interrupting a brief task directs the process.

For those seeking to improve group processes in organizations, these results have two implications. First, simple process interventions might be effective in altering both group processes and outcomes, but groups might be more receptive to interventions offered later rather than earlier. At a minimum, this study suggests timing is paramount in that they are offered too early, with many scholars focusing on pre-task instruction rather than in-process coaching. These results suggest that relying on pre-task instruction is a suboptimum strategy, and waiting for a group to accrue collective experience rather than jumping in immediately allows group readiness for interventions to increase.

Overall, these studies provide an initial look into how the timing of an intervention shapes its effectiveness, based on changing group readiness for intervention. Although this study suggests timing is paramount, many questions remain unanswered. Why and how does group readiness change over time? To what extent does the task or period matter? How do ongoing groups in organizations, who might have multiple or contradictory secondary agendas, respond to formal interventions over time? By examining these questions, both scholars and practitioners gain better understanding of the role of timing in both group processes and outcomes.


*Organizational Behavior and Human Decision Processes, 47*, 65–97. doi:10.1016/0749-
5978(90)90047-D

Gigone, D. & Hastie, R. (1993). The common knowledge effect: Information sharing and group

Ginnett, R. C. (1993). Crews as groups: Their formation and their leadership. In E. L. Weiner,
Orlando, FL: Academic Press.

examination of activity cycles in creative project teams. *Small Group Research, 44*, 159–
194. doi:10.1177/1046496413483326

Hackman, J. R. (2002). *Leading teams: Setting the stage for great performances*. Cambridge,

Hackman, J. R., Brousseau, K. R., & Weiss, J. A. (1976). The interaction of task design and
group performance strategies in determining group effectiveness. *Organizational
Behavior and Human Performance, 16*(2), 350-365.


### Table 1

*Study 1 Descriptive Statistics and Correlations*

<table>
<thead>
<tr>
<th></th>
<th>Mean (M)</th>
<th>Standard Deviation (SD)</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Minimal Interaction Condition Dummy</td>
<td>0.33</td>
<td>0.47</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Early Stages Condition Dummy</td>
<td>0.33</td>
<td>0.47</td>
<td>-0.50**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Initial Preferences</td>
<td>0.57</td>
<td>0.67</td>
<td>-0.04</td>
<td>0.07</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Decision Quality</td>
<td>0.43</td>
<td>0.50</td>
<td>-0.04</td>
<td>0.14</td>
<td>0.51**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Pooled Unshared Information</td>
<td>14.02</td>
<td>4.81</td>
<td>0.04</td>
<td>0.18*</td>
<td>0.04</td>
<td>0.26**</td>
<td></td>
</tr>
<tr>
<td>6. Pooled Shared Information</td>
<td>11.67</td>
<td>4.24</td>
<td>0.01</td>
<td>0.24**</td>
<td>0.06</td>
<td>0.26**</td>
<td>0.78**</td>
</tr>
</tbody>
</table>

*Note: All correlations are Pearson’s correlation coefficients, except the binary variables (1, 2, 4), which are Kendall’s Tau-b coefficients. All coefficients were calculated at the decision level (n = 120) such that each group had two scores.*

*p < .05, **p < .01 (2-tailed)*
## Table 2

**GEEs Comparing the Effects of Pre-task and In-process Interventions on Information Sharing and Decision Quality**

<table>
<thead>
<tr>
<th>Dependent Variables</th>
<th>Unshared Information Pooling&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Decision Quality&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( B )</td>
<td>( SE )</td>
</tr>
<tr>
<td>Intercept</td>
<td>2.52</td>
<td>0.07</td>
</tr>
<tr>
<td>Initial Preferences</td>
<td>0.00</td>
<td>0.03</td>
</tr>
<tr>
<td>Pre-task Condition Dummy&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.18</td>
<td>0.08</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Goodness of Fit Indices</th>
</tr>
</thead>
<tbody>
<tr>
<td>QIC</td>
</tr>
<tr>
<td>QICC</td>
</tr>
</tbody>
</table>

<sup>a</sup>Poisson link function specified

<sup>b</sup>Logistic link function specified; Coded 0 = incorrect, 1 = correct

<sup>c</sup>Coded 0 = in-process (n = 80), 1 = pre-task (n = 40)

*p < .05, **p < .01, ***p < .001
### Table 3

**GEEs Comparing the Effects of Intervention Timing on Information Sharing and Decision Quality**

<table>
<thead>
<tr>
<th>Dependent Variables</th>
<th>Unshared Information Pooling</th>
<th></th>
<th>Decision Quality</th>
<th></th>
<th>Decision Quality</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$B$</td>
<td>$SE$</td>
<td>$X^2$</td>
<td>$B$</td>
<td>$SE$</td>
<td>$X^2$</td>
</tr>
<tr>
<td>Intercept</td>
<td>2.52</td>
<td>0.07</td>
<td>1232.41***</td>
<td>-1.80</td>
<td>0.54</td>
<td>11.14***</td>
</tr>
<tr>
<td>Initial Preferences</td>
<td>0.00</td>
<td>0.03</td>
<td>0.00</td>
<td>1.98</td>
<td>0.36</td>
<td>30.48***</td>
</tr>
<tr>
<td>Early Stages Dummy</td>
<td>0.22</td>
<td>0.08</td>
<td>6.83**</td>
<td>0.77</td>
<td>0.58</td>
<td>1.73</td>
</tr>
<tr>
<td>Min. Interaction Dummy</td>
<td>0.14</td>
<td>0.11</td>
<td>1.65</td>
<td>0.26</td>
<td>0.65</td>
<td>0.15</td>
</tr>
<tr>
<td>Unshared Info Pooling</td>
<td>0.14</td>
<td>0.11</td>
<td>1.65</td>
<td>0.26</td>
<td>0.65</td>
<td>0.15</td>
</tr>
</tbody>
</table>

*Goodness of Fit Indices*  
- QIC: 221.60  
- QICC: 212.86

*p < .05, **p < .01, ***p < .001*
### Table 4: Study 2 Descriptive Statistics and Correlations

<table>
<thead>
<tr>
<th></th>
<th>M</th>
<th>SD</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. T1 Initial Preferences</td>
<td>0.56</td>
<td>0.68</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. T1 Preference Negotiation</td>
<td>3.29</td>
<td>0.72</td>
<td>-0.10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. T1 Unshared Info</td>
<td>17.88</td>
<td>5.18</td>
<td>0.10</td>
<td></td>
<td>-0.62**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. T1 Correct</td>
<td>0.61</td>
<td>0.49</td>
<td>0.49**</td>
<td>-0.24**</td>
<td></td>
<td>0.31**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. T2 Initial Preferences</td>
<td>0.53</td>
<td>0.72</td>
<td>-0.04</td>
<td>0.05</td>
<td>0.00</td>
<td>0.08</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. T2 Preference Negotiation</td>
<td>3.02</td>
<td>0.83</td>
<td>-0.11</td>
<td>0.75**</td>
<td>-0.57**</td>
<td>-0.34**</td>
<td>-0.06</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. T2 Unshared Info</td>
<td>18.43</td>
<td>5.40</td>
<td>0.13</td>
<td>-0.48**</td>
<td>0.67**</td>
<td>0.49**</td>
<td>0.00</td>
<td>-0.61**</td>
<td></td>
</tr>
<tr>
<td>8. T2 Correct</td>
<td>0.64</td>
<td>0.48</td>
<td>0.15</td>
<td>-0.23**</td>
<td>0.21**</td>
<td>0.29**</td>
<td>0.27**</td>
<td>-0.34**</td>
<td>0.32**</td>
</tr>
</tbody>
</table>

*Note: All correlations are Pearson’s correlation coefficients, except the binary variables (4, 8), which are Kendall’s Tau-b coefficients. All coefficients were calculated at the group level (n = 105).*

*p < .05, **p < .01 (2-tailed)
Table 5

**GEEs Comparing the Effects of Intervention Timing on Information Sharing, Preference Negotiation and Decision Quality in Study 2**

<table>
<thead>
<tr>
<th>Dependent Variables</th>
<th>Unshared Information Pooling</th>
<th>Preference Negotiation</th>
<th>Decision Quality</th>
<th>Decision Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>SE</td>
<td>(X^2)</td>
<td>B</td>
</tr>
<tr>
<td>Intercept</td>
<td>2.63</td>
<td>0.07</td>
<td>1354.77***</td>
<td>3.58</td>
</tr>
<tr>
<td>Initial Preferences</td>
<td>0.01</td>
<td>0.02</td>
<td>0.16</td>
<td>-0.05</td>
</tr>
<tr>
<td>Midpoint Dummy</td>
<td>0.35</td>
<td>0.08</td>
<td>21.54***</td>
<td>-0.49</td>
</tr>
<tr>
<td>Early Dummy</td>
<td>0.34</td>
<td>0.08</td>
<td>20.59***</td>
<td>-0.56</td>
</tr>
<tr>
<td>Unsh. Info. Pooling</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pref. Negotiation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Goodness of Fit Indices**

<table>
<thead>
<tr>
<th></th>
<th>QIC</th>
<th>QICC</th>
</tr>
</thead>
<tbody>
<tr>
<td>QIC</td>
<td>297.95</td>
<td>291.41</td>
</tr>
<tr>
<td>QICC</td>
<td>128.77</td>
<td>124.97</td>
</tr>
<tr>
<td>QIC</td>
<td>243.48</td>
<td>242.32</td>
</tr>
<tr>
<td>QICC</td>
<td>213.53</td>
<td>212.62</td>
</tr>
</tbody>
</table>

\(^{†}p < .10, *p < .05, **p < .01, ***p < .001\)
Table 6

*Study 2 Means and Pairwise Differences for Group Processes and Outcomes*

<table>
<thead>
<tr>
<th>Condition</th>
<th>Preference Negotiation (SE)</th>
<th>Unshared Info Pooling (SE)</th>
<th>Decision Quality (SE)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Task 1</td>
<td>Task 2</td>
<td>Task 1</td>
</tr>
<tr>
<td>Control (C)</td>
<td>3.58 (.17)</td>
<td>3.51 (.16)</td>
<td>13.63 (.96)</td>
</tr>
<tr>
<td>Early Directive (ED)</td>
<td>3.01 (.16)</td>
<td>2.73 (.19)</td>
<td>19.34 (.98)</td>
</tr>
<tr>
<td>Early Participative (EP)</td>
<td>3.20 (.14)</td>
<td>2.94 (.17)</td>
<td>19.72 (.88)</td>
</tr>
<tr>
<td>Midpoint Directive (MD)</td>
<td>3.15 (.12)</td>
<td>2.57 (.15)</td>
<td>20.18 (1.03)</td>
</tr>
<tr>
<td>Midpoint Participative (MP)</td>
<td>3.40 (.13)</td>
<td>3.15 (.16)</td>
<td>18.22 (.94)</td>
</tr>
<tr>
<td>LSD Pairwise Comparisons</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ED/MD &lt; C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ED/EP/MD &lt; C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C &lt; all</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C/EP &lt; MD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C &lt; ED/MD/MP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ED/MD &lt; MP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MD &lt; MP</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note:* Italics denote a between-task difference for the variable within condition, $p < .05$. Cells show estimated marginal means from GEE equations, controlling for the effect of initial preferences, estimated at .55.
Figure 1. The effects of intervention timing and style on decision quality
Figure 2: The effects of intervention timing and style on unshared information pooling
Figure 3: The effects of intervention timing and style on preference negotiation over time
Appendix A: Intervention Text

Note: All **bolded** text is part of the participative intervention only. All *bracketed italic* text is part of the directive intervention only. All other text is in both interventions.

[Experimenter enters the room and sit down at the table] “I wanted to **go through and facilitate a discussion about** [take a few moments to discuss] the strategy you’re using, to help you formalize it a bit more. I have no **opinion** [advice] about which choice you make, but want to make sure that you have as much information as possible before you make your final decision.

So, **what I’d like to do is to have you all [let's]** step back from the task for moment and **talk about whether the strategy you are using is the best one** [I'll share some general thoughts with you about the best way] to make an informed decision based on all of the information. **I don’t want to tell you** what to do, but rather to have you think more about your decision-making and information sharing strategies. **How would you describe the strategy you are using? What other ways of approaching this are there?** [The experimenter acknowledges and lightly praises member participation, making sure that all group members participate, and asks follow-up questions, such as: “What do the rest of you think of that?”, “What other strategies might you use?” and “What can you do to implement that idea?” After about 5 minutes, the experimenter closes the discussion.]

**Before I go, I’d like to share one thing we’ve learned** [This advice is based on some of what we've learned from research] about good decision-making and information sharing strategies. We've found it helps groups to make good decisions if first they focus on sharing all the pieces of information before evaluating their impact on your decisions. In other words, **it is good to collect** [be sure you have collected] all the information before discussing its importance or advocating for a specific choice. I hope this was helpful and good luck with the rest of the task.
Footnotes

1 Timing of the early-stages intervention was chosen based on pretests, which showed that process was typically established but incomplete at this point; nearly all groups were sharing information, and all members had spoken, but groups were not nearing consensus.

2 Tests *a priori* hypotheses of pairwise mean differences in H1a and H1b, presenting 1-tailed p-values. All other tests—including competing hypotheses H2/H3, omnibus tests, and *post hoc* tests—presenting 2-tailed p-values.

3 When using categorical variables as predictors, each level (k) of the categorical variable must be used as a main predictor, while k-1 other levels of the categorical variables are conceptualized as controls, yielding separate estimates of direct and indirect effects for each category (Hayes, 2013).

4 Several studies explore links between leadership style and group decision-making. However, many use leaders that advocate a decision and take part in decision-making. Since process interventions, by definition, do not offer advice about what decision to make, studies in which directive leaders advocate decisions do not impact the logic above (Larson et al., 1998; Cruz, Henningsen, & Smith, 1999).

5 The first 75 groups were assigned randomly to conditions. However, member pre-discussion preferences were distributed non-randomly across the five conditions for this subset. The remaining 30 groups were matched to conditions by their pre-discussion preferences such that no condition varied from the overall proportion of groups with that configuration of initial preferences by more than two. Chi-square tests for non-random distributions of group preferences x condition were non-significant for both tasks 1 and 2.

6 All means are estimated marginal means, evaluating initial preferences at .55.