Don’t Even Think: Virtual Team Process for Flexible Decision Making

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A theory-driven task process intervention was proposed to improve decision-making in virtual teams. Twenty-six teams performed an online decision task using chat communication and a shared document. Experimental teams used a structured decision process including coordination, monitoring and back up behaviors, while control teams used ad hoc processes. Experimental teams made stronger, more accurate decision than control teams. The intervention shows promise for reducing bias that obstructs online decision making. The research provides understanding and importance of process design and training to improve outcomes for virtual teams where communication cues are limited and members may have limited online collaboration experience.

INTRODUCTION

As technology evolves, it changes the way we live, learn, and work. The ability to adapt to the digital environment is critical for business and organizations where learning and work activity is increasingly performed online, and success is often dependent on the ability to solve problems and make decisions collectively. Cognitive Flexibility Theory was designed to assist learning in ill-structured domains and typically uses contextual cases as the basis for learning (Jonassen, 1997). Learning in ill-structured domains requires sufficiently complex representation of the knowledge, and the way it applies to individual cases varies greatly. Perhaps most importantly, learning complex representations require structures for assembling information into useful knowledge. Spiro and colleagues theorize that these representations make learning actionable through multiple representations of information, support for context dependent knowledge, and variability and interconnectedness of cases (Spiro, Coulson, Feltovich, & Anderson, 1988).

Similarly, organizational psychology research recommends process strategies to increase team effectiveness by providing mechanisms for organizing, managing, evaluating, and acting upon information. Marks, Mathieu, and Zaccaro identify four key action processes for team work including monitoring progress towards goals, systems monitoring, team monitoring and back up response, and coordination (2001). These processes reflect periods of direct action where teams perform work relating directly towards the goal, and transitional periods where members evaluate progress and pan next steps. The structuring of these phases helps ensure that appropriate process behavior occurs when needed to ensure success. Considering decision making in virtual teams action processes are especially critical having strong task orientation and close ties closely to dimensions related to team interaction like communication, information sharing, task technology fit, and adaptation to changing conditions (Powell, 2004).

Functional Models and Learning

Functional models help guide team learning by defining what the system and related processes are designed to do, and how performance is measured (Guzzo & Shea, 1992). In terms of learning, models guide instruction by helping identify learning needs, examine teaching and delivery options, and evaluate learning systems and learner outcomes (Magliaro &Shambaugh, 2006). For example towards improving knowledge acquisition in the Second Life environment, Wang and Hsu, 1) conducted analysis of learner characteristics, technology, and goals, 2) created a design that included clear objectives, activities, and strategies for delivering content, 3) developed and integrated materials into the environment, 4) facilitated student interaction with materials, and 5) evaluated the system through data collected from instructors and learners (2009).

Organizational psychologists have also relied upon functional models to predict and improve team effectiveness. The input-process-output model provides a way to describe systems and develop interventions related to performance (Hackman & Morris, 1975). In general, inputs are tangible things such as human and material resources, knowledge, and task and technology requirements (McGrath, 1984). Given this, team outcomes are typically measured by the quantity and/or quality of products, the consequences for members, and the potential for teams to perform effectively in the future (Guzzo & Dickson, 1996). As such, team action processes represent dynamic between group members and resources, and help define how teammates interact and work together to reach goals (Lee, Espinosa, & Delone, 2009).

Cognitive Flexibility and Action Process

Action process drives task interaction, including group communication, task technology fit, and adaptation to changing conditions (Powell, Piccoli, & Ives, 2004). Action processes for performing task work include: monitoring progress toward goals, systems monitoring, team monitoring and backup responses, and coordination activities (Marks, Matheiu, & Zaccaro, 2001). These processes help members maintain awareness of the work environment, align with and judge progress towards goals, synchronize activity, and provide corrective action.

Monitoring progress towards goals requires self-directing the exchange of information, objectively tracking team progress, and adapting action as the decision process evolves (Nutt, 1999). Teams with strong progress monitoring understand what needs to be done, and review and evaluate activity to detect performance gaps, correct errors, and ensure work is performed correctly. Systems monitoring includes tracking of internal resources such as technology and information used by the team and provides a way to understand information and make careful judgments (Waller, Gupta & Giambatista, 2004). Equally important is the ability for team members to understand the status of the team environment. Team monitoring and backup behaviors are actions that aid in task execution. Monitoring and backup actions support effective observation and adaptation of team member behavior (O'Dea & U.S. Army Research Institute for the Behavioral and Social Sciences, 2006). Monitoring enables decision makers to identify alternatives, make more informed choices, and offer and receive assistance when needed. Research shows team process interventions that contain monitoring and backup components can help teams identify choices, recognize types of information to collect, engage in interdependent actions, and adapt to changing conditions in the information environment (Nutt, 1993).

Finally, coordination process provides sequence and timing to manage team activity. This often involves information exchange and mutual adjustment of team actions, and is strongly correlated with team effectiveness in a number of organizational scenarios (Brannick, Roach, & Salas, 1993). In virtual teams task work often requires simultaneous action, coordination becomes more complex, and breakdowns in communication and timing of activity are more likely to happen (Tesluk, Mathieu, Zaccaro, & Marks, 1997). As information is integrated across the team, new arrangements arise that could not be developed from individual components, and the shape and meaning of the representation may change over time (Hutchins, 2001). As such, coordination of information across team, tools, and the environment is critical to effective team performance (Preece, 1994). Key to effective action process is interactivity among team members. As Hackman notes, group interaction impacts ability to coordinate activity, and the strategies teams use to work together (1975). Considering decision making, action process is critical as it directly impacts information sharing and exchange activities that determine outcomes (Marks & Panzer, 2004).

Cognitive Flexibility and Process Design Intervention

Because online learning often requires mediating interwoven resources and tracking changes to information, cognitive flexibility principles in the collaborative environment may foster knowledge construction by providing a variety of rich information representations that help learners categorize and connect cases, and transfer existing knowledge to novel situations (Carvalho, 2000). Supporting this, Spiro and colleagues caution that conventional teaching methods often fail to support advanced conceptual learning, which is interconnected, dependent on prior knowledge, has multiple contexts, and requires learners to work through ambiguous, complicated situations (Spiro, Coulson, Feltovich, & Anderson, 1988). In the learning setting, cognitive flexibility principles can be applied to reduce bias toward significant information by, 1) avoiding simplification of complex information, 2) reducing reliance on singular representations and fixed schemas of understanding information, 3) providing contextually relevant cases, 4) conveying relationship between interconnected structures, and 5) supporting transmission of knowledge between learners (Spiro, et al,, 1988).

For example, Lowrey and Kim developed a CFT web interface that used authentic scenarios to connect cases and related contexts (2009). Experienced subjects using the CFT format read and elaborated on content more effectively, but there was no effect for novice users. Additionally, the study found no overall support for memory retrieval, understanding connections between concepts, or ability to discuss concepts critically. The authors' suggest that simply using a CFT based environment may not engage mechanisms needed to make conceptual connections. The results imply that interaction plays a role in team information sharing that leads to stronger representations of information, and connections between ideas.

Similarly, Heath and colleagues used CFT principles to assist medical students studying complex concepts. They found learning modules that included multiple representations and supported knowledge construction improved performance. But although pair interactions were positive, dyads did not improve more than singles. One explanation is the module supported cognitive flexibility for individuals, but lacked a process component to engage collaboration. Additionally, small group size may have impacted results (Heath, Higgs, & Ambroso, 2008). Hackman and Vidmar suggest pairs may become overly intimate, preventing members from expressing disagreement that generates constructive conflict leading to solutions (1970).

Cognitive flexibility and Team Decision Dynamic

Cognitive flexibility theory works by maintaining complexity of information, while providing fluid connections between contexts and cases (CiFuentes, Alvarez, & Bettati, 2010). It can be argued that cognitive flexibility only occurs when there is sufficient interaction to engage information and enable problem solving. For example, obvious information held by all persons is more likely recalled, discussed, and given greater value, causing critical information to be overlooked (Stasser & Titus, 2003). Further, decisions are often based on initial individual information, and preference for this perspective persists even when other information is presented, limiting acknowledgement of potential alternatives (Greitemeyer & Schulz-Hardt, 2003). Teams with strong interaction, opportunity to express diverse thinking, and open attitude for change have more alternatives to choose from, and tend to make better decisions (Mohrman, Cohen, & Mohrman, 1995). For instance, Maier found teams often begin to generate and evaluate alternatives before analyzing the task thoroughly (1963). Likewise, Hoffman found potential solutions gain or lose strength depending on support or criticism from member discussion (1961). To address decision bias process, Hackman and Vidmar recommend process designers arrange conditions in the problem space so obvious solutions are not adopted prematurely, and alternative options encouraged (1970).

Applying Cognitive Flexibility to Improve Decision Making

Cognitive flexibility requires application of specific knowledge to meet problem needs. Groups must assemble information effectively to get a clear picture of the knowledge required to maximize decisions (Spiro, Feltovich, Jacobson, & Coulson, 1992). Research suggests process guidelines for coordination, monitoring, and backup response help teams construct and manage multiple views of complex information, and provide ways to build connections among team actions and resources (Marks, et al., 2001).

Coordination may help support cognitive flexibility by sequencing activity of team members to focus on relevant knowledge so logical representations can be developed as individual cases change the overall information set. Monitoring goal progress is a regulating function that helps teams judge whether actions are effective in solving the problem, and what performance gaps need correction. In terms of cognitive flexibility, goal monitoring helps members decide which cases are most relevant to solving problems, or where cases may need to be integrated, or removed.

Team monitoring and backup behaviors on the other hand help mediate information brought forward by the team and provide clarification about changes to the collective value of the information as it is organized by team members. The interaction among team members impacts ability to coordinate member effort, and cognitive flexibility and action process reflect the generative potential of information. Thus it is reasonable that a learning process that supports cognitive flexibility through action process would increase decision effectiveness in learning teams. Given this it is expected teams using collaboration process that supports information complexity, multiple representations, and connections between team members and team information will make more effective decisions than those with ad hoc processes.

Hypothesis 1: Action process structure will be positively related to decision accuracy.
Hypothesis 2: Action process structure will be positively related to decision quality.

METHODS

Participants

Population for the study was students at two Midwestern universities. Recruitment methods were approved by the institutional review board at both universities. Students were invited using email and in-class presentations. The recruiting materials provided students with a description of the study including: purpose and task, benefits, compensation, confidentiality, and a link to the study sign-up calendar. The final sample was 104 participants assigned to 26 complete teams.

Study Design

The experiment used a single factor design with two levels to test the impact of an intervention for increasing decision performance by structuring the collaborative process to increase cognitive flexibility. Because single factor designs manipulate conditions between a proposed treatment and typical conditions, they are often used to evaluate the effectiveness of new methods or interventions (Gliner, & Morgan, 2000).

Evaluation Task

A hidden profile task was used to determine impact of the process on decision making. Participants acted as committee members assigned to choose an airline pilot from four candidates. Each pilot candidate had a set of ten personality attributes including some distinctly positive and negative traits. Positive attributes included characteristics such as, “has excellent depth perception”. Negative attributes were statements like, “is sometimes arrogant” (Schulz-Hardt, Brodbeck, Mojzisch, Kerschreiter, & Frey, 2006). Candidate information sets were distributed so each team member had some unique information about each candidate, and some that was shared with other members so no one person had the complete information required to make an accurate decision. The distribution of positive and negative attributes across profiles provides a set of information where no clear choice is available at the individual level, but an optimal solution is available when all information is aggregated by the team. Initially, candidate C appears weakest with only three positive qualities, while candidates A, B, and D have four. With complete sharing, candidate C has seven positive and three negative attributes, while all others have four positive and four negative. Given complete information sharing C is clearly the strongest choice. As such, learning gains occur when team members integrate all relevant information into the discussion (Greitemeyer, Schulz-Hardt, Brodbeck, & Frey, 2006).

To perform the task, participants logged in to individual Google accounts. Each team member had an individual Google document containing candidate information, and access to a shared document which provided task instructions and a way collaborate with the team. The chat feature was used to communicate using text, and the body of the document was available for teams to input and view task information. There were two phases. First participants were asked to read the candidate attributes and choose a pilot based on the information. In addition, they were asked to rate suitability of each candidate on a scale of 1-5 (coded 1-not suitable at all to 5-very suitable). Individual decisions were entered into an online form. Second, participants assembled with the team by opening a shared team decision document. This document included instructions for conducting the team discussion based on one of the two treatment conditions reflecting levels of the action process structure variable described in the next section. Team members discussed the candidate attributes as prescribed in the instructions using either the experimental process structure or an ad hoc process. After the team discussion, each individual again ranked the suitability of candidates, and all members entered the same team decision for the pilot selection into the final decision form.

Independent Variable

The independent variable was action process structure with two conditions. Teams in one condition followed a procedure using a turn taking discussion format with monitoring, backup, and coordination elements felt capable to foster systematic team interaction to improve decision making. The communication structure for the team decision used two communication channels, a chat message system, and a shared online document. In the high action process structure all team members were instructed to monitor and report on teammate actions and members were encouraged to perform backup actions during discussion. In addition, team members had equally coordinated input, responsibility, and consideration opportunity for highlighting and responding to critical decision information. According to Maholtra and colleagues, discussion structures which support information exchange and keep team members aligned with the task enable stronger team interdependence and performance (Malhotra, Majchrzak, & Rosen, 2007).The action process structure was designed to support CFT principles by providing sufficient information complexity, alternative representations, and connections between cases in the decision task. Teams in the control condition had the same task environment, decision information, goal, and communication affordance, but were given no specific task procedure. These teams could discuss and manage information using the chat and shared document tools in any way.

Dependent Variables

Decision accuracy was an objective measure of the team decision based on selection from one of four candidates (Stasser & Titus, 1985). Given complete information, candidate C was the optimal choice over candidates A, B, and D. Data was collected on this variable from individuals before discussion with only partial information available, and again after team discussion when the complete information set was available. The variable reflects the amount of novel information teams integrated from individual member data sets into the final representation. Enough information must be integrated to show distinct difference between candidate C and the others. However the final decision set does not need to be complete for an accurate choice. Decision quality was defined by the strength of perceived suitability of candidate C at the time of individual decision with partial information available, compared to individual perceptions after complete information was made available to the team. The variable reflects the strength of the decision based on the completeness and acknowledgement of the information set.

RESULTS

Logistic regression results supported hypothesis one. The test provided evidence that the action process had significant predictive effect on decision accuracy, (β =.926, $\chi 2$ = 4.40, p =.036 with df =1). The effect size was moderate (OR=2.52) indicating the likelihood of accurate outcomes for teams using the experimental action process structure was 2.5 times greater than those using ad hoc process. Experimental groups picked the optimal candidate significantly more often (79.0%) than teams in the control condition (60.0%). Hypothesis two was also supported. The shift in perceived suitability from initial preference to the optimal candidate was stronger when action process supported cognitive flexibility. A meaningful relationship was indicated between process condition and decision quality. Namely, action process teams had increased positive perception of candidate C after discussion, $F(1, 104) = 13.07$, $p < .001$, $\eta 2 = .038$. The results suggest process structured groups exchanged information more effectively leading to higher quality decisions, (M = 3.53, SE = .128) than those in control groups (M = 3.16, SE = .128).

DISCUSSION

Although the study offers a single example of the action process intervention in use, the results may help explain how structuring process behavior improves decision making by addressing knowledge acquisition challenges. In general, action process may enhance decision making coordination and management by providing support for bottom-up review of information, case comparison, and making connections between novel points in the information set which clarify the viability of alternatives. In this study, it may have reduced overgeneralization of initial impressions about the candidates. Further the tendency to bias shared information presented to the group was likely reduced (Schulz-Hardt, et al., 2006). Alternately, the action process may simply have been different than what participants had used before, and so these teams paid closer attention to the details of the process and related decision information. For instance Hackman and Morris suggest novel strategies can free learners from routine approaches, exposing more effective ways of performing tasks (1975). Adopting a novel, self-directed approach appropriate for solving the problem may also explain how some control groups using only ad hoc process were still able to solve the decision problem.

Another implication is that action process allowed teams to create better representations of the information. Teams using the action process intervention took turns listing candidate information individually one a time at a time, with pauses for comment and reflection about each candidate from all members as information was entered. This coordination function may have generated more comprehensive perspectives of the information that demonstrated irregularities, and highlighted divergent examples as the information was pooled (Spiro, et al., 1988). In this way, teams were better able to differentiate routine shared information from critical non-routine information needed to make the decision. Further by using monitoring and back up behavior to analyze and reflect on candidate attributes, teams may have been better able to track and interpret system information including the changing relationship between the positive and negative attributes in a given candidate profile, and how this influenced the relationship to other candidate cases (Marks, et al., 2001).

The differentiation of information value is important to success as teams often reach an incorrect conclusion because they fail to understand the relationship between decision goals and information context. Context independence supports the ability to view cases as unique, with some more suitable than others (Spiro, et al., 1992). In this study, teams were asked to review and compare four job candidates and reach an objective decision. But to do this they needed to understand that ultimately the strength of candidate cases were based on unique information held by certain members, and that suitability of candidates changed when this information was acknowledged by the team. Understanding decision context allows teams to tune in and adapt to small changes that can occur, and reduce the belief that all decisions are based on a singular circumstance (Cervone, 2005).

In this study, as new information was added to the team environment, multiple representations of candidate information were generated. The regulating and supporting effects of coordination, monitoring, and backup behaviors seemed to help maintain context independence of candidate profiles by alerting teams to changes in information that altered the potential of each candidate. Supporting this idea, DeSanctis and Gallupe note that effective decisions require adapting interaction in a positive way throughout the process (1985).This adaptive interaction allows members to revise meaning about individual cases, adjust team understanding to the information, and act accordingly.

Another implication is that action process guidelines provided more interaction directly related to the goal which fostered active exploration, involvement, and transmission of knowledge that helped these teams develop and share more meaningful knowledge representation of the candidates. Accordingly, ability to balance structured team activity throughout the decision process while allowing teams ample opportunity for interdependent exploration is vital in ill-structured contexts where the "absence of information" is essential to problem solving (Spito & DeSchryver, 2009, p.110). Finally, action process team members individually reviewed and provided feedback on each candidate for the team. Reasonably then there was greater chance that decision information was evaluated equally and objectively by all team members. Jonassen describes this dynamic as reflective dialogue between problem solvers and problem elements (1997). This could have prompted members to reduce focus on singular representations which reduced bias for member's initial preference. Likewise, preference for shared information at the group level may have been overcome as well as attributes for each of the four candidates was critically compared to the others during discussion.

STRENGTHS AND LIMITATIONS

While numerous studies on collaboration and decision making have used similar populations, one suggested limitation is that participants in this study were university students, As such, results may not be generalizable to other work teams, and additional research using action process structures to improve team learning in other contexts and organizational settings is suggested. In addition, given the completely distributed nature of the study, there may be issues related to the control of the action process variable. All teams performed the same exercise in the same virtual setting with the same goal. But some teams received additional instruction designed to guide the decision process. Teams using this structure seemed to perform better presumably due to the effect of the intervention. But it is difficult to tell how closely they followed the scripted instructions, or whether the process was adapted in some other way by the team that would have impacted the outcomes.

Likewise, teams in control groups used completely self-directed process, and while decision performance was lower, some teams were nonetheless able to solve the problem. Because it was a discussion based problem, some interaction must have occurred to complete the task. But it is unsure if, when, and to what degree action process behaviors were used, or in what manner. Towards this, future research would benefit from collecting qualitative data from both experimental and control groups to better operationalize distinctions between factor levels. In addition, this measure may also help clarify subtleties in the decision process that fall outside the gross procedural elements. For instance, misunderstandings about the semantic meaning regarding the relative positivity or negativity of candidate attributes may have played a factor in both conditions.

CONCLUSIONS

Process interventions designed on action process elements may support CFT principles that can help improve virtual decision making. Designers might integrate more active learner involvement in defined decision making scenarios to develop skill managing complex information (Spiro, et al., 1992). Also, when developing process interventions, guidelines should stress what is communicated, to whom, when, and what for (Malhotra, Majchrzak, Carmen, & Lott, 2001). In addition, future studies may provide greater understanding by discretely examining action process variables. Determining the amount, frequency, and quality of monitoring, backup, and coordination behaviors used in the decision making process may identify which actions are more salient for team learning and performance and under what conditions. Finally, team experience is carried forward as an input to the next activity. Longitudinal study of action process intervention across ongoing learning teams across disciplines, contexts, and problems may help refine how action process can foster learning and team development over time.

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