Exploring Idea Quality Evolution During Convergence

Research-in-Progress

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Abstract

Today’s organizations need to develop innovative ideas through teamwork, be it in small teams or large crowds. While organizations can swiftly gather a rich set of ideas, they are increasingly challenged with how to focus on a manageable set of ideas that are likely to serve their goals. Facilitation techniques can support convergence, a team process in which members reduce and clarify ideas, but facilitation effects are thus far largely unexplored. We conducted an exploratory laboratory experiment to address this gap involving 150 participants randomly assigned to 38 teams. We tested the associations between two facilitation components attention guidance and discussion encouragement, on convergence quality, operationalized as task relevance and extent of idea development. Our preliminary results suggest that idea quality increases from generation to convergence across treatments and attention guidance is associated with extent of development. We present plans for additional analyses and further theoretical exploration.

Keywords: Attention guidance, convergence, collaboration, discussion encouragement, experiment, facilitation technique, team, quality

Introduction

Increased market competition, fast technological developments, and shortened product life cycles set increasingly challenging requirements on organizations’ ability to be productive and profitable. A key concern for organizations is the identification and development of innovative ideas through teamwork, be it in small teams or large crowds (Hansen and Birkinshaw 2007). To this end, organizations seek high levels of productivity in terms of idea generation, evaluation, and selection (Hansen and Birkinshaw 2007; Zhang and Zhang 2014). There is a vast body of literature on brainstorming or ideation, spanning different disciplines such as psychology, information systems, and management (Fjermestad and Hiltz 1998) (Dennis and Wixom 2002; Michinov 2012; Paulus et al. 2013). This research has shown that under a variety
of conditions, teams using IT-supported collaboration techniques produce more ideas of higher quality than do individuals who do not use such support (Dennis and Wixom 2002; Fjermestad and Hiltz 1998)(Dennis et al. 2013; Paulus et al. 2013).

The wealth of research on idea generation techniques and technologies, however, leaves unaddressed the next critical challenge for organizations: once a large number of ideas has been generated, how can an organization efficiently and effectively focus on a manageable set of ideas that are most likely to serve its goals (Hansen and Birkinshaw 2007; Limayem and DeSanctis 2000)? Even small teams can produce many more ideas during a well-designed brainstorming activity than can be implemented, or even considered in detail (Chen et al. 1994; Dennis 1996; Reinig et al. 2007). Crowdsourcing approaches present even more challenges: Crowds can generate thousands of ideas in a matter of hours (Brabham 2008), making it impractical to consider the meaning and qualities of each idea to isolate those that merit further consideration (Eppler and Mengis 2004; Helquist et al. 2013).

In the 1970’s, Herbert Simon famously predicted that, in the future, the scarcest resource would be human attention (Simon 1971). That future is upon us. The cognitive capacity to sieve through brainstormed ideas and extract the most promising ones is at a premium. Given that today’s organizations have many avenues at their disposal to swiftly gather a rich set of ideas, it is thus useful to gain a deeper understanding of so-called convergence processes – team processes in which members reduce the number of ideas in a shared set to focus on the few they deem worthy of more attention, and clarify those ideas to increase shared understanding among the team members (Briggs et al. 2003). Convergence can be a time consuming and difficult process for groups and it becomes more challenging as brainstorming productivity increases (see e.g. (Grisé and Gallupe 1999; Paulus and Nakui 2005). By the mid-90s, researchers had discovered that team satisfaction levels tended to drop during convergence as the cognitive load for identifying redundancies, clarifying meanings, and considering relevance, increased (Chen et al. 1994). Team leaders and facilitators still report convergence to be the most challenging aspect of team collaboration to moderate (den Hengst and Adkins 2007).

To date, relatively little research has been done on idea convergence, and here particularly on facilitated idea convergence. Most facilitation studies draw upon three types of facilitation interventions, i.e. task, process, and technical facilitation to describe the collaboration setting under investigation (Bittner and Leimeister 2014; Dowling and St Louis 2000; Tan et al. 1999; Wong and Aiken 2003). Yet, it is difficult to single out the effects that each type of facilitation intervention has on team processes and outcomes, since they usually occur in some kind of combination. In other words, the explanatory and/or predictive potential of the types of facilitation intervention is considerably limited. Consequently, theory evolving around the concepts of task, process, and technical facilitation can largely be considered as being of descriptive nature (Gregor 2006) making it challenging to examine the relationships between types of facilitation and team phenomena of interest. Researchers have identified several phenomena-of-interest to convergence processes, among them quality of convergence, shared understanding, and satisfaction with process and outcome, see e.g. (Bittner and Leimeister 2014; Davis et al. 2007; Limayem et al. 2006; Wheeler and Valacich 1996). Yet, little is known about the effects of different facilitation interventions on the outcomes of convergence processes and on the attitudes of team members toward these interventions and toward their work products.

Our research aims to gain a deeper understanding of convergence processes and the effect of facilitation interventions on convergence outcome quality. Specifically, we investigate how the quality of an idea set evolves from a baseline quality level at the conclusion of the brainstorming phase to the quality of the final converged idea set. To this end, we explore variations in quality of convergence across three IT-supported convergence treatments that represent different facilitated convergence techniques. We examine differences in the ways each technique guides and focuses participant attention, differences in the ways each technique encourages discussion of brainstormed ideas, and look for the degree to which those differences are associated with the quality of convergence outcomes. We expect the final results of our study to inform the design of procedures for conducting convergence teams and new collaboration technologies to support such procedures. This will equip organizations to better manage and process large idea sets originating from ideation efforts in teams and crowds.
Background

Researchers have defined convergence as “to move from a state of having many concepts to a state of having a focus on and understanding of the few worthy of further attention” (Briggs et al. 2003; De Vreede et al. 2009). The input for a convergence activity is a collection of ideas related to problems and/or solutions (Fu et al. 2010), which need to be reduced and clarified to prepare for evaluation (Briggs et al. 2003; Davis et al. 2007). The outcome of a convergence activity thus consists of a reduced set of unique and task-relevant ideas that are on a useful level of detail (Davis et al. 2008; Davis et al. 2007; Grisé and Gallupe 1999).

Researchers have proposed different measures to evaluate convergence. Some measures address the convergence process itself, such as the time the process took or participants’ satisfaction with the process (Bittner and Leimeister 2014; Davis et al. 2007). Other measures are related to the outcomes of the convergence process such as satisfaction with outcomes, the shared understanding concerning the idea set, and the quality of the resulting idea set (Bittner and Leimeister 2014; Davis et al. 2007; Dean et al. 2006). The quality of the resulting idea set can be determined along different dimensions, most commonly by the extent to which these ideas are (a) unique, (b) relevant to the task at hand, and (c) developed to a useful level of detail (Bittner and Leimeister 2014; Davis et al. 2007; De Vreede et al. 2009; Dean et al. 2006; Grisé and Gallupe 1999). An idea can be considered unique if it is semantically non-redundant compared to the other ideas in an idea set (Dean et al. 2006). Unique ideas can be identified by coding the idea set, if necessary using disaggregation and disambiguation rules (Badura et al. 2010; Dean et al. 2006). When considering relevance in the context of a convergence activity, task relevant ideas can be understood as ideas that are appropriate (Shalley 1995) or able to solve a problem (Valacich et al. 1995). Level of detail relates to idea specificity – the extent to which an idea is developed and has a complete and elaborate description (Dean et al. 2006). An idea’s level of detail is useful to the extent that it offers sufficient details to be considered for selection by the team as the final outcome of their decision-making or problem solving process. This is typically evidenced by the idea’s depth of development (Durand and VanHuss 1992) or extent of description (Cady and Valentine 1999).

Teams often employ facilitators to guide them through convergence (and other) activities to make it easier for them to achieve their goals (Aakhus 2001; Niederman et al. 2008). A facilitator may use specific interventions to lead a team such that it can commit more attention to the task at hand while the facilitator attends to the coordination and management of the teamwork. Such facilitation techniques might, for example, offer guidance on how the team should execute activities such as filtering, analyzing, synthesizing, and clarifying ideas (Davis et al. 2007). Past research on convergence and facilitation has examined convergence (1) as a single phenomenon (Davis et al. 2007; Van Dolen et al. 2007), (2) in connection with generation and evaluation tasks (Dowling and St Louis 2000; George et al. 1990; Kwok et al. 2003; Reagan-Cirincione 1994; Tan et al. 1999; Wheeler and Valacich 1996), or (3) in larger collaboration settings considering additional team processes such as problem analysis, organization, and building commitment (Adkins et al. 2003; Bittner and Leimeister 2014; Hostager et al. 2003; Khalifa et al. 2002; Lowry et al. 2009). This body of literature is inconclusive about the conditions under which teams supported by various forms of facilitation and IT support would or would not outperform teams supported in different ways. Most studies (Dowling and St Louis 2000; George et al. 1992; Kim et al. 2002; Tan et al. 1999) created conditions, which employed a mix of process, task, and technical facilitation cues to best represent close-to-practice settings. Furthermore, the reported effects typically cannot be attributed to convergence techniques alone, since most studies considered additional team activities, e.g., generation and evaluation as well. Consequently, it is difficult to single out the effects that different types of facilitation interventions have on team outcomes.

Our study aims to contribute towards a deeper understanding of the effect of facilitation interventions on convergence outcomes. To this end, we focus on two aspects of convergence techniques that aim to support teams in reducing and clarifying ideas so that what remains are unique and task relevant ideas, which are formulated on a useful level of detail.

First, a facilitator provides attention guidance: they break down complex processes into sequences of activities and guide deliberations (e.g., ‘first rank and evaluate these ideas and then focus on the remaining ideas’) (Wheeler and Valacich 1996). This (re)focuses team members on their goals and limits non-task behavior (Aakhus 2001). For this purpose, a facilitator typically acts on the basis of a structured, yet flexible procedure (Kolfschoten et al. 2012) since receiving goal specifications and clear procedures reduces collaboration...
challenges (Espinosa et al. 2012). Attention guidance in the form of information processing strategies influences team interactions (Griffith et al. 1998) to avoid shallow processing of exchanged information (Rietzschel et al. 2010) and to keep interaction on topic (Clawson et al. 1993; Wheeler and Valacich 1996). Thus, we expect that attention guidance will influence convergence quality which leads to our first exploratory research question: What is the effect of attention guidance on the quality of convergence results?

Second, facilitators provide discussion encouragement to actively engage teams in conversations about ideas to clarify and develop them. Facilitators may stimulate information exchange among team members, constrain the amount and duration of discussions, or divide a team in sub-groups to enable parallel discussions. Thus, facilitators influence how the communication climate evolves. In a supportive communication climate, teams are more likely to share information and be cooperative (van den Hooff and De Ridd 2004). During team discussions, the team members collectively engage in collaborative learning processes (Bandura 1977; Van den Bossche et al. 2011). This may lead to externalizations of individual understandings, which in turn allows teams to develop ideas by re-arranging and re-defining existing knowledge (Kimmerle et al. 2010). Consequently, the facilitator’s discussion encouragement will influence team members’ ability to collectively develop ideas (Bittner and Leimeister 2014; Mulder et al. 2002). Therefore, our second exploratory research question is: What is the effect of discussion encouragement on the quality of convergence results?

Method

We recruited participants from an undergraduate Information Systems course at a European university for our between-group laboratory experiment. Students received extra course credit for participating in the laboratory experiment. In total, 150 participants were randomly assigned to 38 teams, of which there were 32 four-person teams, four three-person teams and two five-person teams. Each team performed the same experiment task which was designed based on an existing task (Santanen et al. 2004) and set in the context of a flooding crisis in a fictive city. The goal of the task was to come up with help measures that would stabilize the situation in the city over the next seven days. The task represents a decision-making challenge that has no correct answers (McGrath 1984). The between-group factor refers to the convergence facilitation script that varied attention guidance and discussion encouragement in three treatments of AG teams, DE teams and AG/DE teams (Table 1).

We used three facilitation techniques, adapted from the thinkLets pattern language for collaborative work practices (De Vreede et al. 2006; Kolschoten et al. 2006). ThinkLets are named, scripted facilitation procedures for invoking patterns of collaboration during a group activity. A thinkLet specifies the rules and technology affordances team members have to work with for their task (De Vreede et al. 2009).

For AG teams, we used a thinkLet called ‘FastFocus’. The facilitator distributes all brainstorming ideas so that each team member only sees a subset of ideas and calls on team members in turn to select or develop an idea from their subset that they believe is worthy of further consideration. The facilitator guides team members to focus on task relevance, avoid redundancies, and to generalize or specify the idea to an appropriate level of detail and checks if the idea is clear to all team members. If so, the facilitator adds the item to a public list of converged items that every team member can see and applies the requested changes in wording. After each team member has had a turn, the subsets are re-assigned until no team member wants to add any more ideas to the public list.

For DE teams, we used a thinkLet called ‘SelfSifter’, which affords unrestricted team discussions to develop a list of converged items. The facilitator advises the team to discuss the brainstorming ideas to identify a collection of most promising ideas. (S)he does not provide any additional guidance on how to execute the task; the team members have to figure this out themselves. The facilitator sets and monitors the time available and records each idea that the team wants to add to the list of converged items.
For AG/DE teams, we used a thinkLet called ‘Treasure Hunt’ which follows the attention guidance structure of FastFocus and in addition stimulates discussion. The facilitator creates subteams and distributes all brainstorming ideas so that each subteam only sees a subset of ideas. Subteams discuss their ideas in order to select two ideas that they would like to see considered. The facilitator calls on each subteam in turn to share the ideas that they want added to the public list. Identical to the FastFocus process, the facilitator guides team members to focus on task relevance, avoid redundancies, and to generalize or specify the idea to an appropriate level of detail and checks if the idea is clear to all team members. After each subteam has had a turn, the subsets are re-assigned until no subteam wants to add any more ideas to the public list.

The dependent variable in this study is convergence quality. We measured convergence quality by the extent to which these ideas are (a) unique, (b) relevant to the task at hand, and (c) developed to a useful level of detail. *Uniqueness* describes that the list of converged items is free of duplicates which is considered a baseline in this study as all teams delivered a non-redundant list no matter what convergence technique was applied.

*Task relevance* describes the ability of an idea to describe an action that addresses the problem at hand. We measured *task relevance* (tr) for each item (li) in the list of converged items representing a team’s outcome. If the item li was both actionable and on scope, a value of 1 was assigned (a(li) = 1), otherwise 0 (a(li) = 0). An item was considered actionable, if the item label contained a verb or an action-noun plus an object (e.g., “provide water pump”; “water preparation”). An item was considered to be not actionable, if the label lacked one of those components (e.g., donations) (Leopold et al. 2013). An item was considered on scope, if the item described an idea potentially relevant to solve the problem at hand (e.g., collect donations), and out of scope, if the item was unrelated (e.g., go on vacation). We used a relative measure of task relevance in its operationalization to account for the differing lengths of the lists. We divided the number of actionable items by the length of the list of converged items (n) (see Equation 1).

\[
tr = \frac{\sum_{i=1}^{n} a(li)}{n}
\]

**Equation 1: Task relevance**

*Extent of development* describes an idea’s level of detail to clarify the context in which the action should take place. It was assessed by the number of contextual dimensions considered in the item labels. We build upon the dimensions of communicative interaction (Yates and Orlikowski 2002) for assessing the six contextual dimensions Why (purpose), Who (participant), How (form), When (time), Where (place) and If (condition) describing in which situation a help measure comes into effect. In its operationalization, *extent of development* (eod) was measured for each item (li) in the list of converged items representing a team’s outcome. If the item li addressed the context dimension cd, a value of 1 was assigned (dev(li, cd) = 1), otherwise 0 (dev(li, cd) = 0). The values of dev(li, cd) are summarized over all list items li of a team’s outcome and over all context dimensions cd and are divided by 6 (i.e. the total number of context dimensions). We used a relative measure of extent of development to account for the differing lengths of lists, which was normalized by the length of the list of converged items (n) (see Equation 2).

\[
eod = \frac{\sum_{i=0}^{n-1} \sum_{j=1}^{6} dev(li, cd_j)}{n}
\]

**Equation 2: Extent of development**

We conceptually model convergence quality as a formative construct with possibly further dimensions such as novelty, which are not in the focus in this study. Consequently, each quality indicator is independent from the other and might not correlate. For example, an item “organize donations” would be assessed as actionable and on scope (task relevance is high) but is rather unspecific because not contextual information is given (extent of development is low).

To test the associations between our independent variables, i.e. attention guidance and discussion encouragement, and our dependent variables, i.e. task relevance and extent of development, we formulate the following hypotheses.
Hypothesis 1. Teams with high attention guidance will produce a converged idea set of higher quality in terms of task relevance (H1a) and extent of development (H1b) than teams with low attention guidance. Hypothesis 2. Teams with high discussion encouragement will report higher quality in terms of task relevance (H2a) and extent of development (H2b) than teams with low discussion encouragement.

We further collected information on four control variables, i.e. experience with collaboration systems (technology knowledge), past participation in facilitated meetings (facilitation knowledge), experience of previously working with team members (working history), and IT-support.

The preparation of the experiment comprised the training of facilitators and the set-up of PCs for each team member. Six PhD candidates and one post-doc acted as facilitators. They were trained on the facilitation scripts in terms of what to monitor and what facilitation cues to give. Their training also included a demonstration of each thinkLet by a professional facilitator using a group of volunteer students. Finally, two test sessions were performed to provide feedback on the facilitators’ performance and solve any issues they experienced. All team members used the collaboration software ThinkTank 4 by GroupSystems for their collocated idea convergence session. We set up a convergence activity with a number of preconfigured lists holding subsets of all brainstorming ideas that matched the number of team members and one list to hold public ideas. The brainstorming ideas were selected from a set of ideas collected in a brainstorming experiment which we conducted earlier using the same task and a comparable group of participants. The selected brainstorming ideas represent an average list of this earlier brainstorming experiment concerning quality and list length. This list of selected brainstorming ideas was split into five subsets. The subsets were similar with respect to quality concerning task relevance and extent of development as well as list length. Each team member could view a subset of the items, but not add, edit, reorder, or delete them. The facilitators were trained how to use ThinkTank beforehand and performed all editing of the final lists in order to control for technical facilitation across treatments.

The experimental procedure started with the facilitator explaining the general topic of the session. The subjects received the task description, were given sufficient time to read it and signed the consent form. All teams were encouraged to discuss the task description for up to five minutes in order to jointly analyze the problem situation at hand. The teams then worked for up to 45 minutes on reducing and clarifying the preconfigured lists of brainstorming ideas. Across all treatments, the facilitator assembled the final list of converged items depending on the team members’ inputs.

Information on the sample is given in Table 2. 47 students were assigned to 12 AG teams. 55 students were assigned to 14 DE teams and 48 students were assigned to 12 AG/DE teams. A univariate analysis of variance (ANOVA) showed no significant differences between groups for the control variables technology knowledge (F (2, 145) = .977, p = .379), facilitation knowledge (F (2, 144) = .722, p = .488), and working history (F (2, 145) = 1.837, p = .163). With respect to the control variable IT-support, the configuration of ThinkTank as well as its use by the facilitator was held constant across all treatments.

<table>
<thead>
<tr>
<th></th>
<th>AG teams</th>
<th>DE teams</th>
<th>AG/DE teams</th>
</tr>
</thead>
<tbody>
<tr>
<td>N (Teams)</td>
<td>12</td>
<td>14</td>
<td>12</td>
</tr>
<tr>
<td>N (Subjects)</td>
<td>47</td>
<td>55</td>
<td>48</td>
</tr>
<tr>
<td>Technology knowledge</td>
<td>1.17 (.564)</td>
<td>1.21 (.532)</td>
<td>1.33 (.694)</td>
</tr>
<tr>
<td>Facilitation knowledge</td>
<td>1.78 (.917)</td>
<td>1.68 (.728)</td>
<td>1.58 (.767)</td>
</tr>
<tr>
<td>Working history</td>
<td>1.49 (.906)</td>
<td>1.51 (1.031)</td>
<td>1.85 (1.61)</td>
</tr>
</tbody>
</table>

Table 2: Description of the sample

All data was analyzed with IBM SPSS Statistics 21. There was no missing data concerning the dependent variables. We performed univariate and multivariate outlier analysis for all dependent variables. All potential outliers were investigated in detail and deemed satisfactory to be retained. Multivariate analyses rely on the fulfillment of three critical assumptions comprising normality, homoscedasticity, and linearity (Hair et al. 2010). Normality was assessed for all dependent variables with z-values for skewness and kurtosis (z-values between +/- 2.58), Shapiro-Wilk tests for normality (p > .05), and normal probability plots (Hair et al. 2010). We applied a cube root transformation on extent of development, which was found positively skewed. After transformation, extent of development was reassessed, found normally distributed,
so that we deemed the set of variables as satisfying to assume multivariate normality. Homoscedasticity was assessed with Box’s M test (p > .05), Levene’s test (p > .05), and Bartlett’s test (p < .05) (Hair et al. 2010). All test results reached the conventional thresholds and therefore equality of variances is assumed. Linearity was tested graphically by inspecting scatterplots across all dependent variables. The external assessment involved coding (1) the brainstorming ideas as well as (2) the lists of converged items. The preliminary coding scheme was developed in an initial coding of the lists of converged items and discussed in several meetings among the authors. Two authors jointly coded the brainstorming ideas resulting in the definition and operationalization of the measures task relevance and extent of development. Then, two authors coded the entire set of 38 final lists having 639 items in total (M = 16.8, SD = 5.8) with an intercoder reliability after Cohen’s Kappa of > .8 which is considered acceptable (Lombard et al. 2002).

Preliminary Results and Limitations

This section presents the preliminary results of our investigation into the components of facilitation techniques and their relationships with team outcomes after convergence. First, we tested the change in task relevance and extent of development between the brainstorming ideas handed to the teams and the lists of converged items separately for each facilitation technique. Second, we tested our hypotheses concerning the associations of the components of facilitation, attention guidance and discussion encouragement, and the team outcome convergence quality, again measured with our two metrics task relevance and extent of development.

We conducted a one-sample t-test to check whether the mean change scores, i.e. the mean differences between the quality of the lists of converged items created in the teams and the quality of brainstorming ideas, were different from zero. The quality of the lists of converged items was significantly higher than the quality of brainstorming ideas for task relevance across all treatments (t(37) = 2.046, p = .048). Additional analyses confirm this result for AG teams (t(11) = 2.434, p = .033). The quality of the lists of converged items was significantly higher than the quality of brainstorming ideas for extent of development across all treatments (t(37) = 3.336, p = .007). Additional analyses confirm this result for AG teams (t(11) = 2.849, p = .016) and AG/DE teams (t(11) = 3.546, p = .005). This result lends support to the observation that facilitated convergence helps teams to extract and develop a set of ideas that is of higher quality than the original brainstorming set. The descriptive and test statistics are summarized in Table 3.

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>After generation</th>
<th>After convergence</th>
<th>t-test for the change in quality after convergence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Task relevance</td>
<td>.8462</td>
<td>.8743 (.0850)</td>
<td>t(37) = 2.046, p = .048</td>
</tr>
<tr>
<td>Extent of development†</td>
<td>.1426</td>
<td>.1784 (.0635)</td>
<td>t(37) = 3.336, p = .007</td>
</tr>
<tr>
<td>AG teams</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Task relevance</td>
<td>.9063 (.0856)</td>
<td>t(11) = 2.434, p = .033</td>
<td></td>
</tr>
<tr>
<td>Extent of development</td>
<td>.2050 (.0765)</td>
<td>t(11) = 2.849, p = .016</td>
<td></td>
</tr>
<tr>
<td>DE teams</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Task relevance</td>
<td>.8671 (.0664)</td>
<td>t(13) = 1.178, p = .260</td>
<td></td>
</tr>
<tr>
<td>Extent of development</td>
<td>.1438 (.0503)</td>
<td>t(13) = -.047, p = .963</td>
<td></td>
</tr>
<tr>
<td>AG/DE teams</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Task relevance</td>
<td>.8509 (.9983)</td>
<td>t(11) = .165, p = .872</td>
<td></td>
</tr>
<tr>
<td>Extent of development</td>
<td>.1920 (.0469)</td>
<td>t(11) = 3.546, p = .005</td>
<td></td>
</tr>
</tbody>
</table>

†The variable extent of development was cube root transformed for the one-sample t-tests

Table 3: Means, standard deviations, and one-sample t-tests for convergence quality

We conducted a multiple analysis of variance (MANOVA) to check whether the experimental treatments had an impact on convergence quality (Hair et al. 2010). The main effect of attention guidance was not significant (Pillai’s Trace = .139, F (2.34) = 2.745, p = .079, partial η² = .139). The main effect of discussion encouragement was not significant (Pillai’s Trace = .069, F (2,34) = 1.269, p = .294, partial η² = .069).

H1 suggested that high attention guidance produces a converged idea set of higher task relevance (H1a) and higher extent of development (H1b). Our analysis using univariate independent one-way ANOVAs revealed a significant main effect for extent of development (F (1,35) = 4.538, p = .040, partial η² = .115) and
no significant effect on task relevance \((F (1,35) = 0.239, p = .628, \eta^2 = .007)\). The univariate effect size for extent of development is medium (Sheskin 2007) and shows that 11.5% of the variance of extent of development is accounted for by attention guidance. Therefore, there is support for H1a but no support for H1b.

H2 suggested that discussion encouragement produces a converged idea set of higher task relevance (H2a) and higher extent of development (H2b). Our analysis revealed that there were no significant effects on extent of development \((F (1,35) = .254, p = .618, \eta^2 = .007)\) and task relevance \((F (1,35) = 2.601, p = .116, \eta^2 = .069)\). Therefore, there is no support for H2a and H2b. The test statistics of the ANOVAs can be found in Table 4 with descriptive statistics in Table 3.

<table>
<thead>
<tr>
<th>Source</th>
<th>DF</th>
<th>Sum of squares</th>
<th>Mean square</th>
<th>F</th>
<th>p-value</th>
<th>partial (\eta^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ANOVA 1 – Dependent variable: Task relevance</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attention guidance</td>
<td>1</td>
<td>.002</td>
<td>.002</td>
<td>.239</td>
<td>.628</td>
<td>.007</td>
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<tr>
<td>Discussion encouragement</td>
<td>1</td>
<td>.018</td>
<td>.018</td>
<td>2.601</td>
<td>.116</td>
<td>.069</td>
</tr>
<tr>
<td>Error</td>
<td>35</td>
<td>.247</td>
<td>.007</td>
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<tr>
<td><strong>ANOVA 2 – Dependent variable: Extent of development</strong></td>
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<tr>
<td>Attention guidance</td>
<td>1</td>
<td>.001</td>
<td>.001</td>
<td>4.538</td>
<td>.040</td>
<td>.115</td>
</tr>
<tr>
<td>Discussion encouragement</td>
<td>1</td>
<td>.000</td>
<td>.000</td>
<td>2.254</td>
<td>.136</td>
<td>.007</td>
</tr>
<tr>
<td>Error</td>
<td>35</td>
<td>.006</td>
<td>.000</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4: ANOVA results for convergence quality

This study is not without limitations that need to be recognized. First, our findings are based on an exploratory laboratory experiment with a student sample characterized with low domain knowledge. Second, team size was small and team members were collocated. We know from past research that team size (Reynolds 1971) and virtualness affect team processes (Jonassen and Kwon 2001). Third, scales for assessing outcome quality after idea convergence were self-developed and require further validation.

**Discussion, Implications, and Conclusions**

Our between-group laboratory experiment revealed preliminary findings on how convergence in general and the two components of facilitation attention guidance and discussion encouragement in particular are associated with changes in the quality of team outcomes after convergence. We found that the quality of the resulting lists of converged items was significantly improved after convergence across treatments compared with the quality of the given list of brainstorming ideas. Specifically, we found task relevance improved after convergence in AG teams and extent of development improved after convergence in AG teams and AG/DE teams. When comparing our treatments, we found that teams that were supported by high attention guidance created lists of converged items with a higher extent of development than teams that had been supported by low attention guidance.

Our findings provide some implications for research and practice. The findings of this study provide empirical support for attention guidance and discussion encouragement as components of facilitation, which are novel conceptualizations of how facilitation affects team outcomes after convergence. We deem explorations into the components of facilitation as important to build rigorous theory on facilitation interventions in teams (Gregor 2006). Team leaders can benefit from our findings in two ways. First, team leaders may consider to converge on generated ideas before starting idea evaluation in order to boost the quality of ideas for assessment. Second, depending on the selection of interventions for attention guidance or discussion encouragement, team leaders may be able to steer the level of outcome quality after idea convergence.

While the initial results are encouraging, additional work is required. First, given the exploratory nature of the study we plan to analyze the associations between the two components of facilitation attention guidance and discussion encouragement and team outcomes, such as convergence quality, measured as task relevance and extent of development. We plan on using Cognitive Load Theory (Chandler and Sweller 1991; Potter and Balthazard 2004) as a promising avenue to explain the correlations we found. Our insights gained thus far show that teams with low attention guidance use more time on additional activities such as...
work coordination to figure out how to approach their convergence task. It may be argued that teams with effective coordination processes have a clearer understanding about how things will get done and who does what (Fiore et al. 2001; Salas et al. 2014). This, in turn, allows shifting the team members’ individual cognitive resources, which are otherwise utilized for coordination activities, to working on the task at hand. Thus, teams that spend more resources on their actual task may be more likely to produce high quality deliverables (Shepherd et al. 1995).

Second, for the analysis of convergence quality, we developed and operationalized two metrics to capture task-relevance and extent of development. Items in a final list after convergence may be characterized with additional metrics capturing e.g., the usefulness of abstractions in these items. Experience gained during the coding of final lists shows that some aspects of quality were not yet captured by the developed metrics. AG and AG/DE teams seemed to edit original items more than DE teams to provide more specification, e.g., instead of referring to ‘troops’, teams specified ‘fire brigade’. Our future work will strive to meaningfully capture such specializations and other changes in abstractions as indicators of convergence quality. We also plan to assess the quality of convergence according to how satisfied teams are with the process and outcome of convergence and to what extent the team members perceived they achieved high levels of shared understanding. We plan to analyze the data we collected for these additional constructs. We expect that the component discussion encouragement will play an important role in this respect and provide additional benefits during convergence. To this end, we plan to collect additional team data. To date, we collected data from 150 participants in 38 teams moderated with three different facilitation techniques. Even though the size of our sample can be considered as moderate, additional data will increase the power of the statistical tests, allowing us to include dependent variables such as satisfaction and shared understanding.

References


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