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Introduction

We frequently turn our attention to group meetings or discussions that facilitate an exchange of ideas through communication to forage for new ideas, as most of the important decisions in our society are made by groups, not by single individuals. To further enhance group creativity for diverse ideation (in terms of efficiency, effectiveness, and satisfaction) by utilizing groups' potential capability (e.g., rich resource conveyance and sharability, error checking, etc) and by overcoming communication problems that occur in group interaction, numerous structured techniques such as Brainstorming [Osborn, 1957], Nominal Group [Taylor et al., 1958], and recently Electronic Brainstorming System (EBS) [Nunamaker et al., 1991] have been introduced. Among them, studies [Dennis & Valacich, 1993; Gallupe et al., 1991, 1993, 1994; Valacich et al., 1993, 1994] empirically demonstrate superior performance of EBS, which supports production unblocking features such as parallelism, group memory, and anonymity.

Notwithstanding the outperformance of EBS as advanced information technology, extant group brainstorming studies mention that there still remain many other types of crucial process losses such as production time underutilization [Gallupe et al., 1994], attention blocking [Straus, 1996], cognitive inertia [Dennis et al., 1999], cognitive interference by information overload [Lamm & Trommsdorff, 1973; Speier et al., 1999], incomplete use of information [Mannecke & Valacich, 1998; Stasser, 1992], and so forth that hold back group performance, feeding a chance of the productivity loss. Although group brainstorming research has reached a saturation point over several decades, these examples clearly indicate an uncharted territory of brainstorming that opens up a new window of opportunity for further investigation.

As Pinsonneault et al. [1999:378; Amabile, 1996] suggest that "avoiding or eliminating the process losses that undermine creativity may be more effective in enhancing group productivity than reinforcing the process gains," in this study, we focus on Gallupe et al.'s [1994] finding that is production time underutilization to help alleviate the aforementioned process losses, and in turn, improving group ideation productivity. In their first experiment, it is shown that regardless of group conditions (electronic or verbal), average time spent on producing ideas per person is astonishingly only a fraction of the total amount of time available (167 sec for electronic and 98 sec for verbal out of 900 sec). This result is consistent with the outcomes of other studies even with increasing group size (as mentioned, the size of a group affects the degree of cognitive stimulation, but, extant studies show the same production time underutilization). Table 1 shows a summary of group idea generation outcomes.

Table 1. Summary of Group Ideation Outcomes

	Group size	Per-person participation (number of comments)
Dennis et al. 1990 30 minutes	Small (2-6) Medium (7-11) Large (12 or more)	Small (2-6): 10.57 X 9.5 sec → 100.415 sec. out of 1800 sec Medium (7-11): 11.33 X 9.5 sec → 107.635 sec. out of 1800 sec. Large (12 or more): 10.99 X 9.5 sec → 104.405 sec. out of 1800 sec.
Gallupe et al. 1994 15 minutes	4	EBS:17.58 X 9.5 sec. → 167 sec. out of 900 sec. Verbal: 15.05 X 6.5 sec. → 97.8 sec. out of 900 sec.
Valacich et al 1994 (exp1)	3 9 18	10.1 X 9.5 → 95.95 out of 1800 20.4 X 9.5 → 193.8 out of 1800 26.2 X 9.5 → 248.9 out of 1800

One plausible explanation for production time underutilization is that members seem to spend the majority of time (total-time minus production-time) not only incubating ideas (developing or rehearsing new ideas and processing or reprocessing shared ideas), but also idling [Gallpue et al., 1994]. We, however, know of no studies about how much a given time is allocated and used for combining, developing, or rehearsing ideas or else. Expanding on the above explanation, another plausible explanation is that of 'editability' supported by EBS. EBS certainly eliminates floor time in verbal group by the parallelism. But, (1) the idea generation speed of keyboarding is much slower than talking out. Gallupe et al. [1994] report an estimated production time per idea between electronic and verbal: 9.5 sec for electronic and 6.5 sec for verbal. Chafe [1982] suggests that typing occurs at around one-third the speed of speaking in general; (2) keyboarding may also increase 'attention blocking' and 'cognitive inertia' effects by focusing on incubating and typing in his or her own ideas, missing relevant and important ideas by others to stimulate creative, cognitive synergy at the right time.

Thus, we question that in the process of creative idea generation which prefers quantity of ideas, keyboarding and editability that slow down idea presentation may have a reverse effect on efficient and effective group productivity. In other words, we attempt (1) to increase the production time; and (2) to increase the quantity of ideas by introducing and exploring the potentials of Verbal-EBS that incorporates speech recognition feature into existing EBS. The voice-recognition feature that will seamlessly dictate as members speak into EBS will allow spontaneous idea building, and will thus increase idea addition and feedback with much less time delay compared to typing an idea. We believe that Verbal-EBS that simulates verbal communication in electronic communication way and utilizes current structural features by combining both speaking and reading that are considered the most ideal EBS [Dennis et al., 1990] may facilitate the flow of idea generation better than traditional EBS, providing a new clue to improve group ideation creativity.

Research Questions

The research questions addressed in this study are as follows:

- RQ1: Is voice input better for idea entry than typing?
- RQ2: Is voice input better when “interactive” brainstorming?

Conceptual Framework and Research Hypotheses

Group Brainstorming Research

To facilitate an exchange of ideas that requires conveyance of meaning in ways that others will understand, group members symbolically communicate through spoken and written words through a variety of communication media. In fact, "the medium used for communication makes a difference" [Valacich et al., 1993:251]. An effect of communication media difference on task performance is well known in the perspectives of media richness theory [Daft & Lengel, 1986] and media synchronicity theory [Dennis & Valacich, 1999]. According to media synchronicity theory that expands on media richness (1) by reflecting its conceptual and empirical limitations due mainly to its unaccountability for electronic media (e.g., email, echat, GroupWare) and (2) by suggesting an actual fit between task and technology, not a perceived fit, it suggests low media synchronicity for conveyance. McGrath and Hollingshead [1994:110] also propose that “groups with electronic technology will yield effective task performance if they are doing tasks at or near the generate (low richness) pole of the circumplex.” Group brainstorming is, indeed, a low equivocal and less interdependent task that does not require an intense interpersonal communication and coordination [Straus and McGrath, 1994; Trevino et al., 1987; Valacich et al., 1993; Williams, 1977]. So far, studies have empirically shown that typing (EBS) or written words with no communication (nominal) are more suitable than media with spoken words (face-to-face verbal) in collaborative idea generation. Particularly, EBS has proved its efficiency and effectiveness over other means including nominal. Recently, studies have clearly made a common suggestion to EBS (which uses keyboard and computer screen to communicate and to exchange ideas) to better motivate cognitive stimulation in turn increasing the outcomes of group ideation. Surprisingly, no studies have been done yet on this topic.

1. “Certainly one of the most obvious features of the EBS technology is that most group members are busy typing in proposals most of the time” [Valacich et al., 1993:461]. However, “typing is slower than speaking, while reading is faster than listening” [Dennis et al., 1990:1051].

2. “Participants typed slower than their verbal counterparts could talk. Extra effort is required to keyboard ideas to express them, causing some degree of production blocking than verbal” [Gallupe et al, 1994:82, 84].

3. "EBS requires physical demands of typing as opposed to speaking which may yield less indepth discussion and analysis of issues" [Straus & McGrath, 1994:94].

4. "CMC users' typing requirement reduces the number of messages they are able to transmit in the same period as FtF communicators" [Walther, 1995:189].

5. "Computer-mediated communication would be as efficient as face-to-face communication if group members did not have to type messages" [Siegel et al. 1986:180].

The above reasons may also reflect studies which report computer mediated groups' longer performance time due to its nature (i.e., typing and editability) compared to other groups such as F-t-F or nominal [Parks & Sanna, 1999]. If participants are freed up from keyboarding and error checking, they may focus more on analytic thoughts and articulation while navigating others' comments. Also it may increase the attention to important pieces of information.

Orality Research: Oral vs. Written Communication

Studies in linguistics suggest two forms of communication to exchange information and ideas: oral and written. The linguistic characteristics of the two modes, however, are functionally and situationally different, considering that (1) face-to-face conversation as typical speech and informational exposition as typical writing; and (2) the writers are under less time constraints in typical writing [Biber 1988]. Functional differences are based on four textual dimensions: integration, fragmentation, involvement, and detachment. Integration refers to the degree of information density. A typical sentence in writing is more integrated than a typical spoken sentence due to less time constraints. Fragmentation refers to the degree of sentence structure looseness. A typical sentence in speech is much more fragmented than a typical written sentence due to spontaneity in interaction and time constraints. Involvement is a psychological state, which refers to the degree of interaction between parties. Speaker and listener can interact with each other, whereas writer and reader typically cannot. Detachment refers to the characteristics of writing due to a lack of interaction between writer and reader.

Situational differences include the use of multiple channels (e.g., speech can utilize facial expressions, gestures, and paralanguage, whereas writing relies on the lexical/syntactic channel), the degree of feedback availability (e.g., in speech, feedback is immediate, but, in writing, readers cannot provide direct feedback to the writer), negotiability of communication contents (e.g., in speech, participants can actively negotiate contents, but in writing, readers can not negotiate with the writer), extent of shared time and space (e.g., speaker and listener share a temporal time and space, whereas writer and reader can be separated by a time and space), speed of production and comprehension (e.g., the production speed of speech is faster than writing, and readers can comprehend faster than listener), and purpose (e.g., writing is typically used to convey information, whereas speaking is typically used not only to establish interpersonal relationship but also to convey and share information).

In summary of comparison between speaking and writing, (1) sentence complexity and elaboration of writing is higher than speaking because writers have more time to integrate ideas, but speakers think and talk simultaneously; (2) writing includes more passive constructions in sentence than speaking. It means that writing reflects less personal involvement, resulting in higher abstract, decontextualization, and detachment; and (3) writing is more suited to highly objective informational tasks such as judgment, decision-making, or negotiation, suggesting it's less efficiency and effectiveness on spontaneous, interactive idea generation task.

In natural communication modes, speech & listening and writing & reading go together. Verbal-EBS, however, breaks natural communication modes and combines the best of both modes: speaking and reading. As the linguistic comparison between speaking and typing clearly shows that due to the sentence complexity and elaboration required to understand lexical-syntactic meanings, typing seems to take not only longer time but also lowers the efficiency of idea production than speaking. In other words, idea production speed of speaking is much faster than writing, and reading can comprehend faster than listening. Horowitz and Newman's study [1964] shows that given the same amount of time, a speaker can verbalize more ideas than a writer. In addition, as Hilmer and Dennis [2001] point out that the nature of typing EBS induces the lack of information processing due to the lack of attention to information, Verbal-EBS will increase attention to information because there is no need to type ideas. These points have not been made in any other previous group brainstorming research, and may help explain why computer mediated groups take a longer time than face-to-face. Also, although Verbal-EBS loses many channels (e.g., speech tone, facial expressions, gestures, and paralanguage), the complexity of sentence structures for ideas is expected to be simpler than writing, taking less time to cognitively comprehend and speeding up idea building. In sum, Verbal-EBS may mitigate attention blocking and facilitate information sharing, increasing a cognitive stimulation by combining both speaking and reading that are considered the most ideal EBS. Thus, it is hypothesized that:

H1: Members of Verbal-EBS groups will generate more ideas than members in Typing-EBS groups.

As studies [Gallupe et al., 1988; Hiltz et al., 1986; Parks and Sanna, 1999] often suggest that depersonalization of computer-mediated groups leads to less satisfaction than face-to-face groups, we speculate that part of the explanation might be in the nature of writing. (Jessup and Tansik [1991] and Sosik et al. [1998] also note that anonymity detaches a group member's attachment to his or her comments.) Although the definitions of involvement and detachment, which are the two characteristics to distinguish speaking and writing, do not seem adequate in the EBS context because of the dynamic interaction with one another in EBS, the nature of writing includes more passives which means less personal involvement, resulting in higher abstract, decontextualization, and detachment. This point also has not been made in extant group brainstorming research. Biber [1988] also points out that writing is adequate for highly objective informational tasks that require some degree of detachment between participants such as judgment, decision-making, or negotiation task. Since group brainstorming is a low equivocal task that requires little or no intense interpersonal communication, coordination, and consensus, writing/typing feature of which main purpose is to reduce the degree of equivocality, doesn't seem essential for brainstorming. In addition, as with typing-EBS that has been criticized to be deindividual or depersonal due to a dearth of social contextual cues and anonymity feature, Verbal-EBS also loses many channels (e.g., speech tone, facial expressions, gestures, and paralanguage). However, Verbal-EBS may simulate participants to talk and respond as if they were conversing with others (but, without nonverbal cues). We expect that this will lead to an increased perceived interaction, and in turn, a better satisfaction than traditional-EBS. Thus, it is hypothesized that:

H2: Members in Verbal-EBS will have higher, perceived satisfaction than members in typing-EBS.

Methodology for a Pilot Study

Note: Dennis and Valacich [1999] note that EBS with group size of seven to nine outperforms nominal and no worse than nominal with small group size. Since this is a pilot study that has never been done before, a group size of five will be reasonable to start with for an investigation.

Research Design

A 2×2 factorial design will be used crossing communication medium (Typing-EBS and Verbal-EBS) and tasks (campus parking and a trip on the space shuttle).

Subjects

One hundred upper-division business students will be recruited to satisfy a course requirement. They will be randomly assigned to 20 5-person groups (10 for each communication medium condition). 10 groups will first work on campus parking task with typing-EBS, then will be switched over to a trip on the space shuttle task with verbal-EBS. Vice versa for the other 10 groups.

Task

Two types of tasks will be used: Force field analysis and Guided fantasy. Campus parking task is a force field task, and a trip on the space shuttle (or survival on a deserted island) is a guided fantasy task [Garfield et al. 2001].

Verbal-EBS Technology

The dictation software, Naturally Speaking or Office 2002 (XP), will be installed on Ventana GroupSystems installed at WSU's EMS meeting room. When the software is activated, it takes over the keyboard and allows participants to speak out their ideas, instead of typing.

Measures

Group ideation performance will be measured based on quantity and quality of ideas.

Procedure

First, subjects will be assigned to pre-selected workstations, and will intensively tame and customize the dictation software to their own voices for about two weeks. Second, on the day of the experiment, subjects will complete a pre-session questionnaire, followed by watching a 10-min presentation on the operation of the EBS software, and will then be allowed to practice and ask questions about its operation. Third, the experimenter will read aloud the experimental instructions while the subjects follow along in their own copies. The instructions will remind Osborn's brainstorming rules, and will urge subjects to generate as many possible ideas as possible by piggybacking. Fourth, after the experiment, they will complete a post-session questionnaire to measure their perceived satisfaction. Fifth, the results will be reviewed by a panel of experts and will be assigned an overall score.

Content Coding and Quality Scoring

The transcripts produced by the groups will be analyzed by two raters. Each rater will independently identify and count the number of unique solutions in each group transcription. The raters will then meet and discuss the codings for consensus.

Data Analysis

N/A

Potential Research Outcomes and Importance of Each

Previous group brainstorming studies have indicated many remaining critical process losses. Therefore, we build on a common suggestion made by prior studies to improve the performance of group ideation. We expect interesting and exciting outcomes of this study. The results will have a significant impact on future brainstorming research.

H1 predicts that Verbal-EBS will generate more ideas than typing-EBS. If supported, we can conclude that Verbal-EBS has a significant effect on production time utilization and reducing attention blocking, enhancing group ideation performance.

H2 predicts that Verbal-EBS will lead to a better satisfaction than typing-EBS. Verbal-EBS works as if subjects are conversing with computers and other subjects naturally, reducing deindividualization or detachment. If supported, we can conclude that Verbal-EBS is a more favorable choice for group ideation.

Conclusion

The proposed study attempts to enhance group ideation performance by introducing Verbal-EBS. This study is grounded in both extant group brainstorming research and orality research in communication. The study builds on the limitation of current typing-EBS made by numerous prior studies. The orality research will add new insights to explain why Verbal-EBS may be more efficient and effective than typing-EBS. Thus, the study is expected to contribute both to theory and practice. The findings from the pilot study will provide a road map for further investigation on many group situational factors such as group size and group task.

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