

ONLINE GROUP CREATIVITY: THE LINK BETWEEN THE ACTIVE PRODUCTION OF IDEAS AND PERSONALITY TRAITS

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This article extends the findings in electronic brainstorming about the impact of personality traits on productivity and creativity in a web-based context of synchronous electronic brainstorming (instant messaging, MSN messenger). The sample included 60 students (M= 20, F= 40, average age of 18 years old) from a graphic advertising school. Participants were randomly assigned to ten groups of six subjects each. Each group was asked to solve the shipwreck task using MSN messenger (text communication only), to identify which objects and which actions were required to survive on a desert island after a shipwreck.

Results showed that group productivity and group creativity are strictly related both to the personality of the users and to the characteristics of the communication process. On the one hand, extroverted personality had a positive influence on the active production of ideas online. On the other, the choice of specific words able to convey real-time feedback and strengthen discussion was a predictor of productivity and creativity performance. These findings provide some useful recommendations for improving productivity and creativity in the context of computer-supported collaborative tasks over the Internet.

INTRODUCTION

Group creativity has quite short background history of research and studies. From the middle of the 90's, literature started to show an interest in it. At the beginning, attention focused on how the group was a restriction and limitation on individual production. During this period, organizations started to focus on group work and collaboration and with Osborn (1963), the literature's attention focused on a defined technique of idea generation which could improve individual creativity: brainstorming¹. One of the reasons why Osborn (1957, 1963) believed idea groups would be highly creative is that he assumed there would be a great deal of stimulation by mutual associations. The intuition that groups might facilitate (or "prime") their members to think thoughts they might not have had in the context of solitary brainstorming is reminiscent of the notion from

cognitive psychology that certain ideas are more accessible than others (Tulving & Pearlstone, 1966). The concepts we have stored in our long-term memory can be thought of as being connected in a semantic network in such a way that related concepts are more strongly connected and thus more likely to activate each other (Collins & Loftus, 1975). Thus concepts that are more closely connected to those that are currently active should be more accessible than those that are less strongly related to current ideas. This way of representing the idea-generation process also implies that it is situation or context-dependent: the ideas currently accessible depend upon what is currently active in working memory.

The central assumption underlying our study is that idea generation is essentially a cognitive or mental process that

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¹Group brainstorming is a popular technique for creative idea generation developed by Osborn (1957).

This technique consists in following a set of rules designed to establish a non-evaluative setting and to enhance the idea generation process: (a) criticism is ruled out, (b) free thinking is welcome, (c) quantity is wanted, and (d) combination and improvement are sought

occurs within the individual group member's mind. However, this individual-level cognitive process is strongly affected by other group members, in particular by communication within the group. The SIAM, Search for Ideas in Associative Memory (Nijstad, Diehl & Stroebe, 2003), is based on Raaijmakers and Shiffrin's (1981) SAM (Search for Associative Memory) model of memory retrieval. Following SAM, SIAM assumes two memory systems: a limited capacity short-term memory (STM), in which conscious operations are performed, and an unlimited long-term memory (LTM) system, in which previously acquired knowledge is stored.

According to SIAM, brainstorming is a repeated search for ideas in associative memory. Ideas are generally new solutions to a problem and therefore cannot be directly retrieved from memory.

In general, ideas of others stimulate idea generation (cognitive stimulation) because less time is needed to assemble search cues and search memory for problem-relevant knowledge (Paulus, Nijstad, 2003). Depending on the semantic content of stimulus ideas, two types of effect are possible. First, ideas of others can activate knowledge that otherwise would not be accessible (cf. Brown et al., 1998; Higgins, 1996; Tulving & Pearlstone, 1996; Paulus & Brown, 2003). This is likely to happen when stimulus ideas are semantically diverse. On the one hand, stimulus ideas are generated because the (limited) range of knowledge remains highly accessible throughout the session. This leads to productivity gain as long as the possibilities of generating additional ideas within this limited knowledge domain are not exhausted. On the other hand, stimulus ideas may also interfere with individual train of thought (cognitive interference). With the term "train of thought" we mean a rapid accumulation of semantically related ideas. When stimulus ideas activate an image that is at odds with person's thought, it may be prematurely aborted. This may lead to shorter trains of thought, loss of potential ideas, and increased switching domains (Nijstad, Diehl & Stroebe, 2003).

Paulus et al. (1996) demonstrated that the shared performance feedback increased productivity, compared to the "no feedback" condition. Taken together, these results suggest that techniques which provide a real-time – or a delayed performance feedback – seem particularly useful for

improving productivity because they create many opportunities for social comparison within the group. Thus, the social comparison process is not only useful in evaluating oneself accurately by viewing the performance of group members, but also in improving one's productivity in the group through comparison with (slightly) more productive participants (e.g., Monteil & Huguet, 1999).

Researchers have long considered how to optimize communication to improve group creativity, but the general conclusion of this research is that due to problems in the communication process, people generate fewer ideas when they work together in groups than when they work separately and later pool their ideas (i.e., in "nominal groups"; see Mullen, Johnson, & Salas, 1991; Paulus, Larely, & Ortega, 1995).

A very consistent finding in this literature is that a number of people working individually (nominal groups) can produce more ideas and more good ideas than can an equal number of people working in a group (Mullen, Johnson, & Salas, 1991). One important cause for this productivity loss in groups is mutual production blocking (Diehl & Stroebe, 1987). Usually, only one group member speaks at a given moment, so group members must often wait for their turn before they can express their ideas. It has been shown that group members cannot think effectively while waiting for their turns, and that the blocking effect is thus due to cognitive interference (Diehl & Stroebe, 1991; Nijstad, 2000).

For this reason, brainstorming groups are more productive when they are provided with continuous public display of the ideas generated by anonymous group members projected at the front of the electronic meeting room. Paulus et al. (1996) demonstrated that shared performance feedback increased productivity, compared to the "no feedback" condition. In this study, members of same group can instantly give feedback to the other members on what they have just typed, creating opportunities for social comparison within the group. The social comparison process is not only useful for evaluating oneself accurately by viewing the performance of group members, but also for improving one's productivity in group through comparison with (slightly) more productive participants (e.g. Monteil & Huguet, 1999).

THE STUDY

In our study we used a commercial Web-based instant messaging client (MSN messenger) to enable and support idea production within a group context. The following hypotheses were tested:

- the quality of conversation, assessed by word association and semantic context is a predictor of productivity and creativity performance;
- the personality traits of the members of the group, and in particular the Extroversion trait, is a predictor of productivity and creativity performance.

Sample

The sample included 60 students (M= 20, F= 40, average age of 18 years old) from a graphic advertising school with a previous knowledge of instant messaging tools.

Participants were randomly assigned to ten groups of six subjects each. All groups were divided into two computer classes. All group members were anonymous inside each group. We decided to use anonymous conditions in mediated communication to reduce production blocking (Diehl & Stroebe, 1991), evaluation apprehension (e.g. Brown & Paulus, 1996; Connolly, Jessup, & Valacich, 1990; Diehl & Stroebe, 1987), and social comparison (Shepherd, Briggs, Reining, Yen, & Nunamaker, 1996).

Synchronous electronic brainstorming tool

In the study we used the Windows XP version of MSN messenger, Microsoft's instant messaging (IM) service, which provides text messaging and voice calling. For Windows XP, the IM client is Windows messenger.

The collaborative task

The collaborative task used in the study is a modified version of the shipwreck task (cfr. Jones-Pfeiffer, The Annual Handbook for group facilitators). This is a collaborative task used to evaluate the decision-making skills of a group. We chose this task to avoid the use background knowledge, and to stimulate divergent thinking.

In the task we presented a shipwreck close to an apparent desert island. The group was asked to choose, by discussing on MSN messenger (text communication only), which objects and which actions were required to survive on the desert island after the shipwreck. The duration of the task was 45 minutes. The conversations produced have been saved and analyzed using T-LAB software.

Questionnaire

All the subjects were submitted to the Eysenck Personality Questionnaire (R Short Scale), a 48-item self-report personality inventory based on Hans Eysenck's factor analysis of personality which assumes three basic factors (the two most important being extroversion to introversion and neuroticism). The Eysenck's standardized scores (Extroversion: mean =13.40, SD = 5.50; Psychoticism: mean = 6.37, SD = 4.19; Neuroticism: mean = 11.59, SD = 5.49) were used to identify the extroverted subjects (subjects with a score higher than the standardized mean plus two times the standard deviation).

Productivity analysis

To measure the production level for each group we calculated:

- *a performance index*: two judges (blind to experiment conditions) counted the numbers of actions and words typed for each group member;
- *a productivity index*: the same judges identified the number of non-redundant significant (related to the task) ideas produced by each group. This last measure was used by previous studies to examine productivity in groups (Dennis & Valacich, 1993; Diehl & Stroebe, 1991; Gallupe et al., 1994). To rank the groups we used the tertiles as cut-off scores: groups with a productivity index lower than the first tertile (33%) were ranked as "low"; groups with a productivity index higher than the second tertile (66%) were ranked as "high".

Conversation analysis

For the analysis of the conversations we used T-LAB software (<http://www.tlab.it>). This is an all-in-one set of linguistic and statistical tools for text analysis which are used in research fields like Semantic Analysis, Content Analysis, Perceptual Mapping, Text Mining, Discourse Analysis.

In this study we used the following tools:

- *tools for word co-occurrence analysis*: association indexes, comparisons between word pairs, co-word analysis and concept mapping, sequence analysis, concordances;
- *tools for thematic analysis of the context units*: thematic analysis of elementary contexts (i.e. of chunks, sentences or paragraphs), sequences of themes, thematic classification of documents, key contexts of thematic words.

RESULTS

In Table 1 we divided the groups according to their productivity and performance scores.

First, we investigated whether the performance scores in the different productivity groups (low, medium, high) differ

from one another. The data showed a significant connection between productivity and performance: the highest productivity group produced more ideas. To better understand if these differences are related to the characteristics of the interaction within the different groups we used T-Lab tools.

Table 1. Productivity and Performance Scores

| LEVEL OF PRODUCTIVITY | CUT OFF POINT | PERFORMANCE SCORE | GROUP |
|-----------------------|---------------|-------------------|-------|
| LOW | 0%(31) | 31 | 9 |
| | | 37 | 10 |
| | | 38 | 8 |
| MEDIUM | 33%(38,97) | 39 | 7 |
| | | 41 | 3 |
| | | 45 | 1 |
| HIGH | 66% (46,88) | 47 | 6 |
| | | 51 | 4 |
| | | 52 | 2 |
| | | 64 | 5 |

THEMATIC CLUSTER ANALYSIS

First, we checked how co-occurrence relationships determined the local meaning of selected words (ideas). Second, we identified thematic clusters each of which:

- consisted of a set of elementary contexts (i.e. sentences, paragraphs or short texts like responses to open-ended questions) characterized by the same patterns of key-words;
- was described through the lexical units (words, lemmas or categories) and the variables (if present) most characteristic of the context units from which it is composed.

The results of the analysis for each of the productivity groups are reported in the next pages.

High productivity:

The most frequent headword produced by the high productivity group is “okay” (123 occurrences); this word underlines a correct response to an idea presented from a different member of the team or a sign of the focused attention on the other’s contribution.

The second more frequently produced word is fire (91 occurrences). The word “fire” results fundamental to survive on island; the highest frequency for correlation index is “switch on”, which it is quite intuitive; after this word members of the high performance group identified other survival actions which are shaped in the interaction of words coming from more members, within a group.

Table 2. Thematic cluster: Headword “fire” and respective correlations

| HEADWORD | CORRELATION. | OCCURENCE | ASSOCIATION |
|-----------|--------------|-----------|-------------|
| Switch on | 0,4952 | 28 | 25 |
| Okay | 0,3308 | 123 | 35 |
| To find | 0,3268 | 75 | 27 |
| Wood | 0,3125 | 45 | 20 |
| Water | 0,2964 | 72 | 24 |
| Palm | 0,2907 | 13 | 10 |
| Hut | 0,2905 | 63 | 22 |

As is shown by the output of the content analysis (Table 2), the discussion within the four groups with high level productivity was focused on the identification of critical objects for surviving on the island.

Another interesting analysis is the one related to the headword “thinking”, which was produced only by the high and medium productivity groups (see table below).

Table 3. Thematic cluster: Headword “Thinking” and respective correlations

| HEADWORD | CORR. | OCC. | ASS, |
|-----------|-------|------|------|
| Survive | 0,25 | 8 | 4 |
| Enclosure | 0,22 | 10 | 4 |
| To excuse | 0,19 | 13 | 4 |

It possible to observe that this headword is first related to “survive”, which is a term strongly related to the goal of group. This could be interpreted as a clear focus of these groups on their specific task.

Medium productivity:

The most frequent headword produced by the medium productivity group is to search (47 occurrences).

Table 4. Thematic cluster: Headword “to search” and respective correlations

| HEADWORD | CORR: | OCC. | ASS. |
|-----------|-------|------|------|
| Go by | 0,34 | 9 | 7 |
| To find | 0,322 | 46 | 15 |
| To eat | 0,275 | 34 | 11 |
| Beautiful | 0,273 | 14 | 7 |

As expected the most typed words are related to the goal of the task: finding objects useful to survive. Even more interesting to note is the thematic cluster related to the headword “to think” and its comparison with the previous group (Table 5):

Table 5. Thematic cluster: Headword “thinking” and respective correlations

| HEADWORD | CORR. | OCC. | ASS, |
|--------------|-------|------|------|
| To entertain | 0,38 | 9 | 4 |
| To die | 0,27 | 10 | 3 |
| Hut | 0,23 | 24 | 4 |

The main difference between the two groups is the quality of the semantic association. In the high productivity group, it is evident that there is a greater connection between the word “thinking” and “survive”, the main goal of the task, whilst in the medium productivity group a low quality connection to the first term (e.g. to think-to entertain) is evident.

This is an example that shows how the quality of production of the high performance group is different compared with the other levels.

Low productivity

The headwords most produced frequently by the low productivity groups are “to search” and “to eat”. The fact that two verbs have the same occurrence is not relevant as much as their correlation to the headword “hello”, which was not relevant to purpose of the task.

Table 6. Thematic cluster: Headword “to search” and respective correlation

| HEADWORD | CORR. | OCC. | ASS. |
|----------|--------|------|------|
| Hello | 0,4 | 10 | 8 |
| Wood | 0,3674 | 15 | 9 |
| Hut | 0,355 | 16 | 9 |
| Building | 0,3550 | 24 | 11 |
| To eat | 0,35 | 40 | 14 |

EXCLUSIVE WORD ANALYSIS

More unequivocal results come from the exclusive words analysis, which identifies singular words which belong just to a selected productivity group.

From this analysis it emerged that the high productivity group has the highest number of exclusive words. Those

words are also more task related: weapon, cost, palm, safe, fire stones, starting, to tie, to stay, to cry, to use. In the medium productivity group, on the other hand, the exclusive words are only “jungle”, “to entertain” and “to smoke”. No exclusive words were produced by the low productivity group.

PERSONALITY ANALYSIS

Using the outcome of the Eysenck Personality Questionnaire-R, we identified a subgroup of extroversion subjects (19). These subjects produced the same first ten most relevant words as the remaining subject (41). This datum sug-

gests that the extroversion factor could influence the individual and group productivity.

To address this issue, we made a second thematic cluster analysis using T-lab.

Table 7. Thematic cluster: Headword “fire” and respective correlation

| HEADWORD | CORR. | OCC. | ASS. |
|--------------|-------|------|------|
| To switch on | 0,41 | 15 | 12 |
| Ok | 0,3 | 43 | 15 |
| Power on | 0,293 | 10 | 7 |
| Beach | 0,289 | 17 | 9 |

Extroverted groups (19 subjects)

In the extroverted subjects, the most frequent headword is “FIRE” (57 occurrences).

As we can observe the most typed words are similar to the ones selected by the high productivity group; two things deserve attention: one that the number of people belonging to this category are 19 instead of 24 of the high performance; second, that the word ok, is quite relevant in term of occurrence (43). As we noted in the high performance group, the word ok stands for a confirmation of something said by a group member. Attention should focus on the fact that extrovert subjects seem more able than the non-extrovert to tune in to others contribution, thus reaching the group goal more easily.

Table 8. Thematic cluster: Headword “to search” and respective correlations

| HEADWORD | CORR. | OCC. | ASS. |
|-----------|--------|------|------|
| Fire | 0,295 | 92 | 31 |
| Switch on | 0,2923 | 39 | 20 |
| To find | 0,292 | 100 | 32 |
| Island | 0,281 | 71 | 26 |

Non-extroverted group (41 subjects)

In this group the most frequent headword is to search (occurrence 120).

The correlation of this headword is shown in the follow table.

In this part of sample we can observe that the confirmation “okay” is not present. As expected, confirmation of other’s ideas seems to be expressed more easily by extrovert subjects than by non-extroverted subjects. But if we identify the production of feedback as a positive influence on group production we could hypothesize that non-extroverts could have more difficult in tuning into each others contribution.

DISCUSSION

Results show some important trends on idea production in groups: the three different levels of productivity present some distinctions which are mainly based on types of correlation between the words and the semantic context from which they emerged. The task of the shipwreck has the purpose of making people work on ideas for survival; this excludes use of individual specific knowledge; for this reason the initial main ideas produced by the three groups are mainly the same. The difference emerges from the reciprocal correlation of these key ideas which allows a deeper conversation leading to a more complex concept.

We expected to find that the main ideas related to the original solutions of the shipwreck task would emerge from all the groups. The result shows that the same initial ideas mainly emerged from all three groups.

Because of this apparently analogy, judges, who identified numbers of ideas produced by each member, counted different levels of productivity among the ten groups. How can this variation be explained? In one of our hypothesis we expected to find different correlation among these same words corresponding to different levels of creativity. Results show that different group productivity corresponds to a different semantic association between high frequency words (the ones present in the tables below); this data suggests that beginning from the same basic words, different productivity could depend on how combining and interactive

communication can influence successive and more complex ideas. We also found that the high-productivity group differentiated itself from the rest of the sample by a set of exclusive words that emerged from the interaction and from a task orientated production. These data suggest that there is a qualitative difference in production of those who have produced more non-redundant ideas: exclusive words are more task related and show deeper analysis of the problem then the other two level of performance.

Interesting data has also emerged from repeated measures of correlation in same words through different level of performances (e.g. the word thinking in high and medium performance). Even the same word in two different groups stimulated members in different ways so that in one case (high productivity) one member or more followed the train of thought of another, deepening that semantic category, while in the medium performance the word thinking dropped to a lower conceptual category (entertain) which is not significant to the task.

Finally, we explored a possible link between the personality factor “extroversion” and productivity. Results suggest that production of extroverts is quite similar to the production of the high productivity group. Moreover, the relevance of the word “okay” in the production of the extroverted subjects suggest that social feedback could be considered as a way to improve the general production of group.

In conclusion, given the emerging role of Internet, thinking about how people could be stimulated and supported over their creativity online should be an important field of research. From our exploratory study it has emerged that when members of a team interact more frequently, listen to each other and in particular give feedback, the global production increases significantly. This is in line with existing studies arguing that the process of social comparison and interaction are positive factors of group work.

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