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Abstract

Creative work is often conducted in distributed groups. Therefore information exchange is frequently facilitated by groupware systems. However, group work suffers from several losses such as information overload, production blocking, free riding, evaluation apprehension and production matching and yet has not been tailored to the need of creative work. In order to reduce these losses and to best support creative group processes (CGP), we propose a framework which combines a) the stages of the creative process, b) the potential losses of creative group processes and c) different media characteristics drawn from the Media Synchronicity Theory to formulate groupware design principles. We conclude that idea generation should be supported by asynchronous groupware functionality whilst idea evaluation merits from synchronous functionality.

Keywords: creativity, groupware, creative group process, media synchronicity theory, creative losses

1 MOTIVATION

Creativity is what allowed mankind to evolve; without the creative mind, “we would find ourselves naked in some primeval forest” (Simonton 2006). Furthermore creativity is necessary for competitive advantage and organisational viability. Without creativity and innovation an organisation cannot improve and adapt to environmental changes. However, in an increasingly globalized world creative work is often conducted by widely distributed groups, which means that they cannot meet physically to communicate, cooperate and collaborate. Thus, information exchange and cooperation is often handled via groupware. We follow the definition of groupware from Ellis et al. (1991) who state that groupware are “computer-based systems that support groups of people engaged in a common task (or goal) and that provide an interface to a shared environment”. Nevertheless, former research has shown that group work in general suffers from several losses such as information overload, production blocking, free riding, evaluation apprehension and production matching (Nunamaker et al. 1991, Dennis & Valacich 1993). In order to support distributed creative group work in the best possible way (i.e. to reduce those losses) it is necessary to find the best choice of media for the stages of idea generation and idea evaluation in the creative process (Hitt 1965, Basadur 1995, Runco & Chand 1995). We later argue that the best choice of media is different in those two stages.

We propose a framework which relates the stages of the creative process, group losses and media characteristics taken from the media synchronicity theory (Dennis and Valacich 1999) that affect communication in such a group process. We seek to improve the ability of creative groups to communicate effectively by giving recommendations about the right choice of media in a specific stage of the creative process for a distributed creative group.

Hence the research question of this paper is: What is the media profile and corresponding groupware functionality to reduce losses in creative group processes? In order to answer this research question, the following sub-questions will guide the section-specific division:

- What is the status quo in the field of research of the creative process, creative losses and the media synchronicity theory? (Section 2).
- What is the relation between the stages of the creative process and group losses? (Section 3.1)
- How can group losses be reduced by the right choice of media? (Section 3.2)
- Which media groupware functions support the identified media profiles? (Section 3.3)

The paper concludes with a result summary and a discussion of potentially fruitful avenues for future research.

2 RESEARCH FRAMEWORK

Based on analyses of literature we recommend design principles for groupware applications to foster group performance by reducing potential group process losses (see fig. 1). The appropriateness of groupware functionality to reduce group losses is analysed from the viewpoint of Media Synchronicity Theory. Group performance is a property that both accounts for idea evaluation and generation which on their part form the overall creative group process.

Webster & Watson (2002, p. 13-23) state that literature reviews often differ significantly in both structure and format. Therefore we apply the taxonomy of literature reviews proposed by Cooper (1988, p. 104-126) that defines six substantial review characteristics: (1) focus, (2) goal, (3) perspective, (4) coverage, (5) organisation and (6) audience. In short, the research objective (2) is expressed by the aforementioned research question that we want to answer in a preferably neutral way (3) and thereby lay the basis for recommendations for IS architects, both scientist and practitioners, of

Groupware systems (6). In our analyses we focus on literature of the areas of social psychology, creativity research and information systems (1) based on the research framework (5).

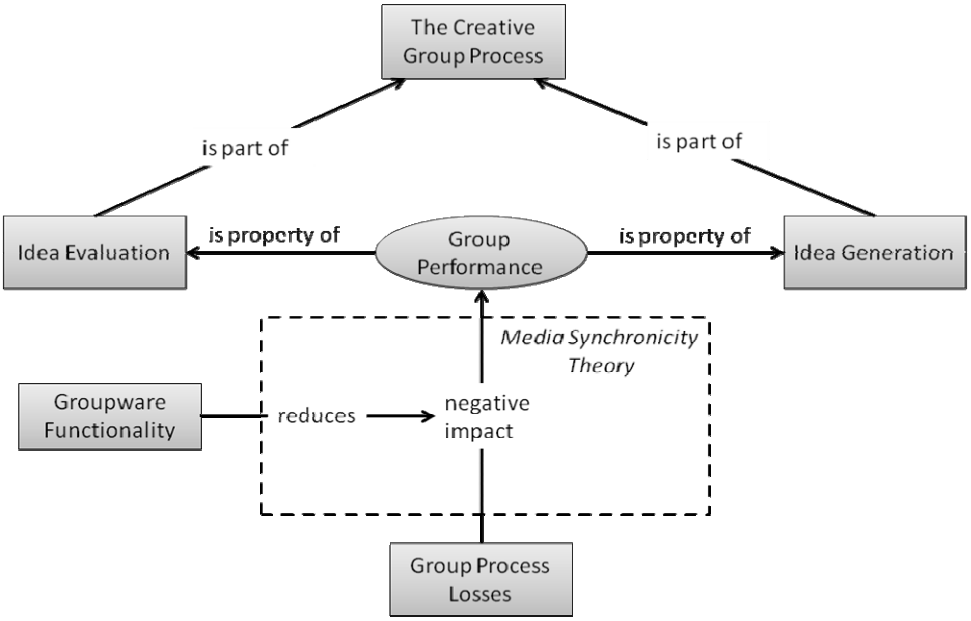

Figure 1: Research Framework

3 RELATED WORK

In the past century, one of the major topics of creativity research has been the creative process. Wallas (1926) presented the four-stage model of the creative process, i.e. the creative process consists of the following four stages: preparation, incubation, illumination and verification. Guilford (1950) agreed that the creative act involves these four important steps. Much research effort has been taken to understand this specific process which leads to a novel and useful product. Numerous researchers adhered to the definition of the four-stage model for the creative process or revised it slightly (Osborn 1953, Taylor & Sutton 1974, Busse& Mansfield 1980, Cagle 1985, Shneiderman 2000). Although this model was only meant for creative processes of individuals, Amabile (1988) proposed similar stages for an organisational setting.

Authors like Eindhoven & Vinacke (1952) or Weisberg (1986) criticized the four-stage model and demonstrated empirically that there are no four distinctive phases in the creative process and that it is rather a blend of processes which recursively co-occur. Instead of sticking to the phases, other researchers focused on sub processes in the overall creative process such as problem finding or problem redefinition processes (Lubart 1994, Jay & Perkins 1997, Reiter-Palmon et al. 1997, Sternberg 1999). For the problem at hand, the definitions of Hitt (1965), Basadur (1995) or Runco & Chand (1995), which focus on the processes of idea generation and idea evaluation, are adequate since they concentrate on the rough distinction between divergent thinking, i.e. generating many alternative ideas in the idea generation phase, and convergent thinking, i.e. pre-structure numerous ideas, evaluate them and select a few promising ideas/concepts in the evaluation phase. As part of the latter phase we disregard idea pre-structuring as creative challenge and focus on evaluation of ideas. These two phases open the way for the application not only to individual but also to group processes (see also Helquist et al. 2008).

Concerning group processes and group performance, vast empirical research has been conducted in the field of social psychology in the 1960s and 1970s. One focus has been the interaction processes which take place among group members while they are working on a task (Hackman, Morris, 1978). “A group is more than the sum of its parts.” This understanding is one of the very bases of social psychology and of our society, which relies on groups e.g. in jurisdiction and politics. It was confirmed in several experiments (e.g. Osborn 1957, Hall 1971, Santanen et al. 2000, Kristensson & Norlander 2003) but also partly refuted because Taylor et al. (1958) found out that nominal groups, i.e. individuals work on their own but their results are measured as though they had actually worked together, almost always outperformed real groups, i.e a groups which actually worked together. The theses that potential performance of real groups is higher than the sum of individuals is highly recognized – but why does empirical research of the last fifty years suggest otherwise? One answer can surely be found in several losses which have been identified to occur in (creative) group process work, or more concretely in verbal group processes. Nunamaker et al. (1991) list at least 18 process losses relevant in group processes. Most cited in literature and subject to further examination are however only four of these: information overload, production blocking, free riding and evaluation apprehension (Dennis & Valacich 1993).

Information overload can have two main reasons: First, entirely wrong information may be articulated, due to bad understanding of the problem. Secondly, more information is brought onto the table than can be processed between the presentations of two ideas. Production blocking describes the phenomenon that in a group, only one participant can speak at a time. The total speaking time per person, which obviously diminishes with increasing group size, is however not the main problem. More grave is the fact that members may forget their respective thought when they are not able to communicate it immediately – or put in other words, thought-in-progress is interrupted. They also may suppress the creative idea because it no longer fits the context of the idea just presented by the speaker.

Evaluation apprehension means that group members are likely not to communicate their ideas out of fear that the idea may seem unworthy, ridiculous, too simple or too original to satisfy the other group members (see also Gavish & Gerdes, 1998 for a profound introduction about the role anonymity and its impact on group dynamics plays in the phase of idea generation).

Free riding describes a quite contrary concept. Since the members of the group expect their results to be analyzed at group level only, they either lose motivation because they feel to be underrated or they feel no need to engage in the group work at all because they feel that the others will produce sufficient results. In individual or in nominal group work, the individuals instead expect to be evaluated on their own and additionally have no chance to free ride on the efforts of others.

Related to all other losses in creative groups is a condition described as production matching. According to this concept, group members tend to compare their respective performance with that of the other members. But because the performance in groups is reduced by the other process losses, members match to this reduced performance. The better the other losses are reduced, the higher is the level that group members match to, and the more efficient groups can work.

These losses lead to the perception that communication is of paramount interest in creative group processes, since permanent communication can reduce a lot of these losses. Group members are to get the possibility to communicate and interact to share knowledge and feedback on shared ideas (Paulus 2000). Assuring possibilities for communication, knowledge sharing and feedback are fundamental success factors. There are certainly further factors like providing incentives, motivating group members or the right team composition but we think that communication is a crucial factor in the whole process.

However, since the modes of thinking change throughout the process, the question remains if modes of communication can remain unchanged. Indeed, the Media Synchronicity Theory proposed by Dennis and Valacich (1999) distinguishes between the features of communication serving either convergent or divergent needs. They identified five media characteristics that can affect

communication: immediacy of feedback, symbol variety, parallelism, rehearsability and reprocessability. For our analyses, we prefer Media Synchronicity Theory over Media Richness theory for its property to estimate the appropriateness of media in a given context rather than evaluating its overall "richness", i.e. general capacity to convey information (Dennis and Valacich 1999). This is crucial to our approach since appropriate media for the reduction of the different potential group losses in creative group processes can only be identified with an approach that facilitates differentiated analyses of media to cope with those losses.

Immediacy of feedback refers to the ability to directly address and question a speaker, thus to have a true dialog. Symbol variety refers to the different ways in which information can be communicated. Dennis and Valacich call it the "height" of a medium. A medium of high parallelism is able to process many simultaneous conversations ("width" of the medium). Rehearsability is the extent to which to which the media enables the individual to revise the message before submitting and reprocessability describes the extent to which the information can be re-examined or processed again.

To sum up, there are two different stages in creative group processes, namely idea generation and idea evaluation, there are several losses, which often occur in group processes, which are information overload, production blocking, free riding and evaluation, and there are five different media characteristics that can affect communication in such a group process. Our aim is to connect those three different dimensions in order to come up with a best possible media choice for the two stages bearing in mind the losses that can occur.

4 ADEQUATE GROUPWARE SUPPORT FOR CREATIVE GROUP PROCESSES (CGP)

4.1 Group Losses in Idea Generation and Idea Evaluation

The CGP has two major stages, the collaborative idea generation and subsequent idea evaluation. In accordance to their diverse divergent and convergent character (Helquist et al. 2008) different group losses account for each of them. In the stage of idea generation the retrieval and distribution of task relevant knowledge is predominant. Thus group communication in this stage can produce information overload for its members. At the same time production blocking is very probable to occur since a huge amount of information can be exchanged at the same time. Idea generation heavily relies on the personal involvement of each group participant. Consequently free riding on ideas of other group members is most likely to happen for more passive members. Taking a chance in contributing new ideas, beside the conventional thinking paths predominant in the group, gives way to criticism which in turn could lead to evaluation apprehension. In contrast to idea generation most mentioned group losses do not account for idea evaluation. After pre-structuring of ideas, information overload is less likely to happen. Contributing one's own opinion on an idea is supposed to be the minimum contribution of every group member – thus free riding does not account for this stage. Evaluation apprehension surely accounts in the evaluation phase since judging on one's colleagues' ideas is subject to group conflicts. Referring to the aforementioned possibility of anonymisation in groupware applications we consider this group loss irrelevant in idea evaluation. However a vivid discussion of generated ideas can lead to a high parallelism in communication and therefore is subject to production blocking. This correlation of group losses and CGP stages is subsumed in Table 1.

Group Losses/Phases	Idea Generation	Idea Evaluation
Information Overload	Relevant	Irrelevant
Production Blocking	Relevant	Relevant
Free Riding	Relevant	Irrelevant

Evaluation Apprehension	Relevant	Irrelevant

Table 1: Group Losses in the two different stages of the CGP

We propose that the group losses in idea generation and idea evaluation can be reduced by an adequate choice of media which is addressed in the following section.

4.2 Reducing group losses with the choice of the right media characteristics

Communication media can be described by the aforementioned characteristics of the Media Synchronicity Theory. We assume that the latter have low or high as parameter value. We now discuss which value is most likely to reduce group losses (see fig. 2). Media characteristics that do not have impact on certain group losses are omitted.

Production blocking can be reduced by media of high parallelism. A group member can participate in different discussions at the same time and therefore communicate a high amount of information in a short time. Given the possibility of immediate feedback to other group members will avoid the blocking of one's spontaneous contributions. This may lead to the situation that a group member will pick up an argument communicated by someone else in the group and immediately respond to it without waiting for the other group member to finish. Also situations might occur where even more than these two communication partners might contribute information at the same time. This requires for media that "stores" the messages exchanged and by this guarantees their reprocessability.

Evaluation apprehension is encouraged when group members have the opportunity to immediately respond to contributions of others. Consequently media that averts immediate feedback contributes to the reduction of this loss. At the same time contributions of members that will have the opportunity to "fine-tune" them before submitting to the group will be of higher quality and less likely to encounter criticism. This speaks in favour of a high degree of rehearsability. The documentation of members' contributions, though, will open way to trace them for later use. They therefore have a higher weight for its sender who in turn will feel more uncomfortable to contribute. Thus reprocessability should be avoided.

One of the major challenges for group communication is the information overload caused by its members. A high symbol variety, e.g. encompassing pictures, videos and other media will help group members to express themselves in an adequate way – as it says, sometime one picture can say more than thousand words. A risky media characteristic in this context is parallelism. This form of communication can overburden ones information processing capabilities and therefore should be held on low level. Not only is the quantity of messages subject to a potential loss in group processes. Also their quality can lead to problems as wrong information could be spread in the group. Therefore a high degree of rehearsability should be the media characteristic of choice.

To rely on other group members contributions without involving actively in a discussion is referred to with the expression free riding. Imposing control on the quantity of members' contributions could be one way to face this problem. This is facilitated by the documentation of messages to assure their reprocessability. The motivation of group members to contribute to a discussion or task can be elevated if one is given the possibility of the preferred means of expression. A high degree of symbol variety offers the choice to post a text or instead a picture or audio file according to the preferences of the sender.

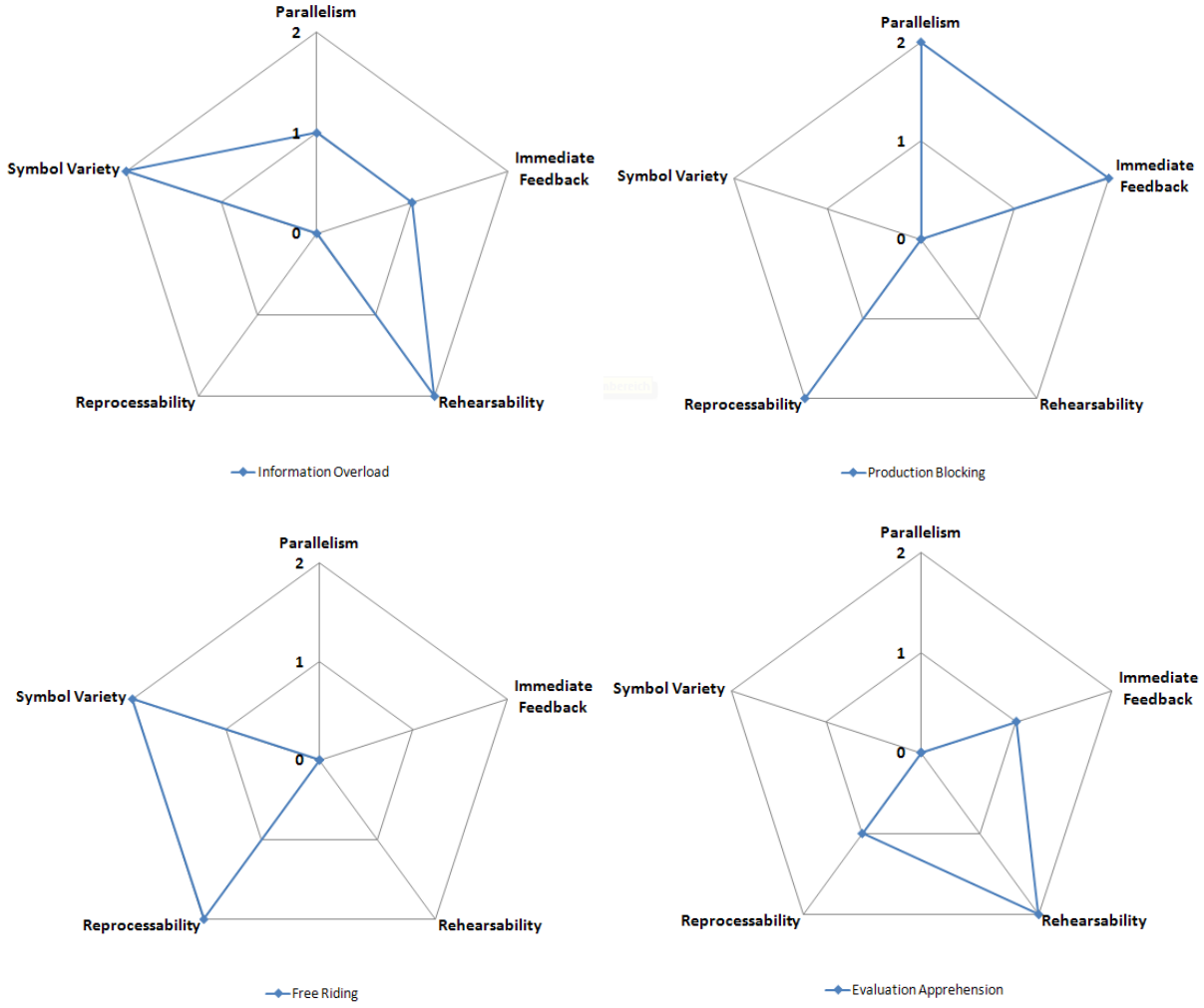

Figure 2: Optimal media profiles to reduce group losses (1: low, 2: high, 0: omitted)

As stated before, all mentioned group losses are relevant for the creative process stage of idea generation. To facilitate the recommendation of appropriate groupware functionalities we subsume the media profiles for the different group losses in one profile. For this we count the value occurrences for each media characteristic in all different group losses and recommend the value with the highest quantity. When equal numbers occur, recommendation for groupware design is omitted.

According to this strategy, the optimal media profile for the stage of idea generation is a low degree of immediate feedback and a high degree of rehearsability, reprocessability and symbol variety. Since the process stage of idea evaluation is affected by production blocking only, the optimal media profile of the latter is the optimal media profile for the evaluation stage.

We subsequently elaborate the coverage of media characteristics by different groupware functions and afterwards match them to the optimal media profiles.

4.3 Identifying media profiles of groupware functions for the definition of groupware support to reduce group losses

Much progress has been achieved in recent development of groupware systems. There are a few tools that compete in the area of group support for idea generation and evaluation. GroupSystem's

ThinkTank is one solution with functionality for anonymous brainstorming, preference voting and task management (Group Systems 2009). Google Wave is another, recently developed web-based collaboration tool that focuses on real-time collaboration. The basic concept is a wave that represents a container of threaded group communication on a dedicated topic and incorporates all communication on that topic, such as chat textual conversations in chats and associated resources in various (multi-media) formats (Ferraté 2010). What is common to groupware systems is that they comprise and to various extend integrate separate groupware functionality. In order to higher our contribution for the recommendation of optimal groupware design to reduce group losses we further consider concrete groupware functionality instead of rather general groupware categories. It later shows up that this bottom-up approach additionally converges to a more general recommendation of functionality choice. Table 2 shows the matching of these functionalities to media categories, again with a binary scale discriminating the values high and low.

Groupware Functionality /Media Characteristics	Symbol variety	Parallelism	Immediacy of Feedback	Rehearsability	Reprocessability
Messenger	Low	High	High	High	High
Forum	Low	Low	Low	High	High
Chat	Low	High	High	High	High
E-Mail	High	Low	Low	High	High
Video Conferencing	High	Low	High	Low	Low
Data Sharing	High	Low	Low	High	High
Optimal Media Profile for Idea Generation	High	(Low)	Low	High	High
Optimal Media Profile for Idea Evaluation	Low	High	High	High	High

Table 2: Media profiles of groupware functionality

Messenger, forum and chat functionality offers low symbol variety as it focuses mainly on text messages. In contrast e-mail (with attachments), video conferencing and data sharing allows for high symbol variety supporting different file formats or rich video experience. Messenger and Chat obviously provide the possibility to have different discussions in parallel as opposed to forum, e-mail, video conferencing and data sharing being all asynchronous communication means (Ellis et al. 1991). A high immediacy of feedback is given with messenger, chat and video conferencing functionality, either through rapid text messages or direct personal response. Again for reasons of asynchrony, forum, email and data sharing is low in this media characteristic. Rehearsability is given in all functionalities except for video conferencing, either by capturing text transmitted, or in case of data sharing by any data format saved. Video conferencing does not account for this (assuming that video sessions are not recorded).

We oppose this media profiles with those identified before to be optimal for reduction of group losses in the two different CGP stages of idea generation and evaluation. Identical background shapes for functions and media profiles show the highest consensus of matching values (Table 2). Accordingly idea generation is properly supported by forum, email and data sharing functionality. It is striking that this functionality appertains to the group of asynchronous groupware. On the contrary, idea evaluation is properly supported by messenger and chat functionality, both being exponents for synchronous groupware functions. Apart from the theory based approach we pursued for our argumentation this conclusion seems to be convincing because the generation of ideas is more likely to happen in persistence oriented systems whilst communication for evaluation is more likely to happen in transient conversation.

Video conferencing is the underdog in this analysis. This again can be explained intuitively. Video conferencing systems are the most realistic imitation of face-to-face communication which revealed the group losses identified by Nunamaker et al. (1991).

5 CONCLUSION AND OUTLOOK

There is an obvious relation between the stages of idea generation and idea evaluation in the creative group process, the group losses that can occur and the media characteristics of the media chosen to communicate, cooperate and collaborate. We evidenced that the media profile and the corresponding best groupware functionality depends on the stage of the process.

The very essence of this paper thus can be subsumed like this: the divergent phase of idea generation in the CGP is properly supported by asynchronous groupware function, whilst the convergent phase of idea evaluation in the CGP merits from synchronous communication. We intentionally did not analyse any comprehensive type of groupware system in order to be able to identify the best choice for the creative nature of creative group processes by recommending dedicated functionality.

The limitation of this paper is the focus on the aspect of communication mirrored by the Media Synchronicity Theory. We see its contribution in the foundation of further research for the aspects of group coordination observable in creative processes. We intent to extend the now predominant aspect of communication to the level of coordination taking into account relevant coordination patterns. With the design of a software prototype we furthermore strive to empirically evaluate the correctness of design recommendations we deduced.

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