Design Heuristics for Computer Supported Collaborative Creativity

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Abstract

Technical support of collaborative creativity is a complex challenge because the interacting people usually have differing backgrounds or ways of thinking, and their collaboration is only weakly structured. We outline the heterogeneous characteristics of creative collaboration and its dimensions, and the barriers to be overcome. On this basis, five CSCW-oriented design heuristics have been derived: Supporting the larger picture – the visualization of rich material; malleability of shared material and stimulation of variations; support of convergence within evolutionary documentation; smooth transitions between different modes of creative collaboration; integration of communication with work on shared material.

1. Introduction: Collaborative Creativity

It is widely agreed upon that the creativity of a team increases if it includes the various perspectives of different experts each with differing scientific or professional backgrounds. We call this phenomenon “collaborative creativity” [21]. Fischer et al. [10] refer to “social creativity” which draws advantage from bringing people with different backgrounds together. The spatial, temporal, cultural, and technical distances between them, as well as conceptual collisions, can enrich the collaboration. Creativity can be roughly defined as the “…ability to produce work that is novel … and appropriate…” [Sternberg, 1999, 3 [32]]. From a global point of view, novelty and appropriateness have to be accepted not only by some individuals but by the stakeholders of a field [6]. There is a huge body of literature on creativity and its psychological background as well as on techniques to enhance creativity. We cannot summarize this literature in this paper but Sternberg [32] gives a helpful overview and we take advantage of Greene’s [12] detailed work summarizing the approaches to creativity. It seems to be widely accepted that the endeavor to achieve creativity is just the opposite of the repetition of routinized, anticipatable activities or of a well-structured project.

Technical support has a decisive influence on collaborative creativity. This can be derived from the research on ideation within groups. “Ideation is an essential component of creativity …” which deals with “… the process of generating or conceiving of new ideas and concepts …” [24:3], and is mainly related to the divergent phase of creativity [27:3] where a sufficient number of ideas has to be produced. According to several studies [27] typical problems – which affect the quantity and quality of ideation – can be overcome with electronic brainstorming systems (EBS). EBS as well as group support systems (GSS) can be considered as a part of computer supported cooperative work (CSCW). Creative work in groups can employ all kinds of collaboration support (joint editing, shared white boards, knowledge management systems etc.). Since collaborative creativity draws its strength from the heterogeneity of the group working together, the technical support also has to reflect this heterogeneity and overcome the limits of domain-specific tools.

Therefore, the question arises of how CSCW can support collaborative creativity, what kinds of CSCW-features are already being used for this support, and what kind of design guidance can be provided. The main literature which is relevant in the field of CSCW is summarized by Shneiderman [28] and Farooq et al. [7]. A NSF-workshop on creativity support tools in 2005 provides 12 general design principles [25], one of them entitled “Support Collaboration”. This principle is not very detailed and generally states that tools are needed which support the integration and iteration of the contributions of team members who have differing strengths and talents. It is apparent that this principle needs to be elaborated to achieve a basis upon which different CSCW-settings can be compared and improved with respect to their appropriateness for support of collaborative creativity.

In several projects [15][16][17] we experienced that it is important to improve and develop CSCW-features which help increase creativity. In these projects we were involved in the design of socio-technical systems or helped to improve organizational processes. We made good progress with incremental improvements but found that our methodological ap-
approach and tool support are limited should more creative and innovative solutions be needed. In every project we facilitated a series of workshops where we employed certain tools to visualize and document the contributions of the participants and the final results. To improve creativity and the socio-technical interplay between the facilitation process and the tool-support, it is necessary to go beyond ideation research [27] by emphasizing the following aspects:

- relevance of CSCW-features as they occur in various software-tools (not only in EBS or GSS),
- varying patterns and degrees of interactivity in groups which include heterogeneous perspectives,
- documentation and permanent visualization of ideas and concepts.

We conducted a series of interviews with CSCW-researchers to get a better understanding of the problems and needs for improvement which can occur when using CSCW for collaborative creativity. It is reasonable to interview these kinds of experts since they are knowledgeable in CSCW, use the technology by themselves, and are frequently involved in creative interdisciplinary teamwork. The in-depth interviews were the basis for an exploratory study which should be useful to build hypotheses and generate hints on how to decide between differing technical options for creativity support. The analysis of the interviews revealed that it is reasonable to condense the results into design heuristics. We employed these heuristics in the continuous improvement of a creativity-oriented facilitation laboratory equipped with an interactive large screen. This usage of the heuristics provided an opportunity to consolidate them.

In the next section we will describe our methodological approach. Section 3 derives dimensions and characteristics of collaborative creativity from the empirical basis and characterizes typical barriers which have to be overcome. Subsequently, the design heuristics will be outlined, and the conclusion will discuss related work and the relevance of the heuristics.

2. Methodology

Our experience with several series of workshops as well as the literature study provided a basis from which to derive the topics and questions for the interviews (table 1). They were mainly about understanding and overcoming the problems which can occur when using CSCW-features for collaborative creative work. We conducted and analyzed interviews with a group of 12 people. The idea behind the selection of the interviewees was to obtain a group which

- consisted of CSCW-researchers frequently involved in interdisciplinary creative collaborations,
- included users of manifold types of groupware functions who are used to reflecting on their own practices and to try out new CSCW-technology,
- represented various disciplines such as computer science, anthropology, business administration, information systems, psychology, philosophy, usability,
- was not built by researchers who work mainly on creativity but by those who have experience with different types of collaboration such as meetings, and asynchronous or synchronous dislocated work,
- included different relations to CSCW: software-engineering and design, developing concrete systems or features, studies on the usage of CSCW, workplace studies, evaluation of concrete systems.

One of the interviewees was from a university in Europe, the others were located at 8 different universities (as faculty members) or research institutes in the US. They have served as PC-members or chairs of CSCW-conferences. The rationale behind this selection of interviewees is twofold: On the one hand their experience and opinion is very important since they are open minded towards CSCW, understand the principles of its functionalities and usage, and they have advanced experience in describing troubles in this area. These interviewees do not represent typical participants of those workshops where we intended to increase collaborative creativity. However, we suggest that the problems which prevent CSCW-researchers from using CSCW for creative collaboration have a certain relevance: they will also discourage other people with other backgrounds from employing CSCW for collaborative creativity. Therefore the overcoming of the problems be described by the interviewees should be prioritized and inspire design heuristics.

On the other hand, the interviewees were selected due to their wide range of different characteristics and therefore comply with the intention to conduct an explorative study. Although the experience of the interviewees is not representative with respect to the whole group of CSCW-researchers, they represent a broad variety of needs and behaviour with respect to creative collaboration. We did not intend to analyze the interviews with statistical methods but rather to identify problems and requirements which stem from practical but reflected experience with CSCW-usage.

The empirical methodology of conducting and analyzing the interviews can be characterized as follows:

- We used a prepared set of questions (cf. Table 1) and went – if appropriate – into further detail.
The average length of an interview was 90 minutes; they were audio recorded and took place at various locations in the US in January and February 2007.

During the interviews and then by listening to them for a second time, significant categories could be identified (cf. Table 2).

Passages of the interviews were transcribed and assigned to the categories.

Contradictory descriptions were juxtaposed to document the range of differing needs for technical support since all these kinds of varying needs can occur in heterogeneous teams.

After the analysis of the interviews, it seems to be a reasonable way to condense the results by formulating a set of design heuristics. The heuristics are built on the basis of statements about problems with creativity and CSCW as well as on expectations or proposals for improvement. However, this information has to be completed by the literature and by contrasting the heuristics with a concrete empirical background. This background is provided by our experience with workshop series and with the design of a facilitation laboratory for creativity workshops. The comparison between the interview results from a CSCW-research perspective and the experience with workshops on socio-technical design was helpful to check the applicability of heuristics against a concrete background.

The heuristics were derived on a level which supports usability evaluation as it is described by Cockton et al. [4]. They are not used as guidelines for implementation but as rule of thumb for experts who have to evaluate systems. General usability testing aims at criteria such as effectiveness, efficiency and satisfaction of users. By contrast, the proposed heuristics are focused on issues such as the quantity and quality of new ideas, flexible switching between playfulness and efficiency, and synergy between various perspectives.

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<thead>
<tr>
<th>Table 1 – Interview guideline</th>
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<tbody>
<tr>
<td>What are - from a subjective point of view – relevant aspects of creativity on an individual as well as on a collaborative level?</td>
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<td>Which kind of creativity and phases therefore can be differentiated between?</td>
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<td>What kind of groupware features and web-applications could be used, are really used, should be improved to support creativity (certain aspects were mentioned such as shared material, mobility, anonymity, experiments, awareness, community building to stimulate the discussion)?</td>
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<td>How can switches be supported (between creative work and routine tasks, between retreated thinking and communication, between synchronous and asynchronous communication)?</td>
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<td>In which kind of situation can groupware features be successfully employed for creativity and what are the characteristics of the appropriate situations?</td>
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<td>Which organizational issues have to be considered with respect to creativity support with groupware features?</td>
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<td>What triggers unconventional thinking?</td>
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<tr>
<td>What are the important differences between academic and industrial settings with respect to creativity?</td>
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<td>What are the future trends to improve creativity with respect to groupware features and web-applications?</td>
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### 3. Dimensions and Barriers

To describe the variety of characteristics and dimensions of collaborative creativity, we refer to Vandenbosch et al. [34]. They use a differentiation between theories explaining the creation of ideas which refer to

- personal characteristics
- the contexts in which ideas flourish,
- the processes by which ideas develop.

#### Personal differences

Some people can only be creative when they communicate (In01) while others need a complete retreat to be able to generate ideas, and can only afterwards contribute to collaborative creativity. However, they may then come up with surprising solutions (In01) when several ideas or discussion threads have to be merged. Creative people can be synthesizers or analyzers (In01). Another contrast is built by multitaskers who go back and forth between different streams of thoughts vs. people staying within a single flow (In02) of a task. People have different ways of expressing themselves; some describe themselves as sketchers (In05), others as writers (In08).

#### Contextual aspects

We found that the potential of creative collaboration differs according to its setting:

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1 The following descriptions refer to the interviews by using “In” in parentheses followed by the interview number.

<table>
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<tr>
<th>Table 2 – Categories</th>
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<tr>
<td>Basic assumptions about creativity</td>
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<td>Description of own creative behavior, cases and patterns</td>
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<td>Observed methods and patterns which enhance creativity</td>
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<tr>
<td>Problems with groupware features with respect to creative collaboration</td>
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<tr>
<td>Types of groupware being used</td>
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<td>Typical ways of how groupware features and web-applications are used</td>
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<tr>
<td>Proposals for improvement, design requirements</td>
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</table>
• **Creativity in everyday work** as a primary task (as is typical for creative industries or companies such as IDEO [19] (In08) vs. secondary task (e.g. the generating of innovative ideas in the course of maintenance work)

• **Workshops or a series of workshops**² imply the possibility of a retreat from everyday work and are helpful if intensive communication is necessary for creativity (In07, In08). They imply the risk that the context of the workplace (e.g. typical constraints) is partially neglected (In06).

• **Seeding**: An artifact like a document or a software-prototype is installed in everyday work life to become a nucleus of creative ideas (In06) (cf. the concept of “seeding, evolutionary growth and re-seeding”[9]).

• **Collaborative writing** is a typical case of creative activities in the field of academia - where thinking emerges while people write (In05). There are different patterns such as:
  - doing collaborative research and then delegating the process of writing and the merging of ideas to a single person,
  - doing research, developing the structure of the paper and then delegating sections of the text to individuals,
  - sitting together discussing, then writing small portions of text, gathering and merging them, then going on with the writing,
  - coupling of sketching and writing as a particular challenge.

• **Learning within a constructivist paradigm** (In11), where people work on certain tasks and sometimes switch on a meta-level to reflect on how they can improve their way of problem solving.

### Processual aspects of creativity

The literature differentiates between phases of creative work. The roughest differentiation compares a divergent phase with a convergent one. Shneiderman’s [29] scheme consists of four phases: collect, relate, create, and donate. Most interviewees point out that their creative collaboration does not follow a scheme of sequenced phases. On the one hand they emphasize the relevance of ***playfulness*** (In02), ***emotionality, resonance with one’s own feelings*** (In05), ***open-endedness*** (In05), flow where the rest of the world falls away, (In02) referring to Csikszentmihalyi [6]. Playing and iteratively going back and forth is correlated to a typical and crucial creativity strategy: producing a huge number of variations on the available concepts, ideas and their elements. They emphasize the relevance of iteration by going back and forth including jumping between different kinds of phases, in particular between divergence and convergence. The iteration resonates with playing, applying trial and error strategies and producing variations. CSCW-concepts should take into account that the deeper the creativity of a proposal is, the more reactions, questions, challenges and concerns it will provoke (In11). On the other hand, the role of ***thorough, deliberate, scientific thinking*** (In05) is stressed, as well as the need for structured, coordinated activities if a larger number of participants or contributions has to be dealt with (In01), if people are dislocated and don’t know each other very well (In04) or if documentation and meta-reflection (In11) is required.

It is pointed out that the back and forth and playing around at one time or another must lead into a phase of ***pragmatism and focusing*** (In10) to make a successful process of creativity complete; after a phase of ***open-endedness, writing*** (In05) or documenting starts to consolidate the results.

Certain phases between which a smooth transition should be possible are:

• **Conversation vs. work on shared material** (In01): With respect to conversation, the interviewees pointed out that it covers the proposing of ideas to others, challenging the ideas, explaining ideas and giving arguments and starting negotiations about proposals while work on shared material covers collaborative experimenting, or trying things out.

• **Coming together and going apart** (In05): It is pointed out that group interaction and work in solitude repeatedly alternate.

• **Synchronous vs. asynchronous interaction** (In02): In synchronous phases one expects conversation and work on shared material to be highly interrelated. In asynchronous phases, maintaining this interrelationship becomes more difficult and a higher degree of coordination is needed.

• **Content related vs. coordinative communication** (In02): Coordination frequently punctuates the conversation about the actual problem.

To get a more focused understanding of the needs for technical support of collaborative creativity we reflect on the barriers which make creativity difficult.

### Psychological barriers

Many problems are caused by the limitations of human memory. Santanen et al. [26] suggest that the limited working memory makes it difficult to have different aspects of the problem space simultaneously in mind and to build manifold and unusual combina-
tions. To handle this limitation, people build semantic-chunks which again guide their thinking and may limit their flexibility. The interviewees didn’t describe problems which could be related to a limited capacity of having new, exceptional ideas. They rather mentioned problems which are related to the long term memory: they forget ideas or cannot find their notes on ideas, or – if they find them – they cannot remember their context (In08). Creative people tend to produce and collect a huge amount of notes which lead to an idea overload (In06, In12) and which have to be reorganized from time to time (In08, In09). It is difficult for some people to start a pragmatic focusing and consolidation (In08), if they assume that some of their ideas have not yet been sufficiently taken into account.

Furthermore, there are barriers which became apparent with so called hidden profile experiments [31]: If someone does not know the knowledge profile of others and therefore does not actively ask them for the needed information, one is not open-minded towards integrating unexpected information. The experiments reveal that items of information delivered by others receive more attention the more the recipient is already familiar with them – new information is usually neglected in the decision process. If brainstorming is electronically supported and leads to a huge amount of gathered items, it is hard for the participants to provide a reasonable synthesizing of the collected ideas. Therefore, the meeting support tools offer a means of prioritizing and sorting out items. However, the ideas which receive the highest scores are mostly those which are already familiar to the voters – and the really valuable new ideas are possibly sorted out. Thus, collaboration support for creativity workshops should emphasize the relationship building between ideas (In01).

Another problem may be caused by undesired interruptions [22] which may suppress creativity (In03), while intentionally sought interruptions can have a positive effect by leading to inspiration or giving opportunities for a brain feed (In12).

**Technology related barriers**

One of the interviewees put it this way: The great irony is that although we work in CSCW we use almost nothing of that sort (In04). The interviewees mention several reasons why they do not use elaborated CSCW-features much to support their collaborative creativity:

- Different participants often use very different tools. If it comes to more specific tasks, they may have different platforms, or reside behind firewalls which make an exchange via more sophisticated media difficult (In04).
- The few tools which are commonly available often do not offer the features and effectiveness one is used to in the context of individual work (In04).
- Installing new tools at everybody’s site consumes too much start up time.
- Tools take you in a certain direction (In04) which is not always compatible with what is intended.
- Communication support, e.g. video conferences is too stiff (In02) or not cognitively lightweight enough. Turn taking is too awkward (In08).
- The established word processors are not feasible for converging ideas (In05) or not flexible enough to arrange information flexibly (In06) which may explain the preference for power points in some companies (In07).

4. **Design heuristics**

The interviewees’ statements can be categorized and condensed by developing a set of design heuristics. Earlier work on creativity tools [28] [18] is focused on human-computer interaction. By contrast, the heuristics described below are focused on collaboration support. We do not argue for the development of a particular platform or suite of tools but we outline general requirements which should be met by those tools being used or developed for collaborative creativity. Usually, design criteria should be domain-specific. However, in the case of collaborative creativity, the aim is to include many different domains and types of persons – therefore the heuristics and the corresponding technical functions have to be domain independent. This is mainly achieved by keeping the formulation of the heuristics on an abstract level – concrete hints or examples for implementation are mainly used as illustration. These domain-independent, abstract heuristics are not conceived as guidelines for software development but mainly for evaluation and for supporting decisions between several options. Usability testing is another area where this kind of domain-independent heuristics is applied³.

To make the heuristics more complete and understandable we also draw on corresponding topics in the literature. Furthermore, we refer to our experience from several series of workshops for socio-technical design. These participatory workshops usually have the task of improving processes of cooperative work by introducing new software. Typical participants beside the facilitator are managers, project leaders, software-engineers and end-users. A typical example is the in-

³ An example of these kinds of heuristics are the seven dialogue principles of ISO9241-10, such as suitability for learning, error tolerance, controllability etc.
Introduction of mobile devices to support the communication between truck drivers and dispatchers in a logistics services company [16]. The organization of the workshops was primarily goal- and efficiency-oriented: the participants were asked to contribute to and comment on graphical diagrams which represented the concept of a socio-technical solution. Since the facilitation strictly pursued the goal to complete the diagrams step-by-step, the creativity of the achieved solutions was limited.

Since October 2007, we have started to renew the facilitation procedures and employed tools which we use for the workshop series to increase creativity. The centerpiece (see fig.1) of the technical support is an interactive large screen (4.8m x 1.2m). Contributions can be entered and manipulated directly on the screen or via WLAN-connected laptops. The new workshop setting allows the participants to work together on representations of their ideas and to combine them with contextual material. Phases of highly interactive communication and retreated thinking can alternate. In between the workshops, they compare the new concepts with the constraints of their daily work and may have time for deeper reflection. The collaboration with others can be asynchronously continued.

The design heuristics can be checked against the experience with the new and the old workshop concepts under the question of whether they inspire improvements with respect to the following issues:
- Increased quantity and quality of ideas
- More possibilities for playing around and going back and forth
- Increased synergy between the ideas.

A) Supporting the larger picture – visualization of rich material

One of the interviewees’ main messages was that the various types of contributions and manifold ways of representing them (e.g. writing or sketching) must be visualizable and composable. The interviewees emphasized that every participant needs an appropriate means of self-expression (In02), that it must be possible to recognize the large pattern (In12), that changing the modes of presentation (e.g. translating temporal relationships into spatial relationships, In12) increases comprehensibility and helps to solve problems. Exclusive focusing on a certain type of representation e.g. the hierarchical relationship-building of the mind map method (In08) is insufficient.

Therefore, supporting the building of a larger picture is a reasonable heuristic [5]. An electronic medium for creativity support has to visualize and combine all participants’ contributions and allow them to flexibly insert all kinds of ideas, opinions, illustrating material or contextual background. Therefore it is important for the collaborative interaction that:
- representations of ideas or additional information for contextualization can be captured and inserted as easily as possible and freely ordered
- different types of vocabulary o symbols as well as varying diagrammatic notations can be combined
- varying types of media such as oral utterances, sketches, pictures, video, diagrams, text can be used, integrated and related to each other
- different degrees of explicitness, formalization, vagueness can be applied and intermingled
- manifold means for expressing relations are offered such as arcs, highlighting, coloring, Venn diagrams, typed relationships
- different degrees of details are possible: overviews and abstract representations are possible as is the simultaneous presentation of subsets of minutiae
- differences and commonalities between the visualized ideas can be easily recognized at one glance; dissent should be particularly comprehensible [7].

Some typical examples which achieve partial compliance with this design heuristic are the Envisionment and Discovery Collaboratory, EDC [1] or the i-land environment [33]. With the interactive large screen a large quantity of brainstorming contributions can simultaneously be made visible and readable. Contributions can be easily related to each other by geome-
trical nearness, while other graphical means (such as arcs, coloring, Venn diagrams) are restricted to what current software tools provide. This limits the possibilities to express synergy.

B) Malleability of shared material and stimulation of variations

The interviewees consider malleability (In08) or openness (In05) of the material – which represents design concepts – as essential for dynamic idea generation. The variability which is achieved with these features is required by the interviewees with respect to the playfulness (In02) they assign to creativity, or the relevance of going back and forth (In08). We know from our workshop experience that participants must be invited to make changes and should not need to be afraid that these changes may have destructive effects. The more perfect the representation of a solution appears, the more reluctant they are to modify it.

The jointly available representations must be modifiable and malleable in manifold ways. This includes:

- the free rearranging of elements with respect to their order or geometrical placing, e.g. to organize text graphically (In05),
- the hiding⁴, highlighting or inserting of (new) elements as well as recombining the relations between them,
- the switching between different modes of representation, support of translating one mode into another (e.g. handwriting into digital text, mindmaps into text etc.),
- the obvious indication of those subsets of elements which are expected to be modified, or the proactive indicating of elements that have to be reconsidered,
- the enabling of “what-if” or “what-else” scenarios of modification to support experiments,
- the possibility of conducting joint modifications simultaneously; this can be supported by offering different layers to every participant which represent their proposals for change and can be flexibly hidden or shown.

Malleability can be increased by offering tangible objects [1]. The use of handwriting or hand sketching also extends the modifiability of shared material [13].

On an interactive large screen, contributions can easily be geometrically arranged, but only by one person who interacts with the wall – e.g. with OneNote™. Collaborative and simultaneous modification of clusters by two or more persons is currently not supported. This deficit limits the possibilities of synergy building.

C) Support of convergence within evolutionary documentation

Extensive phases of divergence by creating ideas via brainstorming or by varying the collated information lead to a huge amount of items and documents. To achieve final concepts, the possible synergy between the ideas has to be identified and exploited, and the contributions have to be merged and condensed. The interviews revealed that this phase of convergence is a time consuming process and is not sufficiently supported (In01, In06) by current groupware functions. In particular, reducing the set of ideas by prioritizing them has to take place without excluding valuable contributions⁵ or possibilities of merging them. Therefore, continuous and evolutionary documentation has to accompany the phase of convergence including:

- semi-automatic identification of correlations, clusters and threads between the participants’ contributions by exploiting their content and the process of cooperation
- the possibility for simultaneous clustering and documentation of relationships
- managing a deliberate process of prioritizing items which includes the directing of attention towards neglected or conflicting aspects (items should be brought into the foreground if they have been neglected – e.g. on the basis of the hidden profile problem [31] )
- unobtrusive support for collaborative documentation which avoids unnecessary interruptions and has to make sure that the convergence is traceable⁶ and can be a subject of going back and forth along the timeline (cf. the bridge tool [7])
- decisions about prioritizing and sorting things out should be documented, e.g. by means of dialogue mapping [5].

Examples of groupware functions which support this heuristic are rating or voting [20]. They help to identify priorities within group decision support systems. Grouping and clustering can be supported with mind maps. However, they have the disadvantage of requiring a hierarchical structure (In08). The expe-

⁴ Hiding certain information temporarily (e.g. the identity of a contributor) helps to the avoidance of problems such as free riding, evaluation apprehension, cognitive inertia, or motivational pressure toward group uniformity [27].

⁵ This requirement is derived from the context of “hidden profile” experiments [31].

⁶ Most interviewees (e.g. In08) mentioned that the most popular word processor’s tracking function does not sufficiently make the history of the merging of ideas comprehensible.
These requirements also help to achieve a balance between the advantages of nominal and interactive groups [27] and to switch flexibly between different ideation techniques as described by Nov & Jones [23].
While Wikis are an example of how people can combine knowledge from different perspectives, they are also an example of insufficient integration of communication (In02).

5. Related work and conclusion

“Collaborative creativity” can be finally defined as a process
- where people – who represent various perspectives – communicate, work on shared material, and document their mutual results,
- where phases of retreated work and reflection, asynchronous contributions and highly intertwined simultaneous interaction alternate, and
- where the participants try to produce a large number of ideas and to synergize them so that the results are new and useful in their fields.

In this context, Hailpern et al. [14] present a list of six requirements which are comparable with the developed heuristics. Requirements such as keep multiple design ideas visible simultaneously and shared ideas should always remain in the collective consciousness are covered by the “larger picture” heuristic. Other parts of Hailpern’s et al. requirements can be related to the need for unobtrusive but continuous and complete documentation. A difference to our findings can be seen in the requirement that the results during individual work phases should not be visible to others (since its producers may feel unsure about its value) while we assume that it doesn’t matter whether such results are visible to others or not, as long as the individual phases remain undisturbed. The appropriateness of these two options may depend on the degree of trust which underlies the specific constellation of creative work. Further hints are included in the work of Farooq et al. [7],[8] who emphasize the relevance of awareness and supporting the attention for dissent. It is plausible when Shneiderman [30] suggests that collaboration-oriented tools such as Eclipse, JDeveloper, Wikipedia, Blogger, Slashdot, Flickr, Youtube have a positive influence on social creativity. However, these tools have still to be improved with respect to the proposed heuristics and the underlying opinions of the interviewees.

Furthermore, the implications of process design for Bounded Ideation Theory [3] can be related to the developed heuristics: Integrating contextual information into the larger picture might help to overcome the understanding boundary; switching between lower- and higher-level concepts can be supported by malleability, the smooth transition between various modes supports flexible interventions (to increase diversity of stimuli, minimize outside distraction or to use formal and informal breaks). The proposed heuristics go beyond current ideation theory since they address features for collaboration support instead of platforms and tools such as EBS or GSS. These features allow a group a varying degree of interaction on a continuum between work in solitude and simultaneous collaboration of several participants on the same material. It is reasonable for psychological research on ideation to compare the effect of different treatments (e.g. types of stimuli), while the proposed heuristics focus on flexibly mixing various modes of collaboration support. Furthermore, the support of heterogeneous teams is more explicitly emphasized as is usually the case in studies on ideation.

CSCW-support for collaborative creativity in heterogeneous teams cannot be aligned with a certain domain or type of user. Such an approach would be inadequate because of the huge variety of possible participants and constellations. Since the creative collaboration may take place in virtual meetings or may be continued asynchronously, the provided tools should be applicable in diverse IT-infrastructures – preferably via web-browsers – without requiring intensive preparation.

The proposed heuristics can be used to facilitate creative collaboration, to improve CSCW-features, to compare different settings of creativity support and to inspire further research. The heuristics differ from existing usability criteria and CSCW-design guidelines because they do not focus on effectiveness and efficiency but have to take playfulness and openness into account. Further substantiation and consolidation of the heuristics should be undertaken by conducting experiments or surveys which include a large number of experts from different fields.

6. References


