

Design Issues for Supporting Collaborative Creativity

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Abstract Technical support of collaborative creativity is a complex challenge because the interacting people usually have differing backgrounds, thought processes or self expression, and their collaboration is only weakly structured and should be highly flexible. We outline the heterogeneous characteristics of creativity and their dimensions, and describe the barriers to be overcome. On this basis, five CSCW-oriented design heuristics are derived: Supporting the large picture – the visualization of rich material; the 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.

Keywords: cscw, creativity, tool design

1 Introduction: Collaborative Creativity

It is widely agreed upon that the creativity of ideas and concepts increases if they are developed from various perspectives by different experts with differing scientific or professional backgrounds. We call this phenomenon “collaborative creativity” (Mamykina, et al. 2002 [20]). Fischer et al. (2004 [9]) outline that collaborative creativity (in their words “social creativity”) draws advantage from bringing together people with different backgrounds and that 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 [28])”. From a global point of view, the novelty and appropriateness have to be accepted by the stakeholders of a field (Csikszentmihalyi, 1996 [5]). There is a huge body of literature on creativity and its psychological background as well as on techniques to enhance creativeness. We cannot summarize this body of literature in this paper, but Sternberg (1999 [28]) gives a helpful overview and we take advantage of Greene’s (2001 [11]) detailed work summarizing the approaches to creativity within a framework of 42 models. The main literature which is relevant in the field of CSCW is summarized by Shneiderman (2000 [24]) and Farooq et al. (2005 [6]). It seems to be widely accepted that the endeavor of achieving creativity is just the opposite of the repetition of routinized, anticipatable activities or of a well-structured, effectively manageable project.

If creativity happens collaboratively, the question arises of how CSCW can support it, what kinds of CSCW-features are already used for this support, and what kind of design guidance can be provided. Since collaborative creativity draws its strength from the heterogeneity of the group working together, the technical support also has to

reflect the heterogeneity of technical support requirements and it is not reasonable to provide domain-specific tools. For example, if a team of an architect, a software-engineer, a chief physician and a business administration manager starts to develop ideas for a new type of hospital, it is not feasible to offer them documentation and collaboration tools which are specifically adapted to one of these domains. By contrast, some kind of documentation support is needed which helps them to articulate their different perspectives and to represent them in a shared artifact which can be the subject of their ongoing process of developing, planning and modifying of the new concept for hospitals.

This paper derives design heuristics which help to develop or evaluate the tools which support shared documentation and the work with these documents in heterogeneous design teams. In the next section we describe our methodological approach. Section 3 derives dimensions and characteristics of collaborative creativity from the empirical work, and characterizes the typical barriers which have to be overcome. Subsequently, we describe the design heuristics and present (section 5) the comparison with related work and concluding remarks about how to use the heuristics.

2 Methodology

The focus of our design issues – visualization and modification of collaboratively developed and documented concepts – is based on a series of case studies (Herrmann et al. 2004, 2007a, 2007b [15][14][16]) where we were involved in the design of socio-technical systems and processes or where we helped to improve processes. In these cases we tried to build a bridge between the open discussions and construction of the requirements on the one hand, and more formal specifications of software functionality or process control on the other hand. We found that our methodological approach and our tool for collaborative work on shared documentations (mainly process diagrams) are limited when it comes to creativity.

To understand the problems which can occur when using CSCW-features for collaborative creative work, we have analyzed interviews with 12 people who all in all represent the following characteristics:

- CSCW-researchers who are involved in interdisciplinary creative collaborations from time to time, and are used to employing groupware functions
- Interdisciplinary orientation of every interviewee, varying focuses such as computer science, anthropology, business administration, information systems, psychology, philosophy, usability engineering
- Only few interviewees are directly involved in research on creativity.
- Different relations to CSCW: methods of software-engineering and design, developing and implementing concrete systems or features, studies on the usage of groupware, workplace studies where collaboration is especially relevant, evaluation of concrete systems.
- Getting used to reflecting on their own practices and being willing to try out new technology in the field of CSCW
- One of them located at a university in Europe, the others are located at 8 different universities (as faculty members) or research institutes in the United States

- The set of interviewees covers experience with different types of collaboration such as meetings, asynchronous work with dislocated colleagues, synchronous communication .

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. We suggest that those problems which prevent these people from using CSCW for creative collaboration keep even more users from different backgrounds away. Therefore the overcoming of their problems should become a priority and be used to inspire design heuristics. On the other hand, the selection of interviewees represents a wide range of different characteristics and therefore complies with the intention to conduct an explorative study. Although the experience of the interviewees is not representative with respect to the whole group of

Table 1 – Interview guidelines

- What are - from a subjective point of view – relevant aspects of creativity - on an individual as well as on a collaborative level?
- Which kind of creativity and phases therefore can be differentiated between?
- 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]?
- How can switches be supported (between creative work and routine tasks, between re-treated thinking and communication, between synchronous and asynchronous communication)?
- In which kind of situation can groupware features be successfully employed for creativity and what are the characteristics of the appropriate situations?
- Which organizational issues have to be considered with respect to creativity support with groupware features?
- What triggers unconventional thinking?
- What are the important differences between academic and industrial settings with respect to creativity?
- What are the future trends to improve creativity with respect to groupware features and web-applications?

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 to identify problems and requirements which stem from practical experience with CSCW-usage.

Conducting and analyzing the interviews included the following steps:

- We started by explaining the background. We followed a prepared set of questions (cf. Table 1) and went – if appropriate – into further details.
- The average length of interview was 90 minutes; they were audio recorded.
- During the interviews and by listening through them a second time, important categories were identified (cf. Table 2).
- Passages of the interviews were transcribed and assigned to the categories.
- Diverging or contradictive descriptions were combined to understand the wide range of differing needs which has to be technically supported. We have supposed that every kind of differing need or problem can occur in heterogeneous teams and has therefore to be met by appropriate technical features.

The following description refers to the interviews by using “In” in parentheses followed by an indication of the interview’s number.

3 Dimensions and Barriers

To describe the variety of characteristics and dimensions of collaborative creativity we refer to Vandenbosch et al. (2001 [30]). 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

With respect to collaborative creativity it is decisive that some people can *only be creative when they communicate* (In01) while others need a complete retreat to become able to generate ideas, and can only afterwards contribute to collaborative creativity. However, then they may *come up with surprising solutions* (In01) when several ideas or discussion threads have to be merged. Creative people can be **synthesizers** or **analyzers** (In01). Similar to the **communicator** vs. **retreated thinker** comparison we have **multi-taskers** going back and forth between different streams of thoughts vs. **people staying within a single flow** (In02) of working on a task idea. Furthermore, people have different ways of expressing themselves; some of the interviewees characterize themselves as **sketchers** (In05), others as **writers** (In08).

Table 2–Categories
<ul style="list-style-type: none"> • Basic assumptions about creativity • Description of own creative behavior, cases and patterns • Observed methods and measurements which enhance creativity • Problems with groupware features with respect to creative collaboration • Types of groupware being used • Typical ways of how groupware features and web-applications are used • Proposals for improvement, design requirements

Contextual aspects

We found that the settings in which creative collaboration takes place make a difference. We roughly differentiate between the following situations:

- Creativity in everyday work as primary task (as is typical for creative industries or companies such as IDEO (cf. Kelley, 2001 [18]) (In08) vs. secondary task (e.g. the generating of innovative ideas in the course of maintenance work)
- *Seeding*: An artifact like a document or certain kind of software-prototype is installed in everyday work life to become a nucleus of creative ideas (In06) (cf. the concept of “seeding, evolutionary growth and reseeded”, Fischer et al., 1994 [8])
- *Workshops or a series of workshops*¹ 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).

¹ Group Decision Support Systems (Gray & Nunamaker, 1993 [10]) or meeting support systems (Barent et al. 1995 [2]) can be employed to support creative activities in workshops.

- *Collaborative writing* as 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 start to work on certain task and switch on a meta-level from time to time to reflect on how they can improve their problem solving methods.

Processual aspects of creativity

The literature differentiates between phases of creative work. The roughest differentiation compares a divergent phase with a convergent one. Shneiderman (2002 [25]) starts by citing Couger (1996 [4]) (Opportunity, delineation, problem definition; Compiling relevant information; Generating ideas; Evaluating, prioritizing ideas; Developing and implementation plan). Then he proposes his own scheme (collect, relate, create, donate). The interviews reveal that the creative collaboration of the interviewees 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), *flow where the rest of the world falls away* (In02) referring to Csikszentmihalyi (1996 [5]). 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.

Furthermore, it is pointed out that the back and forth and playing around sometime must lead into a phase of *pragmatism and focusing* (In10) to make a successful process of creativity complete; the atmosphere of *open-endedness must be completed by efforts of writing* (In05) or documentation to consolidate the results.

Other phases between which a smooth transition should be possible are

- ***conversation vs. work on shared material*** (In01). With respect to conversation, the interviewees mention 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)
- synchronous vs. asynchronous interaction. In synchronous phases one expects that conversation and work on shared material to be highly interrelated. In asynchro-

nous phases, maintaining this interrelationship becomes more difficult and a higher degree of coordination is necessary.

- content related vs. coordinative communication. The conversation about the actual problem is punctuated with coordinative acts of communication.

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. (2004 [23]) suggest that the limited working memory makes it difficult to have different aspects of the problem space in mind and to build manifold and unusual combinations. To handle this limitation, people build semantical chunks which again guide their thinking and may limit their flexibility. The interviewees didn't describe this kind of problem which could be related to a limited capacity of having new, exceptional ideas. However, they mention problems which can be related to the long term memory: they forget ideas or cannot find their notes on ideas, or – if they find them – they don't understand them since they cannot remember their context (In08). Creative people tend to produce and to collect a huge amount of notes which lead to an idea overload (In06, In12) and which have to be re-organized from time to time (In08, In09). It is difficult for some people to start a pragmatic phase of focusing and consolidation (In08), if they know that there might be some of their ideas around, which have not yet been sufficiently taken into account.

Furthermore, there are barriers which became apparent with so called hidden profile experiments (Stasser & Stewart, 1992 [27]): If someone does not know the knowledge profile of another 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.

In those workshop situations where 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 clustering of ideas and the relationship building between them (In01).

Another problem may be caused by undesired interruptions (Mark et al., 2005 [21]) 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 some 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 level of 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 you actually want.
- Some types of communication support, such as video conferences are *too stiff* (In02), *turn taking is too awkward* (In08) or they just are simply not cognitively lightweight enough.
- The established word processors are not feasible for converging ideas (In05) or not flexible enough to arrange information flexibly (In06) what may explain a preference for power points in some companies (In07).

4 Design heuristics

There is a wide range of aspects which can be supported by technical functionality in the course of collaborative creativity. We propose an underlying scenario of a series of workshops which lead to the development of creative concepts. During the workshops, the participants work together on representations of their ideas and contextual material and phases of communication and retreated thinking 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. This scenario serves as a background for the following design heuristics. As mentioned above, the heuristics try to cover a wide range of different needs and problems because of the heterogeneity of the teams to be supported.

Earlier work on creativity tools (Shneiderman, 2000 [24] or Hewett, 2005 [17]) 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 the requirements which should be met by those tools being used or developed for the purpose of supporting collaborative creativity. Usually, design criteria should be as specific as possible with respect to certain domains or to the characteristics of the user. However, in the case of creativity workshops, the aim is to include many different domains and types of persons – therefore the heuristics and the corresponding technical functions of collaboration support have to be domain independent.

A) Supporting the large picture – visualization of rich material

An electronic medium which visualizes and combines all participants' contributions and allows them to insert all kinds of ideas, opinions, illustrating material or contextual background information into a large picture has to be available (cf. Conklin 2005, [3]). Therefore during the collaborative interaction it should be possible that:

- representations of ideas or additional information for contextualization can be captured and inserted as easily as possible
- different types of vocabulary and 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
- different degrees of details can be displayed: overviews and abstract representations are possible as is the simultaneous presentation of subsets of minutiae
- the differences and commonalities between the visualized ideas can be easily recognized ('at one glance'). Dissent should be particularly comprehensible (Farooq et al., 2005 [6]).

This design heuristic is based on hints from the interviewees who emphasize 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 the comprehensibility and people's ability to solve problems, and that exclusive focusing on a certain type of representation e.g. the hierarchical relationship-building of the mind map method (In08) is insufficient.

Typical examples which achieved partial compliance with this design heuristic are the Envisionment and Discovery Collaboratory, EDC (Arias et al., 2000 [1]) or the island environment (Streitz, 1999 [29]).

B) Malleability of shared material and stimulation of variations

While the "large picture" heuristic focuses on the mutual availability and visibility of all information, it is also crucial that creativity supports dynamic work on the material and going back and forth in a playful mode. The representations which are jointly available via the large picture must be modifiable and malleable in manifold ways. This includes

- rearranging the order of elements
- the hiding of elements and the insertion of (new) elements as well as recombining the relations between them
- switching between different modes of representation, support of translating one mode into another (e.g. handwriting into digital text)
- obvious indication of those subsets of elements which are expected to be modified, or proactive signalling that some elements are "waiting" to be reconsidered
- enabling of "what-if" or "what-else" scenarios of modification to support experiments
- the possibility of making 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.

The variability which is achieved with these features is required by the interviewees with respect to the *playfulness* (In02), which is assigned to creativity or the relevance of *going back and forth* (In08). The *malleability* (In08) or *openness* (In05) of the material, which represents design concepts, is essential for dynamic idea generation. Furthermore it is proposed that turn taking problems have to be overcome by making clear that people are invited to make changes and that they don't have to be afraid that

these changes may have destructive effects. Malleability can be increased by offering tangible objects (cf. Arias et al., 2000 [1]). The use of handwriting or hand sketching also extends the possibilities to modify shared material (Guimbretière et al., 2001 [12]).

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 reveal that this phase of convergence is a time consuming process and is not sufficiently supported (In01, In06) by current groupware systems. In particular, reducing the set of ideas by prioritizing them has to take place without losing valuable contributions. Therefore, continuous and evolutionary documentation has to accompany the phase of convergence including

- semi-automatic identification of correlations and threads between the participants' contributions by exploiting the process of cooperation
- support for collaborative clustering of contributions, detecting correlations between them, finding combinations of items
- clustering and documentation of relationships which can happen simultaneously
- managing a deliberate process of prioritizing items which includes the directing of attention towards neglected aspects
- that items which have been forgotten – e.g. in the context of the hidden profile problem (Stasser & Steward, 1992 [27]) – are brought into the foreground
- unobtrusive support for collaborative documentation which avoids unnecessary interruptions and has to make sure that the convergence is traceable² and can be a subject of going back and forth along the timeline (cf. the bridge tool of Farooq et al., 2005 [6])
- decisions about prioritizing and sorting things out should be documented, e.g. by means of dialogue mapping (Conklin, 2005 [3]).

Examples of groupware functions which point into the direction of this type of heuristic are rating or voting (Limayem, 2006 [19]). They help to identify priorities within group decision support systems. Support for grouping and clustering can be offered with mind maps (www.mindmeister.com) which have the disadvantage of requiring a hierarchical structure. Non-hierarchical grouping can potentially be achieved with tagging, which should be combined with an appropriate means of visualization.

D) Smooth transitions between different modes of creative collaboration

It became apparent that collaborative creative work includes a manifold of different modes and varying preferences of the participants: phases of divergence and convergence alternate, people separate and come together, collocated meetings are followed by dislocated cooperation and vice versa, synchronous interactions alternate with asynchronous ones and collaborative work with that of the individual. These modes are assigned to different tools or functions between which a smooth transition is required:

² Most interviewees (e.g. In08) mention that the most popular word processor's tracking function does not sufficiently make the history of the merging of ideas comprehensible.

- People must be supported to contribute to a solution or a concept by thinking it through individually without being disturbed – that means without receiving hints of what others are doing, communicating or observing.
- An intermediate mode is offered between individual, retreated thinking and active collaboration or communication. Within this mode, participants can easily resume the collaboration with others by getting information about what has been discussed and worked upon while they were absent, and they receive continuous awareness clues about what is going on so that they can flexibly switch between working on their own and being involved in collaboration.
- Flexible switching between synchronous and asynchronous communication and work on shared material by providing awareness functions and tools which support the re-synchronization and merging of individual work on shared material, as well as the mutual solving of replication conflicts.
- The smooth integration of communicative contributions to creative concepts and their documentation. The documentation should happen as a concurrent task which requires as little extra attention as possible.
- Subtle signaling when others have retreated or need a retreat.
- Making one's behavioral rhythm comprehensible to others. E.g. how often need the involved individuals or groups a break, or a switch between divergence and convergence or between communicating and documenting etc.

These requirements are backed by the overall comparison of the interviews which reveals the variety of different activities and behavior patterns which can be essential to achieve creativity. It is particularly clear (In08) that switching between different activities and perspectives – as they are assigned to roles – can be very helpful. Our own experience with walkthrough-oriented workshops (Herrmann, et al. 2007a [14]) revealed that the continuous inspection and modification of artifacts needs a kind of documenting which is unobtrusive on the one hand but also has to clarify that all contributions by the participants have found their way into the discussed concepts.

Applying this heuristic means, for example, that currently available meeting support systems which impose a certain scheme of phases on the participants should be highly adjustable. As another example it is apparent that the available video conferencing systems or media spaces do not provide sufficient signals about people's switching their attention focus between communication and the problems to be solved.

E) Integration of communication with work on shared material

From the viewpoint of the interviewees, conversation and joint work on shared material are not sufficiently integrated. For example, it should be possible to *see it as a tandem* (In05) when people are jointly changing a text and are communicatively reasoning about these changes in the case of collaborative writing. Documentation builds the bridge between communication and mutual work on shared material. The playfulness of creative sessions requires light-weight, poorly structured communication on the one hand, while its continuous documentation requires discipline and compliance with prescribed conventions on the other. With the help of technical support it should be unnecessary to *develop certain conventions before the communication can start* (In02). The following features can support the integration:

- support of an extra role which is in charge of the documentation and which can easily be taken over

- providing means to make references by inserting hyperlinks into the documentation. These hyperlinks refer to contextual background material that helps us to understand the documentation and avoids the need to complete it with explicit explanations
- tracing of joint editing activities as an appropriate means for implicit documentation
- supporting deixis which help to relate the communication to the shared material
- integration of dialogue mapping (Conklin, 2005 [3]) which mirrors the argumentative structures of reasoning about joint editing activities
- smooth insertion of recorded oral utterances or handwritten annotations etc. into the shared material
- the structure of the medium which represents the material should mirror the structure of the communication e.g. turntaking: those who are allowed to edit an element are also allowed to speak.

While Wikis are an example of how people can combine knowledge from different perspectives, it is also an example of insufficient integration of communication [In02]. “Concert chat” is a typical example of how joint editing and communication are intertwined (cf. Wessner et al., 2006 [31]). It supports active references between a chat room and a whiteboard. However, what is possible with certain platforms can often not be used because the potential participants cannot, or don’t want to, be registered or install the required clients before they start to contribute to a creative endeavor (In04).

5 Related work and conclusion

A NSF-workshop on creativity support tools in 2005 provides 12 design principles (Resnick et al., 2005 [22]), one of them entitled “Support Collaboration”. This principle generally states that tools are needed which support the integration and iteration of the contributions of team members with their differing strengths and talents. The proposed heuristics attempt to detail this principle. Comparable with the above described heuristics, Hailpern et al., (2007 [13]) present a list of six requirements. Requirements such as keep *multiple design ideas visible simultaneously* and *shared ideas should always remain in the collective consciousness* are covered by the “large 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 result of 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 trustfulness which underlies the specific constellation of creative work. Further hints are included in the work of Farooq et al. (2005 [6]) who emphasize the relevance of supporting the attention for dissent and of Farooq et al. (2007 [7]) who emphasize the relevance of awareness. It is plausible when Shneiderman (2007, p22 [26]) suggests that collaboration-oriented tools such as Eclipse, JDeveloper, Wikipedia, Blogger, Slahsdot, Flickr, Youtube may have a positive influence on social creativity. However, these tools are still to be improved from the viewpoint of the proposed heuristics and the underlying opinions of the interviewees.

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 and the neglectable relevance of routinized activities. 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 and to inspire further research. Further steps include:

- comparing systems and deciding which of them comply better with the need for creative collaboration in heterogeneous teams
- evaluating existing solutions with respect to the listed requirements
- extracting those features of existing systems – in particular research prototypes – which increase their compatibility with the heuristics. These features can serve as role models.
- identifying those aspects of the heuristics which have so far not been sufficiently supported. We assume that the support for a qualitative synergizing of ideas is one of the urgent problems to be solved.
- offering web-based tools which are easily accessible, support confidential information exchange and comply with the heuristics.

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