Backdoor Creativity – Collaborative Creativity in Technology Supported Teams

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Abstract. This case study describes collaborative creativity in technology-supported teams with the task of making an interactive artefact. The teams work in the iLounge, which is designed and built with the purpose of supporting co-located collaborative work. iLounge is equipped with several vertical and horizontal large screens, called smart boards, where the team members can make their contributions available to all others. Creativity is discussed as a collaborative effort manifested in relation to technology support rather than some individual trait. Collaborative creativity is then examined and discussed as transactions between team members and their use of the workspaces. The main conclusion is that collaborative creativity is supported by using several Smart boards, and that the teams make use of the Smart boards when proposing and collectively refining ideas. Physical space also matters in terms of getting ones ideas into the discussions, but peripheral participation does not mean that one cannot be of great influence. This kind of backdoor creativity is interesting as it shows how even peripheral, in a physical sense, team members are contributing to the teams overall creative work.

Keywords: Creativity, Technological support, Situated cognition, Co-located collaboration, Interactive spaces

1. Introduction

The main entrance for creativity, as it is portrayed in media and general folklore, is the solitaire individual gushed with several innovative ideas, which takes others by astonishment. Earlier theorists within cognitive science have treated concepts such as intelligence, talent, creativity, giftedness, ability and cognition as something internal, and more particularly as traits or possessions of individual minds [5, 11]. This view on cognition and a focus on an individual mind has been criticized and rivalled by for instance situated [3, 4] – and distributed [6] perspectives on cognition. Central to these perspectives is that cognition is not placed in the heads or minds of individuals but rather in the individual-environment transaction where action (and interaction) takes place [2]. If, cognitive, social, cultural and historical external processes are to be treated as integral parts of competent action, then traditional conceptions of cognition and intelligence should be re-examined [15], as several researchers have argued, for instance Pea [11]. As stated by Barab and Plucker

> *In part, constructs such as ability and talent (or creativity) have the mixed blessing of people having widely held implicit theories of these constructs. Their unofficial definitions, therefore are often taken for granted, making definitions even more difficult* [2, pp. 174].

The authors focus on the concepts of ability and talent (or creativity, authors' remark) and theoretically ground these in situated action, activity theory, distributed cognition and legitimate peripheral participation. Barab and Plucker make a convincing argument and suggest that instead of looking upon these as properties of an individual, these should be looked upon as *"…a set of functional relations distributed across person and context, and through which the person-in-situation appears knowledgeably skilful"* [ibid pp. 174]. I.e. in the dynamic transaction among the individual, the physical environment and the socio-cultural context, ability and talent arise. In this view ability and talent are part of the individual-environment transaction and as such an opportunity that is available to all, but it may be actualized more often by some. Part of the individual-environment transaction is of course artefacts of various kinds (papers, pencils, computers etc.) that are there to support an ongoing activity. Following the line of reasoning above, an important goal for educators, designers, etc., should be to provide with environments and contexts through which talented and creative interactions can emerge.

Our research concerns co-located collaboration, where teams work in technology supported environments (called interactive spaces). The case study reported on in this paper focuses on the concept of creativity in the context of collaborative activities. We have studied two groups of students working on a design task in an interactive space for two weeks with the purpose of describing how this interactive space (as an example of an environment meant to support collaborative work) can support collaborative processes through which creative interactions can emerge.

1.1 Creativity as Collaborative Activity

Collaboration shares a great deal with cooperation as has been defined by Marx [cited in 16, pp. 13] as *"multiple individuals working together in a conscious way in the same production process or in different but connected production processes."* Inasmuch as this definition might be true in a general sense we would like for our purposes to refine it by adding a few features, particularly with creative teamwork in mind. The concept "conscious" may imply some intentional plan for how the cooperation is organized, but collaborative creativity cannot be fully planned. This is because it relies on close and manifest interdependence, rather than loosely coupled production processes. Even though each member might have his own area of expertise and responsibility it is only through the joint coordinated effort of their knowledge and skills that they can accomplish the task. Thus collaboration in creative teams requires the articulation of each individual's activity so that each team member can contribute with ideas, criticise or compromise the mutually shared goal. This goal, in turn, can be highly abstract and must be negotiated at all times as petite elements may change or constrain the general goal.

The constituent parts of situated collaboration can be analyzed into communication and coordination. Collaborative activity is therefore implicitly defined by the use of these two concepts. Communication is often scientifically, as well as by common sense, regarded as the passive transmission and reception of information, rather than the active process of interpretation [14, 23]. In the same commonsense manner coordination is simply considered as "*the act of working together harmoniously*" [9, pp. 358]. We expect collaborative creativity to rely more on communication breakdowns as a vehicle for innovation. Furthermore, we expect collaborative creativity, as a consequence of its manifest situated-ness, to be closely connected to the layout and use of artefacts.

From these critical aspects of perspectives on creativity and collaboration, creativity can be viewed upon as one vital aspect of ongoing activities in computer supported

collaborative teams. More precisely, creativity can be viewed as, and investigated as, one aspect of an ongoing dialogue in computer supported collaborative teams.

We will especially focus on how the team members interact in relation to the layout of the room, how they utilise the artefacts and how the ideas are constructed and negotiated. Viewing creativity as dialogue might help to discuss creativity as a social and communicative transaction between individuals who in some sense share a mutual goal. In this sense a communicative contribution can be viewed as objectively creative and innovative, but will only pass as creative and innovative if it at the same time finds a response in other team members [5]. An objectively creative act might thus not be viewed as creative given that others do not respond to it. At the same time a relatively mundane act (or fact) might give rise to responses that are propagated to something creative. A very strong idea can on the other hand encapsulate the creativity, for example several members reject new forms of ideas as a consequence of that these do not fit the picture. Just as communicative acts are indexed to certain contexts, creativity will be severely constrained by the interactive space and what it affords. The layout of the technology in the room might help to spread ideas but at the same time function as inhibiting people to disturb the general picture.

1.2 Supported Creativity

Creativity is bounded by external constraints either they are physical, structural, economical or social. Computers can support the creative process, and the highest chance to obtain creativity is when users are able "*to move comfortably and smoothly among the information*" [20, pp. 31].

Meeting the challenge of designing effective tools to support creativity Shneiderman [17] has constructed a framework, called a four phase's genex (generator of excellence). The four phases of the genex consists of: collect, relate, create, and donate. The phases are furthermore complemented with eight activities: searching and browsing digital data; consulting with peers and mentors; visualizing data and processes; thinking by free associations; exploring solutions; composing artefacts and performances; reviewing and replaying session histories; disseminating results. The focus of Shneiderman's work is how to support the single user in his or her creative work process through the design of the user interface (regardless of searching for information, exploring solutions or consulting with peers, etc). Our focus on the contrary is on how an environment that provides with a set of artefacts and allows for co-located collaborative work can support the emergence of creative interactions.

The eight activities described above should be supported, but the main challenge here is to design environments that support both individuals and groups. The computer supported environment should support the different individuals in the group, simplify the visualization and sharing of information for the other group members, and have a general setup for supporting the emergence of creative interactions.

1.3 Interactive Spaces

The traditional approach within human-computer interaction is to focus on the one user – one artefact situation. The workspace changes dramatically when there are many users in a space with many artefacts, and it changes even more when information can be displayed in public as well as in private. The ideas with ubiquitous computing, pervasive computing, ambient computing, and calm technology are more or less the same. More precisely, from

only using desktops (or laptops) there will be technologies, that become more and more invisible, and that will be embedded in the environments. The technology disappears in the environment, but gets visible when it is needed. This is also to some extent already the case; more and more of the computers we interact with are embedded in devices. Weiser [21] defined ubiquitous computing as a *"new way of thinking about computers in the world, one that takes into account the natural human environment"* [pp. 94]. Central to his vision was interaction between humans and computers in a natural way, without the human subject thinking about it in any detail. Computers would become part of the background and indistinguishable from the fabric of everyday life. Computers are spread out in the environment and the user should get the feeling that she is interacting with the whole environment and not with separate computing devices.

By interactive spaces we mean environments that support collaborative work, co-located and distributed, where one has both public and private displays, and where there are many ways of working and sharing information with other people. One of the main strengths when working collaboratively in an interactive space is that one can easily share information with the other group members. A common problem when looking at shared digital information is that only one or a few of the group members have an appropriate representation of the information displayed [10]. However, in a space where one has public displays this problem disappears, but the problem here is to make it easy to hand information over from personal to public displays. The metaphor we have worked on when designing the interaction in interactive spaces is giving/handing a document from one person to another.

Another strength is that this workspace offers several different ways of searching and presenting data, and there is also different ways of sharing it with the other group members. When for instance having touch-sensitive displays one can interact with the computer with ordinary mouse and keyboard, but also using the fingers or pen to write, draw or navigate on the screen directly.

1.3.1 iLounge

At the Royal Institute of Technology in Kista there is an interactive space called the iLounge designed and built with the purpose of supporting co-located collaborative work. It is used both as a learning facility, and as an experimental research facility. The room has two large touch-sensitive displays known as Smart boards [18] built into a wall. In front of this wall there is a table with a horizontally embedded plasma screen, also touch-sensitive. This interactive table is large enough for 6 to 8 people to sit around. In one of the corners of the room a smaller table and three chairs are placed in front of a wall-mounted plasma display, enabling a part of the group to work separately. Figure 1 shows a plan of the room. The room has a wireless network and contains a laptop computer with a wireless LAN card. Keyboards and mice in the room are also wireless, using Bluetooth technique. Finally, the iLounge contains high quality audio and video equipment that for instance can be used when having videoconferences, or during user studies.

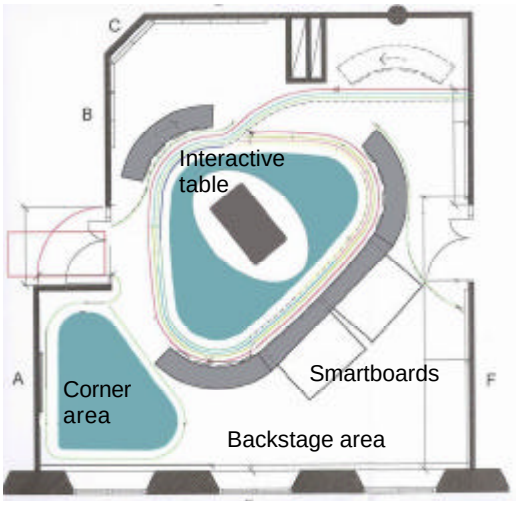

Figure 1. Plan of the room. The working areas are marked in blue.

There are many computers in the room and it is also possible to bring personal artefacts into the room, and therefore it is in no way obvious how information is shared between the different work surfaces. To facilitate and support work in the iLounge our research has been focused on the development of services that help and support the user to move data between the devices present in the room. Tipple [1] is a service with which one can open any file on any other computer that runs the Tipple service. The interface of Tipple shows icons representing all other computers running the service. If you want to start a file on another computer you drag the file icon to the icon representing the other computer (an early prototype is described in [22]). The service Multibrowse allows the user to move web content between displays in the room. When right-clicking a page or a link, the user is given the opportunity to "multibrowse" it either to or from its present location (see [7], for a more thorough description). PointRight makes it possible to use the same pointing device or keyboard on more than one computer in the room. When the pointer reaches the border of the screen it continues on the screen next to it having the service. PointRight together with iClipboard makes it possible for the user to cut or copy text between computers in the space. The text is placed on a clipboard that is shared by the computers running the service. [2]

In the study reported on in this paper we also introduced some of SMART Technologies services to the participants, specifically the virtual keyboard and Smart Notebook. Smart Notebook is an electronic whiteboard application, where one can create documents containing typed text, hand-written text, and pictures. The document is visualized as a book with pages.

1.4 Related Research

Research on creative teams at five companies [19] show that the creative teams seldom use advanced technologies. The teams rather rely on traditional equipment such as flip charts, whiteboards and overhead projectors. These teams were not reluctant to new forms of technology, but rather open to technology and new experiences. The teams would like to have access to databases for preparing meetings and sharing ideas, systems for participatory

[1] Tipple is developed by the FUSE group, Stockholm University/ Royal Institute of Technology, and can be downloaded at http://www.dsv.su.se/fuse/downloads.htm

[2] Multibrowse, Pointright and iClipboard are part of the iWork package and are developed by the Interactive Workspaces at Stanford University. The iWork services can be downloaded at http://iwork.stanford.edu/download.shtml.

presentations, visualizations for inspiration, and different modalities for communication. Still computers must stand in the background. The teams further want systems that are reconfigurable but at the same time invisible. Such design must include a strong aspect of learning as the reconfiguring will hardly make the computer invisible until reconfigurable practices are automatized.

In a former study of interactive spaces, with a quite similar set-up to ours, Artman & Persson [1] studied how officers in a simulated command and control unit collaborated. In that study it was found that the expected interaction between different officers representing different areas of competence was more structured around a social protocol than the possibilities to interact. The team was gathered and each officer informed the others about the states of affairs of his/hers specific units. The word was given in sequential order, by the commander, which did not admit for creative discussions. Another aspect, which seemed to inhibit general and/or in-depths discussions, was that the interactive table contained almost all aspects of the area the command and control unit, was to control. The pattern was broken when one officer produced a very simple representation of the area, which did not include all aspects. When presenting this representation to the team people started to discuss the general situation and what they could do about it. In a sense this embodied the slogan of "less is more". The present study is less tradition-bound and might give rise to different interaction patterns. The task in itself is very different as the command and control is to control an area out-there, while the groups' task in the study reported on here is to come up with an interactive system that attracts a group of unknown persons. Thus the present group is less bounded and we expect to find discussions, idea swapping and close collaborative activities – collaborative creativity.

2. Method

Five female and four male students in the ages of 21 to 45, divided in two groups, participated in the study. One group consisted of three men and one woman, and the other group of one man and four women. A couple of them in the groups knew each other from before. The students attended a course in design of interactive systems at our department. The students' task was to design a digital, multimedia guide for an exhibition "4, 5 Billion Years - The History of Earth and Life" at the Swedish Museum of Natural History. The two groups were responsible for designing the multimedia guide describing "from Big bang to first life", and "pre-historical mammals" (the mammals living before the primates). The target group was children about twelve years old. We followed the students during the conceptual design phase of their assignment. The conceptual design phase lasted two weeks and consisted of brainstorming, sketching of scenarios and the multimedia product, and information search. During this time the groups had four and five sessions, respectively, in the iLounge. Prior to this, they received an introduction to the environment and the specific services introduced in the section "1.3.1 iLounge".

Data were collected through observations, pre- and post-study questionnaires, and ended with semi structured group interviews. The questionnaires have mainly helped us in the analysis of roles of the group members. Both the work sessions and the interviews were video taped. The recordings consist of four angles to cover the whole workspace (see Figure 2), and one channel for sound. Altogether the data material consists of 21, 5 hours of video data. As a tool for our analysis we have used Interaction Analysis [8], and more particularly certain foci for analysis, namely spatial organization of activity, participation structures, artefacts and documents, turn-taking, and trouble and repair.

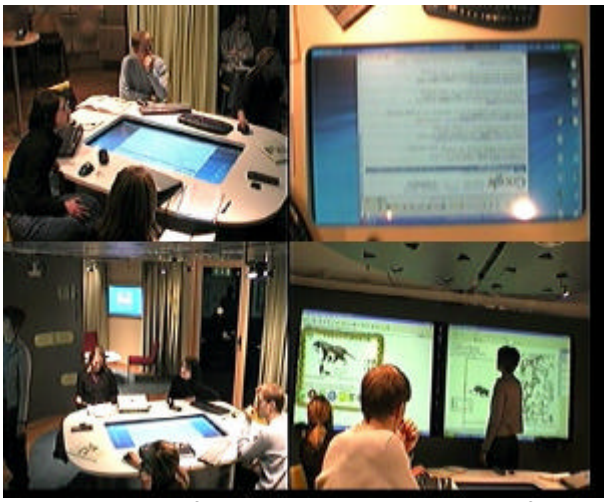

Figure 2. The view of the video recordings with the four angles

3. Results

The results will focus on how the groups used the workspace, and how they came to a creative dialogue, and not the resulting multimedia guides. But a short description of the groups' work processes and the resulting multimedia guides, described in 3.1 will help to understand the excerpts and the discussion that follows.

3.1 Description of the groups' general work process and design product

The two groups of students worked rather differently. Group 1 was driven by the ideas they came up with during their work sessions. The group did not really consider different design proposals, instead they stuck to ideas that someone came up with, and in this way the design evolved. Already during the second work session the storyboard and features of the guide was close to the final solution. This is characteristic for the way they worked: very impulsively, and without thinking of involving the end user in the design process (although the teacher stressed the importance of involving the users in the design process many times). Group 2 on the other hand more strictly followed the instructions given at the beginning of the course and were thus more focussed in their work in coming up with different ideas. After three sessions they had eight design proposals, and after negotiation, they agreed upon one of them. They brought children to the exhibition at the museum, tested the design proposals on children before deciding upon which of their proposals that should be chosen, as well as made a user test of the final multimedia guide. During the design process they continuously documented their work and the process itself.

Group 1 designed a multimedia guide that described the evolution from Big bang to first life. They built a game called "Spaceflower", in which a woman (who is controlled by the user) finds a space rocket resembling a flower in her father's garage. When the user clicks on the space rocket the woman jumps into it, flies away, and gets lost in the universe. In finding her way back she is in contact with her father (who is a professor), and he helps her to get back by giving instructions. In order to get home the woman (user) has to solve different problems. Group 2 designed a game that teaches about the pre-historical mammals. When the game starts, the user meets a researcher in a library. The researcher has documents about pre-historical mammals sorted in piles in accordance with the era in which they lived. There is only one problem: the papers in the piles have become disorganized, and the task of the user is to get the piles in order again.

3.2 Use of Workspace

Most software resources in the environment are standard Microsoft© products which the teams have some familiarity with. In spite of this, the teams need to learn to navigate between different screens. This concerns both the general pointing devices and for sharing information, or rather sending information to different screens.

Figure 3. A student group discussing their design sketches made on the Smart boards

Most of the time the participants worked on one of the two Smart boards for making sketches, (as illustrated in figure 3), or for showing information found at the Internet to each other. While producing a sketch, one of the group members usually stood in front of the Smart board, and the other participants were sitting around the table. The person in charge of drawing the sketches alternated. For instance, one participant would be using the touch functionality of one of the Smart boards, another using the keyboard and mouse working on the same document, and the third using PointRight and iClipboard to insert a piece of text, and together they created a sketch. The transition between individual work and public presentation is often negotiated as illustrated in Excerpt 1.

Excerpt 1. Group 2, session 2. Transition between individual and public [3]

Time 0.12.55	Person	Transcript of interaction	Characteristic of action
1	#3	"We can also put some picture here [in the Notebook]".	Sits down. Looks at the right Smart board
2	#1	"You mean, when we draw the proposals we can do it with the Smart…"	Looks at #3 sitting next to #1.
3	#3	"Mmm, but we can draw now. We have written down some things about what we want. I don't know exactly what we are going to do now."	Looks at the right Smart board.
4	#1	"Mmm… We can do that."	Looks at #3.

In the post-survey, group members said that they had experienced that the work they had performed had been more effective than the group work they usually perform. One of the advantages they stressed was that everyone could check if the person in charge of writing or

[3] The transcriptions below are divided with resemblance to the work of [12]. But in our case "Characteristic of action" describes the actor's action, not the abstraction of the utterances.

drawing did that correctly. Also advantageous was the way the whole group could come to mutual agreements, which is next to impossible when a group works together in front of a desktop. At the same time a woman pointed out that it was frustrating to see another person making mistakes, without being able to change those, since only one person could work at a time. Excerpt 2, gives an example of the dissatisfaction of being the one that "goes public" and exposes ones creations.

Excerpt 2. Group 2. Direct continuation of excerpt 1. The embarrassment of going public with ones drawings.

Time 0.21.05	Person	Transcript of interaction	Characteristic of action
5	#3	"But if one draws something under here [shows with the pointer]. Or to make some more space.	Points with the pointer in the Notebook, on the right Smart board.
6	#4	"Hm…"	Looks at the right Smart board.
7	#3	"Some screens or something or… [refers to the design of the multimedia guide]"	Looks at the Notebook.
8	#4	"Yes. Is anybody good at this, to draw?"	Looks at #3.
9	#3	"I am very bad…"	Works with the Notebook.
10	#5	"So am I."	Looks at a Word document on the left Smart board.
11	#4	"There are others…"	Looks at #3.
12	#1	"On where? There? [points to the right Smart board] It is just to go there and draw with the hand."	Points at the right Smart board.
13	#4	"Yeah, right! If… Is there anybody with some talent of drawing?"	Looks at #3.
14	#5	"We don't care about how the animals looked."	Looks first at #3, then at the left Smart board. Talks simultaneously with #1, line 12.
15	#5	"What are we supposed to draw?"	Looks at #2 and #3. Talks simultaneously with #3, line 13.
16	#2	"Draw pictures of a screen with all the animals, maybe. It is just to make some dots."	Looks at #5.
17	#4	"Someone with some talent of drawing."	Talks at the same time as #2, line 16. Talks to #1.

Here is seems the Smart board is more inhibiting, than supporting, creativity. This seems to have more to do with the embarrassment of making drawings rather than the Smart boards affording something particular. The problem was resolved by ripping pictures from the Internet and by making simple symbols, as squares and circles, signifying animals. This was done using two smart boards in parallel, one for using the Internet and one for using the drawing program. This shows the interdependence of two seemingly independent processes, and the relation of how the workspace layout is supporting creative solutions and creative use of symbols in collaborative activities.

Only one of the groups used the corner space with one of the wall screens. The group used the corner when they wanted to divide the work and search for information on the Internet. The other group did not make use of the corner at all. They said that it would have felt like leaving the group. Both groups used the interactive table. Group 2 used it continuously for searching for information, and for reading documents. They found it annoying though, that they could not flip the view of the computer, since it always gives the person(s) sitting on one of the sides around the table a preferable view. Group 1 on the other

hand used the table at one session for showing and discussing pictures, which worked as an inspiration for their design.

3.3 Roles of the Group Members

An interesting result is that the group members' roles seemed to change. In professional and standard projects there is often a dedicated project leader who is responsible for the project's progress towards the goal. In the pre-test questionnaire we asked the students if they usually when working in groups experienced that the group members take on and fulfil different roles, which they all agreed on. When we asked the same question regarding this particular group work in the follow-up questionnaire everyone but two disagreed[4]. This observation could point to that working in an interactive space can lead to a work process, that is less prone to support only certain people. Expressed differently, the interactive space is an environment where opportunities to come to different expressions are more available and also actualized to a larger extent. This may be the case since much of the work and discussions are made in the open, in front of all team members, which gives all team members an opportunity to contribute. An advantage with the interactive space is that it invites possibilities to work in different ways, and to create documents together. It was obvious when working with the sketches on the Smart boards that some of the participants preferred to do the work at the board directly using the pencils or the fingers for drawing and writing, while others preferred to sit down typing and inserting pictures, or looking for information at the web on one of the computers in the room. Figure 4 shows an example of the different ways of searching for information. This could also be seen as an indication of how the work equalises, and that everyone can contribute in a personally preferred manner.

Figure 4. Group members focusing on different activities

[4] The ones who agreed on the question explained that "the roles rotated [between the group members]", and the other commented the work rather than the roles by stating "I talked, but did not do so much practical".

This kind of work can have many advantages, but one disadvantage in this context is that it is harder to hold on to the project goals. Interactions around new information, new ideas are so creative that the goal and progress of the project is forgotten. New ideas tend to take over the team and inspire them into unforeseen directions.

3.4 Swapping Ideas by the Use of Smart boards

The Smart boards were mainly used in two different ways. The most common way was to present rudimentary sketches, often visual, to other team members. Individual sketches on paper sometimes preceded this. The other way to use the Smart boards was to present web pages from the Internet, in order to discuss the information that was found, design or other issues coupled to the project. In both cases the goal was to make information available to others in order to discuss (which makes it open for re-interpretation and contribution or to dispute the idea). In this way the team gets the "raw" information, rather than some pre-processed summary prepared by another team member. Excerpt 3 shows how the Smart board is used to present an idea. The excerpt is taken from an early part of session 3, where the group still neither has decided upon the design proposal, nor agreed on the concept of the multimedia guide. Before the excerpt below begins the members of the group have discussed what children would like to know, and how deeply they should go in to particular details. While other group members tried to solve some practical things, #1 stands up, and starts to make a sketch of a proposal of a game on the left Smart board. The theme is a competition, "like a boxing game", between animals.

Excerpt 3. Group 2, session 3. Presentation of ideas

Time 0.23.07	Person	Transcript of interaction	Characteristic of action
1	#2	"As one of the games, or…?	Sits down. Looks at #1.
2	#1	"Yes, but you can like this [pointing]… eh, I mean to eat or to be eaten, but you can choose, so you in one way or another, or maybe not like this. But you present the information about them, and then you can… or even if one might go here. But maybe also like this. "	Stands in front of the left Smart board. First looks and points at the sketch, then looks at the group around the table, and finally points at the sketch again.
3	#1	"You might go like this in the forest somewhere. Here you have…"	Opens a new page in the Notebook and starts to visualize how #1 thinks by drawing with the finger.
4	#3	"But if you think we are going to do this in a real way, then we need to know what they sound like, and how they use the body, and knock, and…"	Sits down. Looks at #1 and #5. #3 sits on the opposite side around the table.
5	#1	[Mumbles something inaudible]	Sketches in the Notebook. Nobody pays attention.
6	#5	"It is built upon research [inaudible]..."	Sits down. Looks at #3
7	#1	"Then you can have different animals."	Looks at the Smart board, and start to draw with the finger in the Notebook. Nobody listens.
8	#3	"Watch Jurassic Park [the movie]."	Looks at #5.
9	#1	[Mumbles something about "a cave"]	Sketches first, then turns around and looks at the group.
10	#5	"Mm…"	Looks at #3

As we can see the idea is forming as it is formulated. The team members are partly open to the idea, partly developing the idea but also tend to take the idea to a practical level of implementing it. As the discussion continues, the practicality of implementation becomes more focussed, illustrated in excerpt 4 below.

Excerpt 4. Group 2. Continuation of excerpt 3. Conceptual design crashes with implementation practicalities.

11	#3	"Some animals had such bone plates [shows at her own face], but of course, that were dinosaurs."	Looks at the sketch on the Smart board.
12	#1	"A cave and you can check who lived there, and, or you can also have such, as it was with the fox [?], that you have energy, and you have to eat, and you need to find someone to kill. And then you can have here [pointing at the sketch]. Walk a bit, and maybe there is [paints something in the sketch with the finger]."	Looks at the sketch, gesticulates, looks at the other group members, and finally continues to draw on the sketch.
13	#3	"Can you... How do you randomise things and such in Director, if you're going to do…?"	Looks at #1.
14	#1	"You can randomise things."	Looks at #3.
15	#3	"Can you?"	Looks at #1.
16	#1	"Yes, we did…"	Looks at #3.
17	#3	"Can you randomise any page, I mean any frame?"	Looks at #1.
18	#1	"Hm, we did somewhat... we randomised... we did it with a panda."	Looks at #3.
19	#3	"Hm..."	Looks at #1.
20	#1	"And then it randomised like... and was put... You have like a dictionary with different... and then it has to randomise."	Looks at #3.
21	#3	"Ok, so there is stuff."	Looks at #1.
22	#1	"Yes, in some way."	Looks at #3
23	#2	"But have we decided upon the game now, or? It feels a bit..."	Looks at #1 and #3, and at #1 again.
24	#1	"No, it's just a proposal."	Looks at the group.

The excerpt shows the way it is possible for any of the team members to form an idea or representation. However, at the same time it interrupts the whole team in trying to both listen to the person who thinks it is worthwhile showing something and reading, or at least glancing, through the information. This public presentation of information seems to generate creative discussions within the group. The person being in charge of a sketch has the power to be able to support a personal preferable idea, not supported by the others. This did not happen here, but it is clear that the #1 has a good tool for trying to convince the others, partly by standing in front of the others as having something to say, and partly by drawing at the same time as talking. In line 12, #1, wanted to tell the concept of the game, and did not care about the groups concern being much more practical.

3.5 Physical Space Matters

The following excerpts, excerpt 5-7, will illustrate how the use of the corner area and the main workspace led to creative dialogue. In the second session Group 1 works on sketching

scenarios, making storyboards, and discussing design solutions. They have started to discuss their scientific knowledge about the "Big bang", when oxygen and water were formed, and the first life occurred. After about ten minutes at 1h 21min the woman suggests that they should search for information by their own now, instead of speculating about the theories, and be "a bit effective". They divide the topics between them, and search individually for information. #1 sits in the corner by herself, relatively isolated from the group.

Excerpt 5. Group 1, session 2. Using the backdoor in collaborative work.

Time 1.27.38	Person	Transcript of interaction	Characteristic of action
1	#1	[laughs] "[Inaudible] I found out what we need to have, we need to have this Dynamite Harry[5] when he says 'What a damn bang'".	Sits in the corner and searches for information
2	#2	[laughs and mumbles something inaudible]	Searches information on the right Smart board. Sits with the back towards #1 and looks at the screen.

Only #2 react clearly to #1s idea. It seems like the idea is found funny, but inappropriate, and left without notice except for #2s laughter. The woman who is still sitting in the corner tries once more to present the idea, now referring to Dynamite Harry as the main game character's father. Once again it is mainly #2 who reacts, and once again by laughter. Soon thereafter #3 responds, but not aimed towards #1 but rather towards the others around the interactive table. Now #4 responds.

Excerpt 6. Group 1. Continuation of excerpt 5. Using the backdoor in collaborative work.

Time 1.30.06	Person	Transcript of interaction	Characteristic of action
9	#3	"His father should be Einstein"	Searches information on the laptop.
10	#4	"Why?"	Reads a scientific magazine.
11	#3	"Who else could build a time machine?"	Searches information on the laptop.

The topic of Dynamite Harry fades and is left, and they individually continued to search for information. About 30 minutes later #1 joins the group around the interactive table. The others are discussing sketches that #4 is drawing. They discuss "Big Bang" and some wild ideas in order to make "Big Bang" interactive.

Excerpt 7. Group 1. Continuation of excerpts 5 and 6. Using the backdoor in collaborative work.

Time 2.07.25	Person	Transcript of interaction	Characteristic of action
22	#2	"Yeah, [Big bang] is not such an interactive concept"	Sits down. Looks at #1.
23	#1	"No. And since it didn't have anything to do with any dynamite men, while there were no dynamite men [inaudible]. No, but I kind of mean…"	Sits down. Looks at #2 and #4, back and forth.

[5] Dynamite Harry (*in Swedish:* Dynamit Harry) is a comedy character in Sweden that together with his two partners try to do coups. A typical Harry statement is "What a damn bang!" (*in Swedish:* "Vilken djävla smäll!").

24	#2	"But…"	Looks at #1.
25	#4	"I found the dynamite was pretty funny. I've found the dynamite pretty funny, in fact, personally, I have to say. It was a pretty funny thing. But exactly that… eh… eh… but I just thought if we can get a scenario…" [laughs]	Stands between the interactive table and the left Smart board, and looks at the group members.

Here, #1 rejects her own idea about Dynamite Harry. In the context of the discussion and the seriousness of the subject it may have felt a bit inappropriate. But now #4 is following up on the idea even though he did not respond to it before or in any other way tried to hang on to it since it was first mentioned. The discussions continue about the game, and it slowly moves to sketching the scenario. The final product, the "Spaceflower", has in some ways inherited aspects of the Dynamite Harry character, although transformed to a professor.

One important characteristic of the corner area is to provide with an area where one can be alone and concentrate on an idea that is only loosely dependent on the general work. At the same time, as experienced by the other group, there is a reluctance to sacrifice the possibility to be within the group. Physical space matters when it concerns getting ideas into the discussions immediately, but this does not mean that a great influence cannot be made in the joint group work. This kind of backdoor creativity is interesting as it shows how even peripheral, in a physical sense, team members are contributing to the teams overall creative work.

4. Discussion

Traditionally the concept of creativity has been regarded as a property of an individual mind. One point of departure in this paper was that instead of looking on the concept of creativity in this traditional sense it could be regarded as *"…a set of functional relations distributed across person and context, and through which the person-in-situation appears knowledgeably skilful"* [2, pp. 174]. It is therefore further suggested that an important goal for educators, designers, etc., should be to provide with environments and contexts through which talented and creative interactions can emerge.

Once again we can see that merely providing people with the appropriate technological tools is not enough in trying to reach this goal. Of course, artefacts of various kinds are part of the individual-environment transaction but the context is set by so much more. As exemplified by Barab [2], the experience from acting in particular socio-cultural contexts has natural consequences for being able to predict and understand what is expected in taking part in certain activities. This of course also concerns experience from interacting with and making use of artefacts of various kinds. Thus, the socio-cultural context, the physical space in which the work is carried out, artefacts and the task to be solved are all part of the individual-environment transaction and put natural restrictions on possible actions. With the concept of backdoor creativity we like to move beyond the traditional conception of individual creativity, as well as beyond creative negotiation between peers, to analyze the hap hazardous creativity of semi-structured group collaboration. Backdoor creativity embrace the mundane forms of creativity were we get inspired by almost anything in our surroundings in order to make something new.

The interactive space is relatively unconstrained, and the design task the groups were assigned to is also relatively unconstrained. Although we can see some general pattern of how ideas are processed within the interactive space we will here try to present it in some phases connected to Shneiderman's genex [17]. The first phase included an unaided

discussion between the team members. Ideas were swapped, criticized, negotiated until some general stance of the idea had been agreed upon. The next phase was when the team members worked by themselves. It seems as if this phase was very much based on individual preferences in choosing how to fulfil the idea. We have seen how some individuals sketched by themselves, others collected information through different information carriers, and sometimes peers who discussed the idea in a subgroup. The third phase consisted in interruption of individual, or sub-group, work; this might be seen as a kind of sub phase. It is constituted by that one individual presented the others with some found information more or less related to the first agreed upon idea. Sometimes these kinds of interruptions were presented as jokes. Regardless of whether the interruption was relevant for the task it was presented in a collective manner, either as speech or by sending the information to a public screen. The fourth phase was to present individual work to the group. This phase often started with presenting information on a public screen but then slowly got more unaided and finally became a general discussion. Then the cycle started all over again. The deeper the group got into a design frame the quicker the cycles and also the more focussed the comments. What we would like to see is some form of aid for collecting ideas and putting them up in a goal-tree or mind-map. Today as it is the users have to come up with some kind of idea and representation of how to collect and depict ideas and goals by themselves, some of these ideas have been discussed in Prante et al. [13].

The observations made in the study support the conclusion that the environment as it is designed today allow group members to work and express themselves and contribute to collaborative group work in different ways. We have tried to portray creativity in mundane teamwork where the task is to collaborate and make an innovative product and seen how people make use of each other for support, idea generation and criticism. We have called those practices of collaborative creativity backdoor creativity, as a way to metaphorically talk about creativity as an interactive effort between a group of designers and a peripheral team member. In this study we have seen that even as a peripheral group member, physically located at another place than the rest of the group, it is possible to influence the work. But not only is it still possible to contribute to the design process, this also provides a possibility to work with a stronger focus on own work without being excluded from the joint activity.

Even if the main entrance, in both concrete and metaphorical terms, is used for the elegant guests, the backdoor is much more often used for mundane and everyday situations, but also as an escape exit when one is trapped in ones own mind – just as creativity can be, and often is, a collaborative effort rather than exclusive for exclusive people. A future step to take is to conduct a more focussed and detailed analysis of the data with a focus on particular parts or artefacts in the environment. For instance, the use of the interactive wall displays, and the use of the backdoor, providing a possibility for creative contribution to the collaboration as a whole. Based on results from these analyses, aspects identified having the potential to support or strengthen creative interactions will be focussed and recommendations for system design will be made.

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