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CAPTURING CREATIVITY IN COLLABORATIVE DESIGN PROCESSES

J. U. Pedersen[1] and B. Onarheim[2]

[1]Copenhagen Institute of NeuroCreativity, Copenhagen, Denmark
[2]Management Engineering, Technical University of Denmark, Kongens Lyngby, Denmark

Abstract: This paper is concerned with the question of how we can capture creativity in collaborative design processes consisting of two or more individuals collaborating in the process of producing innovative outputs. Traditionally, methods for detecting creativity are focused on the cognitive and mental processes of the solitary individual. A new framework for studying and capturing creativity, which goes beyond individual cognitive processes by examining the applied creative process of individuals in context, is proposed. We apply a context sensitive framework that embraces the creative collaborative process and present the process in a visual overview with the use of a visual language of symbols. The framework, entitled C3, Capturing Creativity in Context, is presented and subsequently evaluated based on a pilot study utilizing C3. Here it was found that the framework was particularly useful for detecting divergence and convergence, and for backtracking of explored themes in the design process.

Keywords: *Creativity, Design Creativity, Innovation, Creative Process, Design Process, Innovation Process, Methodological framework, Creativity in Context, Visual Thinking*

1. Introduction

The purpose of this paper is to introduce a novel methodological framework that can contribute to the understanding of the social process of creativity. This framework encompasses a way for researching, structuring, and coding rich data, by providing a visual symbolic language that embraces the complexity of real world design creativity processes. While in many cases, creativity is portrayed as the solitary efforts of an individual, it is now more common to recognize great creative accomplishments as involving a combination of thought from two or more individuals through social interaction (Paulus & Nijstad 2003). The proposed framework is built on the fundamental understanding that social collaboration is an integral component of the creative process and that creativity is not purely an isolated cognitive instance.

A major part of creativity research has, since J.P. Guilford's famous 1950 Presidential Address to the American Psychological Association, been dominated by the understanding of creative production as a cognitive activity. The methods for studying the phenomenon of creativity have subsequently been designed to detect elements such as problem-solving abilities, divergent thinking, the way associations are formed, and so forth. As the individual focus implies, methods have been focused on studying individual cognition, which in turn defines an appropriate reference frame to do so. As a result, various forms of interviews, surveys, and creativity tests in rigorous laboratory settings

have so far been the preferred method to study the phenomenon of creativity. As a consequence, research has contributed significantly at the level of the individual. This provides challenges when researching the context outside the individual (John-Steiner 2000), as when separating the individual from the context an understanding of the social aspects and collaborative relations cannot be obtained (Paulus & Nijstad 2003). As much as the controlled laboratory studies have taught us, it is time to expand our understanding of creativity with new ways of approaching the elusive concept of creativity (Hennessey 2003).

The acknowledgement of creativity as something that happens in social contexts has reached great appreciation amongst researchers and practitioners across various domains such as sociology, organisational studies, design, entrepreneurship, innovation etc. (e.g. Amabile 1996a, Ball & Ormerod 2000; Hosking & Hjorth 2004). Attention towards creativity as an extremely efficient element in enhancing the idea generation phase of design and innovation processes, in hopes of creating greater and more profitable innovations, has furthermore been formed (Sawyer 2012). In this context, creativity takes upon a new role, derived from the social process between individuals and not confined to the form of solitary cognition. John-Steiner (2000) argues that generative ideas emerge from joint thinking, significant conversation, and shared struggle to achieve new insights, all of which are activities relying on purely social interactions that require collaboration between individuals. Csikszentmihalyi (1996), amongst many, describes the conception of creativity as a mental activity restricted to 'creative' individuals as being highly misleading. It is not sufficient to only study individuals deemed 'creative' or their novel contributions (Csikszentmihalyi 1996), and the purpose of the hereunder-presented framework is in line with this belief. While there is an evolving consensus to accept creativity as a collaborative effort, we see a number of reasons why the individual perspective on creativity still seems to be the preferred point of departure for creativity research. When studying creativity in a sterile laboratory environment, it is possible to control and delaminate variables, which are interfering with the object being studied. Once we enter the socially constructed sphere where creativity is formed within the interactions between individuals, researchers have to deal with uncontrollable variables such as social norms, culture clashes, chemistry between individuals, conflicts, group dynamics, and so forth (Hennessey 2003). It is undoubtedly difficult to conduct a focused study of creativity in this socially complex world, which contains many uncontrollable variables. This challenges the scholar to focus the study by working within blurred boundaries of concepts and employing operationalized variables.

In response to the conventional understanding of individual creativity, some creativity researchers have made efforts to undertake studies and developed frameworks that will change our perception on how we study the phenomenon of creativity. Ball & Ormerod (2000), proposed a framework for studying the design process with the focus on the interactions between individuals in a non-laboratory setting. Sawyer & DeZutter (2009), proposed a similar framework with the purpose of studying how the cognitive process of creativity was distributed across symbolic social interactions among members in a group. In line with their efforts, we propose an additional framework that can capture creativity in a complex and realistic environment and present the process at a group level instead of an individual level.

2. Towards a new framework - C3: Capturing Creativity in Context

The purpose of the C3 (Capturing Creativity in Context) framework is to detect emerging patterns within a process, with creativity as the key element. The patterns are presented in ways that enable researchers to perform a comparison analysis across one or several processes. The framework builds on existing frameworks for creativity research, but is furthermore offering a visual overview and presentation of occurring events, which can be presented by symbolic language. The framework consists of various techniques of qualitative and quantitative methods.

The design of the C3 framework has been built with inspiration from Amabile (1996a), with her acknowledged approach of conceptualizing and operationalizing creativity in order to study the phenomenon in context. In terms of designing the object of study, the approach of *Cognitive Ethnography* by Ball & Ormerod (2000), and *Distributed Creativity* by Sawyer & DeZutter (2009) has served as the inspirational foundation. Both apply the context sensitive techniques from ethnography

to study the subjects' collaborative process by observing subjects' creative work over time. A context sensitive technique is required in order to grasp the phenomenon of creativity being applied in realistic social settings. In addition, observational studies are useful for capturing richness by allowing complexity to be detected and experienced by the ethnographer when observing subjects. With inspiration from previous approaches, we can observe teams working throughout a process in a realistic setting. *The Interpretive Approach* by Van de Ven & Rogers (1988) has served as foundation for the framework's method of collecting and analyzing data, with their approach of categorizing concepts prior to observations in order to create scope and focus. The design-centered approach of *Visual Thinking* has been added to generate a symbolic language that can provide a visual overview of the collected data. According to Cross (1982), designers use 'coding' in the form of metaphoric appreciation, translating abstraction into concrete objects. The visualization enables designers to connect pieces of information in a consistent structure (Lockwood 2009; Osterwalder & Pigneur 2010). The visualization allows the designer to capture the bigger picture and the relationship between elements through the synthesis of information (Osterwalder & Pigneur 2010). In addition, the symbolic language functions as a shared reference point that helps the researcher to communicate and disseminate the findings.

2.1. Creativity in context

In order to capture creativity in context, the phenomenon has to be studied in a realistic setting that incorporates elements of creative work in a collaborative environment (Sawyer & DeZutter 2009). This is essential when researchers aim to go beyond the traditional laboratory set-up, where individuals undergo creativity tests based on constructed tasks in a predefined setting (Ball & Ormerod 2000). We aim to study the 'pure' form of creativity as it develops in context, where creativity exists and is created through collaborative activites with two or more individuals working on tasks. Instead of constructing a situation where individuals collaborate on a creative task, it is preferable to study a process where creativity naturally occurs. It is acknowledged by several researchers that creativity is an extremely efficient element in the idea generation phase in innovation processes, used to create greater and more profitable innovations (Amabile 1996a; Glynn 1996; Tushman & O'Reiley 1997). As Theresa M. Amabile argues, "*Successful implementation of new programs, new product introductions, or new services depends on a person or a team having a good idea – and developing that idea beyond its initial stage"* (Amabile et al. 1996b p. 1). In this view, creativity is a crucial factor in innovation, through contributing with the creative idea(s). Hence, the context of an innovation process is utilized as a useful setting to study a structured process where we can capture elements of creativity during which individuals are generating novel outputs. When applying the innovation process as a framework for capturing creativity, it additionally allows us to capture various aspects and forms of creative work, when subjects are progressing through the different stages of working and developing an idea.

2.2. Conceptual and operational understanding of creativity

When observing the creative process, a set of theoretical concepts has to be in place for examination. We therefore see a need to conceptualize and operationalize the understanding of creativity in order to recognize the element in the study. Teresa Amabile proposes a conceptualization definition of creativity that will serve as the underlying foundation for understanding the phenomenon: "*A product or response will be judged as creative to the extent that (a) it is both novel and appropriate, useful, correct or valuable response to the task at hand, and (b) the task is heuristic rather than algorithmic"* (Amabile, 1996a, p. 35). Amabile argues that creativity is the production of *novel* ideas that are *appropriate* to the extent that they have the properties required by the task and hence *useful, correct or valuable* to the individuals from the respective domain. She additionally emphasizes that the creative process is not linear with an identified goal (algorithmic), but rather heuristic in the sense that the problem of its discovery is a part of creativity. In this paper the creative process is in focus, but Amabile (1996a) argues that creating an operational definition for the creative process is not yet possible. Instead, researchers have to rely on the outcome/response/product of these creative thought processes, which can be observed, as she acknowledges the creative process to end with an externalization (ibid.). Therefore, in C3 the creative activities, methods, tools and ideation, which lead

to a response, will be used as the applied concepts enveloping the operational process of creativity. When recognizing creative activities as elements of creative production, we will be able to observe when and how the creative production is occurring.

2.3. Observation and analysis

When obtaining systematic observations of an innovation process, and multiple naturally occurring creative processes, over time, an overwhelming amount of data is to be expected. A method for organizing this raw qualitative data is necessary before processual patterns can be deduced. The approach taken here prescribes coding the data in order to detect patterns within the observed processes, thus obtaining rich insights about the subject. To focus the study, Van de Ven and Rogers (1988) operationalize process concepts prior to the observations made. When a change is happening in one of these concepts it will represent an *event.* According to Van de Ven & Rogers (1988), one can define *change* as an empirical observation of *difference* in *time* in one or more *dimensions* of an *entity.* On a practical level, a change in the aforementioned concepts is studied. Their approach perceives process research as a type of data gathering and analysis that seeks to determine time-ordered sequences of a set of events (Van de Ven & Rogers 1988). In this framework the operationalized process concepts are utilized for both conceptualization and for coding and structuring the data afterwards. However, instead of using words, the C3 framework utilizes visual codes for generating a symbolic language.

2.3.1. Data analysis

The creative activities are operationalized and coded into four different categories, depending on the type of actions it is fostering. The four categories are as follows: *brainstorming, evaluation, prototyping,* and *discussion & other.* The activities are chosen as the recognized creative activities of the creative process that we can observe when our subjects are going through their respective processes. These categorise have been chosen as they facilitates behaviour, such as response generation, response validation and externalization, which are acknowledged to take part in the creative process (Amabile 1996a). These codes are used to map the collaborative activities that are occurring in the creative process, but the underlying sub-processes occurring within the activities will not be mapped in the visulazation. To get a general overview of the creative process, we chose the four broad categorise that could still capture distinct creative activities. However, the categories can be divided into more detailed sub-categories depending of the purpose of the study.

Brainstorming: The activity can be identified as brainstorming when participants generate ideas in the presence of others (Smith 2003). In many cases we understand this activity as a *divergent* activity. The objective is to generate novel combinations of ideas or problems, by exposing ideas to the different knowledge and perspectives within the group. It has to be noted that the general view of brainstorming can be done at an individual and group level. With the focus on collaborative creativity the attention is set on the creativity generated at the group level. However, brainstorming sessions utilizing and combining individual and group ideation is acknowledged as a brainstorming activity, as it still contains a group effort.

Evaluation: In creative production, *convergent thinking* serves great importance when evaluating the ideas put forth and thus determining if the idea or problem is appropriate, useful and valuable (Amabile 1996a). Convergent thinking can be seen as the critical thinking stage that follows the divergent thinking stage. Here, the idea is evaluated using various parameters built on a knowledgeable fundament. For different creative work there exists different evaluation criteria relevant to the solution, and there will always be a tension between evaluating what is appropriate and what is original (Sawyer 2012). Many studies reveal that evaluation and revision of ideas contribute to creativity by leading to greater originality and impact (Lonergan et al. 2004), and the ability to accurately judge the creative potential of an idea is essential to being an effective creator.

Prototyping: When identifying the element of prototyping, the activity is recognized as engaging when individuals that are developing their ideas employ physical artefacts. The conceptual understanding of prototypes are here operationalized as limited representations of a design that will allow individuals to interact with it and to explore various aspects of its functionality, usability and

feasibility (Preece 2002). When prototyping, designers can gain insights to the experience of using the design in a realistic setting. A prototype can have many forms ranging from low-fidelity versions such as sketches of ideas, storyboards, description of scenarios, to high-fidelity versions, which have the look, feel, and function that is closer to the final design.

Discussion & other: Where the formerly explained categories are more specifically defined in relation to a single activity, this takes on a broader scope. The category was initially not specified until the first application of the framework was executed, where it became apparent that the participants were performing activities that did not fit the categorization of brainstorming, evaluation and prototyping. The category was developed to capture activities such as informal discussions and role-play, which have a clear impact on the process, but could not be categorized within the other three categories. This category could in future versions be divided into several new categories.

If it was possible to observe a 'result' from one of the specific activities, this result was noted in the middle of the symbol representing the respective activity (see figure 1). A result from an activity is here understood as the output of the activity. The output for a brainstorming session is the number of ideas generated throughout the activity. The output for a prototyping activity is the number of prototypes produced, and the output for an evaluation session is the final amount of ideas and problems that have been evaluated/selected. In order to capture more details about each session, the analyzed topics were coded into *themes* and *sub themes*. This is done in order to detect how broad the scope of the session is. To differentiate whether they were developing ideas or problems, the stroke of the theme was given a colour illustrating the category.

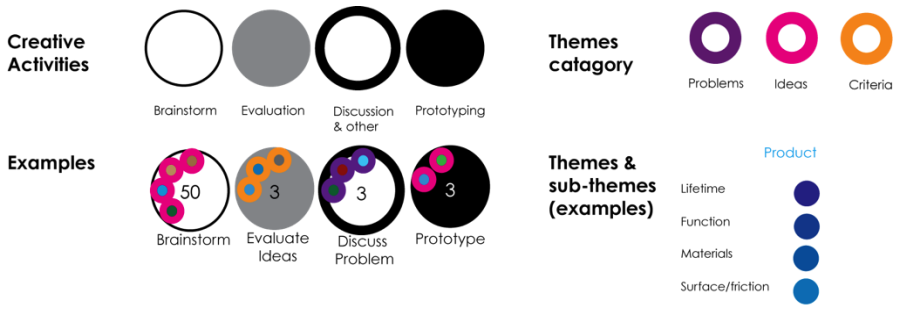

Figure 1. Explanation of creative activities in data analysis

2.4. Advantages and limitations with C3

When developing an experimental framework that challenges the traditional way of studying creativity, there will be both advantageous possibilities for grasping new aspects as well as early-stage disadvantages. As with every other approach of studying creativity, this framework will additionally capture an aspect of creativity and not the phenomenon as a whole.

One of the main advantages with the C3 Framework is its ability to both capture and communicate the complexity of the process being studied, by utilizing a visual and symbolic conceptualization of the operationalized process concepts in different forms and colors. The use of this symbolic language additionally provides a *visual overview* that enables the researcher to detect differences and similarities within or across several processes.

When using this simplifying and conceptualizing framework, the *quantity* and not the *quality of ideas and problems* can be taken into consideration. To use the terminology from Guilford (1968), the framework enables the researcher to capture the collective fluency and the collective flexibility, as the framework detects the number of interpretable ideas produced in response to a stimulus and the number of different themes and sub-themes of ideas produced rather than detecting measures of elaboration and originality relating to the output quality. By condensing ideas into a quantified number and theme, we cannot see all level of detail that has been put into an idea. Moreover, the framework cannot detect how much *time and effort* the subjects spend on developing the idea. As the tool builds on the researchers observation of the collaborative process, the framework furthermore fails to capture the cognitive process. Subsequently, the framework cannot explain if the subjects' interpretation of an idea, problem, or theme changes within the process as they start to work with it further.

3. Application of framework

In order to test the C3 framework an empirical case was used. The case was chosen as the subjects were to go through an innovation process in a realistic setting, where elements of creativity were implemented with methods and activities incorporated into the process. The case was useful for attaining insight to the framework's advantages and limitations.

3.1. Set up

The case study consisted of 40 master students, and the sample population can be seen as rather homogeneous, as most of the participating students were living and studying in Copenhagen and were in the age group of 20-30 years. However, the sample is rather heterogeneous in terms of demographics and age as the students came from very different domains, were speaking different languages, and held different kinds of knowledgeable backgrounds. The students participated in a three-week long program, where they worked in an interdisciplinary group setting. The 40 students were divided into 8 groups consisting of five students with multidisciplinary backgrounds. At the course there were four participating companies challenging these students with their respective innovation challenge. The groups were distributed equally amongst the case companies with two groups working with one case each. In order to attain profound insights, four groups were selected for observation. Group A + B were to solve an innovation challenge proposed by company Y and group C + D, were to solve an innovation challenge proposed by company X. The groups were observed during their three weeks innovation process and the observer took field notes to document the process. In addition, photos and video was utilized to document details for every activity that they performed, to add richness to the field notes. The visual presentation of the study can be found in figure 2.

3.2. Evaluation of C3

Following the pilot test of applying the C3 framework the initial proposed advantages and limitations were as expected. With the visual overview (see figure 2) we were able to identify six different trends across the processes of the four groups, in which we could perform a comparison analysis with the different patterns in each trend. The six trends was categorized as; *Trend 1: Exploring problem*, *Trend 2: Generating problems and ideas*, *Trend 3: Exploring methods*, *Trend 4: Validation of ideas and problems*, *Trend 5: External knowledge input*, and *Trend 6: Developing and externalizing ideas.*

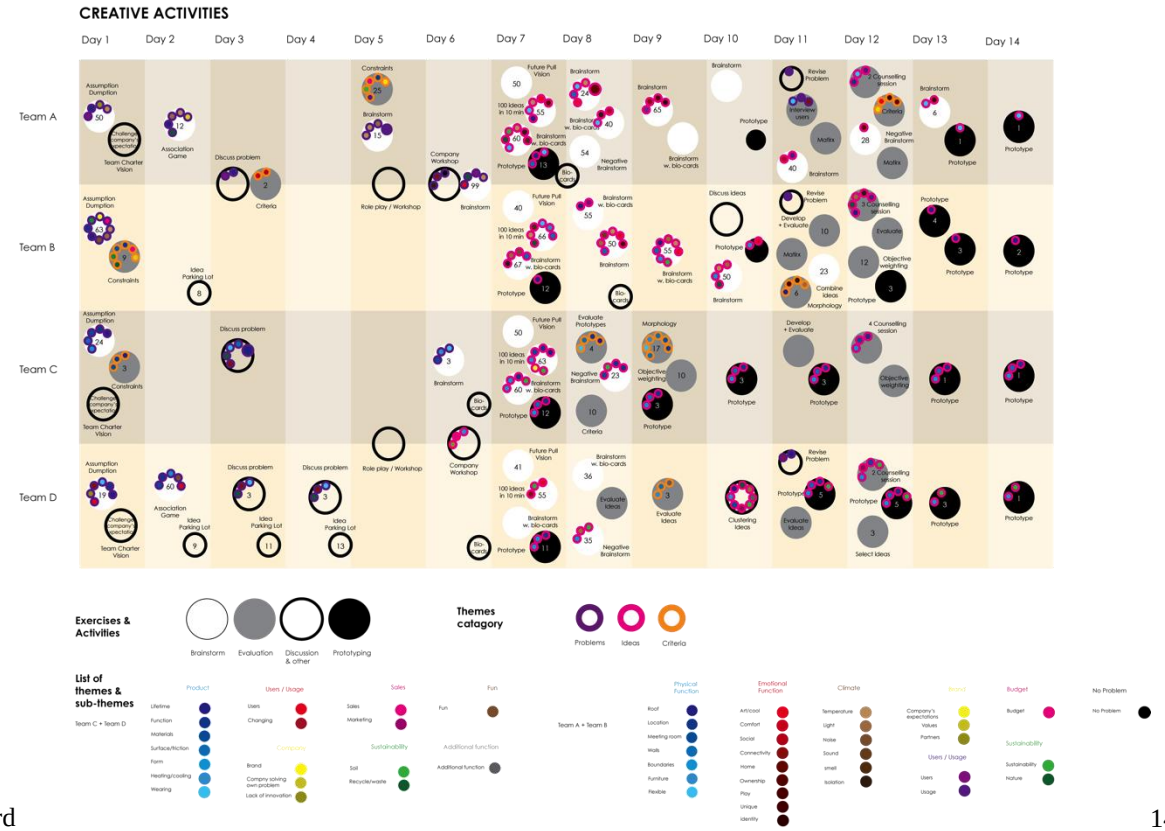

Figure 2. Visual overview of creative activities presented in proposed symbolic language. The full size version of the figure can be found at goo.gl/s587fm

After having coded the process concepts in the symbolic language, patterns quickly became apparent. The symbolic shapes and colours generated a visual representation and structure, showcasing the great amount of variety within the information. It was then possible to use the visual overview as a map or catalogue for our observation notes. If an interesting trend was found in the map, we could go back to the incident or incidents in the field notes to gain richer insights into the patterns within each trend. Once the trend had been formed, we could dive back into our field notes or photo documents if the symbols could not explain the patterns in detail.

When having the visual symbols with the output of generated response from each activity it was possible to detect the flow of divergence and convergence in each of the groups' respective processes. As the framework clarified both the quantity of response and the covered themes from each performed activity, the final overview could provide a picture of the flow of divergence and convergence in a retrospective manner. The framework gave an overview of when and from what specific type of activity the teams were performing divergence or convergence in the process, as the quantity of produced output and explored themes increased as an indication of divergence, or decreased as an indication of convergence. This provided a new insight to our understanding of brainstorming, which we usually view as a divergent activity, as one of the groups performed convergent behaviour in the later stage of their process by utilizing a brainstorming activity.

By having coded the explored themes and sub-themes visually it provided us with the possibility to quickly pinpoint and backtrack where in the process a theme initially was explored. With the visual representation of themes we could go back and consult the fieldnotes in order to comprehend what triggered ideas and problems when exploring a specific theme. In this way we could gain insights on how ideas and problems emerge within themes, and not solely what the final creative product looks like.

As expected the framework had its limitations. It was not possible to detect the quality of ideas and the effort that the groups put into the ideas when analysing the visual representation. However, having coded the themes and the sub-themes it indicated the effort that the groups put into specific areas. In addition, the subjects' interpretation of ideas could not be obtained with the symbolic abstraction. In order to overcome this challenge in future iterations the groups could subsequently go through the visual representation with us, in order to incorporate their perspectives in hindsight.

Additionally, new challenges arose when conducting the study. When observing every activity performed by the groups, a scholar has to be prepared to conduct a time consuming study, as many hours are spent in the field observing, and consequently a great amount of hours spent to organizing the data.

4. Discussion

In this paper we have discussed the need for developing new frameworks that can capture the collaborative process of creativity in a realistic setting, and we have provided our suggestion for such a framework. The C3, Capturing Creativity in Context, framework has been described and tested in order to evaluate the design of the framework. Based on the theoretical conception on the collaborative process of creativity and the presented test of the framework, it is apparent that the framework provides the possibility to visualize the social process of creativity by mapping the activities that the groups undergo when working with creativity. The framework enables capturing creativity in realistic settings as it happens in its natural form. It contributes to the design and creativity research with a new framework for studying creativity, which goes beyond the traditional and constructed lab setting by embracing complexity as it occurs in context. With the use of symbolic language, the framework can visualize the process on a larger scale and patterns within the process can be observed as they emerge. In this way, we could detect how creativity occurs in specific activities and connect this evolvement and reproduction of creativity in the process flow.

With this framework we seek to contribute to the understanding of creativity in social and complex processes, and we believe that further research, in line with our study, is important for continued expansion within this field. The process of design is essentially a collaborative process, and the understanding of the relationship of how creativity evolves in these processes is essential in order to support individuals and teams in creative design processes.

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