
Brainstorming is a Bowl of Spaghetti: An In Depth Study of Collaborative Design Process and Creativity Methods with Experienced Design Practitioners

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Abstract. This article reports the findings of a study which comprised in depth interviews and an exercise using visual aids conducted at Philips research and Technical University Eindhoven in the Netherlands with four designers. The goal of this study was to learn more about how experienced designers interact with creativity tools in collaborative and often multidisciplinary teams in the early brainstorming stages of the design process. Important issues covered in this paper are the role of conversation, cross-disciplinary collaboration, facilitation, the body, planning, reflection and associative thinking as part of the brainstorming process.

Key Words: Conversation, Collaboration, Cross-Disciplinary, Facilitation, Body, Planning, Reflection, Brainstorming, Associative Thinking, Design Methods, Creative Process, Design Process, and Improvisation

1.1 Introduction

This paper reports on a study conducted at Philips research and Technical University Eindhoven in the Netherlands in which in depth interviews followed by an exercise using visual aids was conducted with four designers. One of the aims of this research is to learn about how experienced designers interact with creativity tools in collaborative and often multidisciplinary teams in the early brainstorming stages of the design process; the outcome being a set of descriptors regarding the early conceptual stages of the creativity as well feedback about methods such as sketching, post it notes and mind mapping used by designers at this stage. Important issues discussed in this paper are the role of conversation, cross-

disciplinary collaboration, facilitation, the body, planning, reflection and associative thinking. The data collected from this research will be fed back into the development of a creativity research tool, RePlay, being developed to observe creativity in action and investigate how theatrical improvisation techniques might be used more broadly in an often inter-disciplinary design process.

This paper begins with a brief description of some of the recent research done the area of creativity research. From there section 1.3 will outline the rationale for choosing the RePlay creativity method developed upon Dix's BadIdeas Method (for more info see Dix *et. al* 2006) as a form of action research. Following this, section 1.4 will summarize results from the most recent study conducted. Section 1.5 will focus on highlighting some important feedback which will be used in the development of RePlay. In Summary future directions for this research will also be outlined as well conclusions regarding the outcomes of the study.

1.2 Background: Creativity and Innovation

Creativity Research is a popular area of study in various disciplines from philosophy, psychology, design thinking, generative art, AI (artificial intelligence) and business. Without going into too much detail regarding these disciplines it is perhaps helpful to describe some of the lenses being used by some of the different disciplines to discuss creative process. In terms of theory of mind, early research in the field of psychology focused on the personality of the creative individual. (Sternburg, 2002) More recently there has been more attention in the area of decision making as a part of design activity (Ball,

Christensen, 2009) Along the same trajectory of theory of mind, the field of artificial intelligence (AI) has an interest in modeling the creative process and is less focussed on individual traits as explored by Sternburg (2002) but instead upon the thought processes occurring internally and externally as part of creative process and how they can be modeled by computers (Boden, 2004). A recent project called ‘drawbots’ is a robot that has been programmed to draw based upon influences not only internally but also from the external environment (Bird, Stokes 2006). Another project called AIKON (Tresset, Leymarie, 2007) created controversy in design circles (see Love, 2010) since there was concern as to whether the robot was creating objects which could be qualified as art.

In the area of generative art, creative processes often modeled mathematically are ‘creatively’ programmed as very separate entities from that of the artist’s personality or background. Thus blurring the lines between the creator and the creative product and furthermore, between product and artifact. Net artist Mindaugas Gapševičius has created a project called ‘carpet/?s’ that via the internet allows the client to purchase a personalized carpet made out of ascii (American Standard Code for Information Interchange). The project operates using a php application which mines the internet for unique key words. (Gapševičius, 2006) The project basically simulates the associative process key to creative process in the early stages however in this case all of the associations are being pre-programmed into a system that produces random associations.



Fig 1.1. “carpet/?s” Mindaugas Gapševičius

Due to advances in neuroscience and the use of fMRI technology and PET scans capabilities for locating creative thinking in the mind has become more plausible at least within a neuro- scientific approach and has influenced the ability for computers to model these creative processes such as the example of ‘drawbot’ (see Bird, Stokes 2006). This has also fortuitously meant that the field of philosophy and theory of mind has become enriched with the tangibility of this data as a form of concrete evidence for theories regarding embodiment and the role of the

unconscious in the creative process (Gallager, 2007). A recent study for example linked the process of dopaminergic neurotransmission in the thalamus of the brain and how it plays a role in creative thought and behavior with particular emphasis on divergent thinking and association in the creative process. (De Manzano Ö, *et al.* 2010). Through measuring D2BP in the thalamus and/or higher D2BP in the striatum the associative process was located. The amount of semantic categories created by individuals were measured as well as how much individuals were able to elaborate upon single words. It was shown that a decrease in dopamine D2 in the thalamus and an increase in the striatum is connected to an increase in what the authors call “creative-bias”. The “creative bias” could possibly assist performance on tasks that involve continuous creation and re-combining of mental representations as well as switching between mind-sets. (De Manzano Ö, *et al.* 2010)

In the case of "drawbot" and the ‘carpet/?s’ project creativity has been programmed as an individual event not that of an individual mental processes or even of an interdisciplinary team which is often the case in design process. Researcher Keith Sawyer would argue that in fact all creative outcomes are collaborative by nature just that we may not be conscious of this aspect as part of the process (Sawyer 2007). This concept relates back to theories of embodiment in that our environment may play a larger role than first assumed. Therefore the goal of this research is not just to understand creative process on an individual level but also how this relates to external factors such as environment and group dynamics since collaboration is an important aspect of the design process.

The myth of the lonely creative has been dispelled by notions that novelty is based upon the collaborative nature of creative process and the more diverse the group setting the more novel the outcome will be (Sawyer 2007). Therefore instead of an emphasis upon the individual there has been a stronger emphasis on external environmental influence and creating spaces and tools for facilitating the creative process. With regards to business this has become an important factor in terms of developing products and services in a timely manner while at the same time not risking the loss of knowledge generated as part of the creative process.

Design as a discipline is highly intertwined with industry and for this reason there has been a great deal research done into developing creativity methods for encouraging and devising ways of approaching a design challenge. Design is for the most part cross-

disciplinary either in the nature of the design space being explored, the background of a design team, or the approaches and methods which are used as part of the design process. Tools such as moods boards, sketching and personas as well as many other tools have been devised to assist the workflow of a design team; a team that at times consists not only of designers but stakeholders from various disciplines such as technology, business and engineering. Some of these methods have evolved out of related human-focused disciplines such as sociology or psychology. For example ethnographic methods were borrowed from sociology and anthropology, but have been developed, for example through cultural probes (Gaver, 1999), for use in design; similarly or eye tracking methods originating psychology are used as part of usability research (e.g. Schrammel, 2009).

A number of these methods can be taught, learned or experienced as the designer becomes more conscious and or aware of their design process. It is argued that this explicit reflection on ones actions methods leads to a critical higher level of design (Schön, 1983), echoing the importance of meta-cognitive skills in general (Flavell, 1979).

By necessity collaboration involves some form of external representation of ideas, concepts, and thoughts in order that these may be communicated within a team (Ramduny-Ellis, 2010). However, likewise personal reflection, while possible purely through personal introspection, is often enabled or prompted by external representations or artefacts (Dix, 2008). This focus on external artefacts as an active part of cognition leads naturally to cognitive and philosophical accounts of embodiment (e.g. Gibson, 1979; Gallagher, 2007). This literature usually focuses on the more unreflective interactions with the environment; whereas we are also interested in the way that external artefacts created during interactions can be considered as resources to be considered explicitly and reflectively. In some cases, for example sketches or mind-mapping, an external trace of the activity is naturally persistent, whereas others, such as a vibrant conversation on a topic, the externalization is ephemeral and leaves no natural trace.

1.3 Motivation: Improvisation and RePlay

In an attempt to investigate creative processes an exploratory method RePlay is being developed (Gongora, 2010). RePlay is focused on the creative use of improvisation from the area of theatrical performance. In particular, while improvisation by its nature is ephemeral, RePlay seeks to create

opportunities for reflection by generating video traces, thus deliberately disrupting the normal uses of the technique.

Improvisation was chosen partly because it offers an opportunity to observe a creative process similar to, but different from design – this is as a means to understand and maybe model aspects of creativity in general. However, improvisation also may have the potential to be a useful method in design. So, RePlay is both a form of probe or intervention to study creativity, but also possibly a start point for developing a creativity support tool. Previously research was conducted with a group of improvisation actors in which they worked through the RePlay method and offered suggestions and feedback for its development. Below is an image from a recent pilot study.



Fig 1.2. Initial Exercise with Improvisation actors

In considering tool support for creativity, Shneiderman (2000) proposes four phases of the creative process: collect, relate, create, donate. Of these, RePlay is focused on the 'create' phase, and in particular is related to traditional brainstorming techniques. Thus, in order to investigate the potential role of RePlay in design and design research a study was undertaken of practicing designers.

In summary RePlay is a meta-design method/probe for observing the creative process through an exploratory and descriptive action based research strategy. The term meta-design is used since as a creativity method it functions on a level above the activity of designing and instead seeks to understand the various internal and external forces at work during this type of activity as well as how one can better facilitate the process

1.3.1 RePlay as an Embodied Design Process

However how does RePlay fit within a larger framework of design process? Unfortunately like most

creative processes the design process does not follow a linear route yet instead dives into out of various mental models. Like a bowl of spaghetti, it has no definite end and no definite beginning. However through the process of association and collaboration we begin to connect the strands as we coil concepts around a fork. As we connect the strands the bowl begins to become a steady stream. Design being a creative activity works in the same way. Hence the term wicked problems (Cross 2006, Cross *et. al* 1996) whereby a designer creates associations through defining the problem space. Often times exploring various solutions. However as this occurs the problem space expands and you notice all the strands of spaghetti in the bowl. During design activity this can make the problem seem infinite in scope and offering various possibilities for a solution. At some point however decisions must be made at least until the wicked problem is taken up once more.

1.4 The Study – Design Activity

In order to understand better the potential role of improvisation and the RePlay method as a probe, a set of interviews followed by a study was conducted at Philips Design research in Eindhoven and Technical University Eindhoven with four volunteers three of which from Philips Research and one for TU/e. At Philips design research is conducted by a specific department and results are later presented to other members of the design team. Three of the four participants interviewed were from this department all of which having worked as professional designers. We shall refer to the participants as Beth, Antonella, Luis, and Divo. The study was conducted in two stages, a traditional exploratory interview to uncover methods and activities done as part of a design process followed by an exercise deliberately meant to disturb and provoke the interviewees to reflect upon these activities.

1.4.1 Interviews – What Happens in Design

The individuals interviewed reflected upon methods they used as part of their design process in particular the brainstorming phase. Important themes which came across were the importance that conversation, role play, gesture, conversation and associative thinking was to early stage brainstorming process.

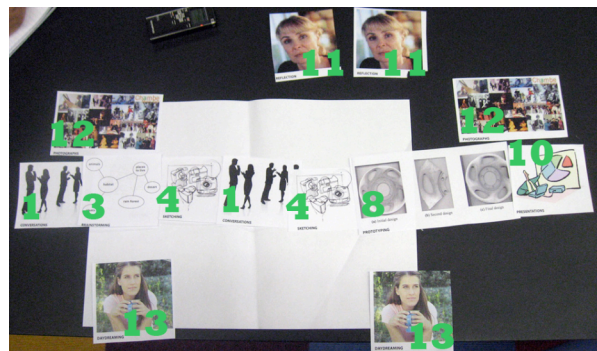
1.4.2 Reflection – What is Important to Design

In the second half of the study participants worked with a set of images which represented particular activities to try and visualize their design process. The facilitator then removed different activities from the process and asked them to predict how this might affect the final outcome. Later each individual was asked to group the methods under larger categories with a view to identify phases in

the process when they used certain tools more than others. During the first part of this phase the images were removed until the designer expressed that it would not possible to work without the removed activities. Figure 1.3 (a) shows one of the visualizations produced by a participant and Figure 1.3 (b) shows what as left as well as the outcome after removing images from the visualization. This progressive removal of images is acting as a form of breaching experiment (Garfinkel, 1966) or deliberate estrangement strategy (Dix, 2010): that is by disrupting the designers ordered view of their world forcing a level of reflection on their own general design processes.



(a). Initial Exercise Luis's results



(b) Second part of exercise Luis's Results

Fig 1.4. Sorting images during reflection phase: *1- conversation, *2- projecting, *3-brainstorming, *4-sketching, *5- moodboards, *6-storyboards, *7 role-play, *8-prototyping, *9- focus groups, *10- presentations, *11-reflection, *12- photographs, and *13- day-dreaming, *14- user insights

1.5 Results

1.5.1 Brainstorming

In the first part of the study the interview questions were focused on early brainstorming in the conceptual phase as this is where the RePlay method will be

utilized, and it was important to find out as much as possible about collaborative brainstorming. Brainstorming is characterized by divergent thinking and then later convergent thinking that creates categories and themes for ideas. However, while the overall goals of the phase are common, the methods and tools adopted in this phase vary greatly. Many of which were not surprising: conversation, mind mapping, and the use of post-it notes and white boards. During their initial interviews both Beth and Luis described sketching as in an important part of their design process. This is to be expected in a design setting. However, most interesting was the way this was used as a form of visual brainstorming in which the team drew on top of each other's sketches in order to communicate concepts to each other.

When describing the brainstorming process, the Philips employees indicated different types of contexts where brainstorming was more open-ended and thematic versus other brainstorming contexts based upon a design brief. One of the interviewees suggested that in the open ended thematic brainstorming she felt more freedom to explore her ideas and found the creative process more enjoyable. However one participant commented that the danger of thematic brainstorming is not knowing how to later on facilitate these sometimes novel ideas into projects.

1.5.2 Facilitation

This observation of the role of the facilitator arose repeatedly:

L: Yea it's the most important thing for me is there should be on person who is overlooking the process and looking from a place in terms of orchestrate the process because some of the people in the group they need to loose themselves in order to be productive

However this facilitation process has to maintain a delicate balance since as facilitator one needs to be a guide and not a director of the outcome. Later in the interview this point of view came across through Luis making an analogy between designers being like cats.

L: I really like this expression that designers are like cats

L: they are if they had to be animal they would be cats and managing them is like herding cats and cats have there own space there own way of doing things there own way of playing and so they need that space they need that – but they also like to play with each other. But if you try to put some sort of ring they will start to be...

Therefore there seems to be a catch to the whole process in that as a facilitator one should not be prescriptive with a method such as sketching. However the facilitator can have the knowledge and experience to understand which method to utilize in the process in order to push the process in a particular direction or make the team more aware of their own processes. Luis also suggested that the approach of staying fluid and open and not very structured as this could limit the process. In the case of the RePlay pilot study this was also the case since the Improvisation actors struggled when rules were imposed upon the process. For example when a technique called expand and advance (Gongora, 2010) was used it blocked the flow of the scene. Facilitation is a very delicate balance between guiding a process and directing it.

1.5.3 Planning

Another surprising theme that came across in the interview process was the importance of planning as was to the overall design process. Note that by 'planning' the participants meant the initial gathering of background materials for insight, that is preparation for creative design, not project planning as such. They believed that without gathering this initial background information beforehand subsequent brainstorming would be useless. This ties into the workflow described by the Philips employees in which they stated the importance of working with user insights and this also related to act of scanning the terrain to get a first glimpse of the design space through picture taking, collecting data and conducting best practices research. User insights are a summary of research collected about a target group this can involve the use of cultural probes, diaries, interviews and personas. This data is later referred back to the target group to check for accuracy and relevance. At Philips Research this planning phase usually takes about three months beforehand of collecting "user insights" which later gets fed back from the target user and later presented as part of the brainstorming process. Philips is committed to a participatory design approach in which user insights are incorporated as part of the design process in the early stages. The other non-Philips interviewee also suggested that personas be used similar to the user insights conducted by Philips Research. In the second half of the interview process every participant agreed that planning could not be eliminated from the design process without causing a detriment to the overall project. Below are images taken (Fig 1.5, 1.6, 1.7) from the second half of the study in which three out of four of the participants stated that without planning as part of the design

process they would be unable to come up with a product or service. One said he could do planning through conversation instead see previous Fig 1.4.

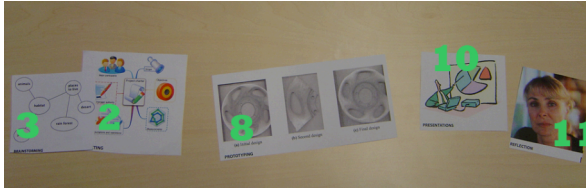


Fig 1.5 Second part of study Divo's results



Fig 1.6 Second part of study Antonella's results



Fig 1.7 Second part Beth's results

1.5.4 Social Dynamic and Divide

When asked to delve into the nature of the creative process all of those interviewed agreed that diversity in disciplines and background was good however that it was important the group have trust and a good social dynamic. One of the interviewees described the process as becoming more “colorful” when there was a history amongst the members of the group. One or two of the designers mentioned that sometimes the engineers due to their educational background may not value as much the brainstorming process and that at Philips it was a struggle to communicate user insights across teams for example marketing and engineering. This could be due to that designers are more focused on the problem space whereas engineers are more solution oriented and focused on technology and requirements.

In terms of RePlay this situation presents an ideal context for its use as it provides an opportunity to

create a shared experience which puts all of those involved in unfamiliar waters through the use of body and incorporation of theatrical techniques. By creating an environment that invokes body language this engages the team in another level of communication besides that of conversation. For example Beth mentioned how in the brainstorming process language worked as a trigger in terms of perception and how one may have a different reading Sawyer refers to this as indexical conversation (2003). Could it be that the body storming of participants may have the same affect of triggering each other's creative process?

B: ye that's the point of collaboration or teamwork. You will talk about something and that will just trigger something else which I won't be able to do by myself.

B: It works for me because I need reflection- then the idea comes up more easily or it will just work. I might need that trigger to be more creative in some cases.

1.5.5 Role Play and Gesture

Since one of the aims of this research is to explore the use of role-play and the more generally the body in the design process. It is important to mention that the majority of those interviewed did not use role-play however none of them were adverse to the proposal of trying out a kind of enacted brainstorming. However in the second part of the mapping exercise with images, only one of the participants included brainstorming as part of their process. However Gesture seemed to be an important part of the creative process with some of interviewees expressing that if they are not feeling self-conscious that they tend to gesture more as part of their creative process.

L: I use it a lot but I need to forget myself or be really involved in what I am talking about sometimes my friends commenting that I have Kermit gestures. But I need to be really involved and forget how it is that I look. I mean this is also the same situation where I need to be comfortable.

Even though the participants may not be practicing formal role-play they may actually be doing a kind of role play in conversation although perhaps not being consciously aware that they are doing this. One of the interviewees suggested that he gestures very little however throughout the interview he was one of the participants who gestured the most which perhaps relates to an early commentary about being not being conscious of one's gestures.

1.5.6 Reflection

Similar to planning the affect of reflection was also surprising in how much it went unaccounted for as well as the confusion surrounding reflection as an activity and whether it was part of the design process. Everyone stated that doing reflection was an important activity throughout the process with one researcher mentioning that she did not do enough reflection and would like to have done more. Luis remarked having done reflection throughout the process as something which was embedded. Divo stated having done this at different points staggered throughout using it as a tool to inform what was working and not working. Beth used illustrator in as well to organize and reflect upon her process. Therefore reflection can be characterized as reflecting in action as in while doing design activity, reflecting upon a process or reflection as a form of daydreaming.

1.7 Conclusion

These were highly individual processes' and the most consistent themes were some kind of planning, scanning of the problem space, brainstorming and presentation with different strategies of reflection throughout. As shown in Fig 1.8 the designers often moved between these phases. How each interviewee went about collecting data however was unique even though some had a common prescribed workflow they had to follow. Some were more visual and others more conversational. For the most part the role of environment and physical attributes seemed to play little if any role in the design process- at least not consciously. In fact with only one of the interviewees indicating that he was inspired by his immediate environment. For the most part the researchers found their work environment to be of little inspiration to their process.

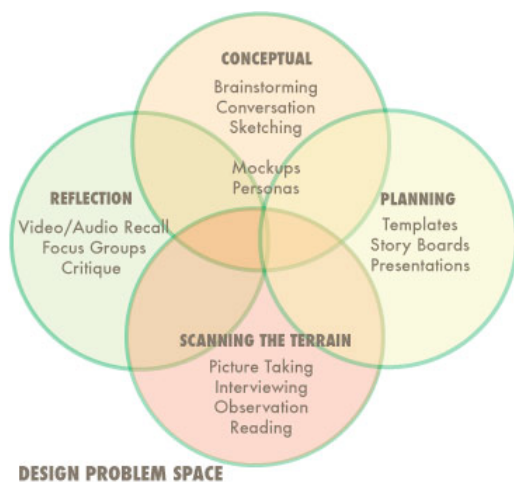


Fig 1.8 Summary of fields of design and examples of activities which inter-relate throughout the process.

Future research will explore whether asking designers to interact more with their external surrounding pushes them to bring this type of physicality into the design process. In which case by triggering designers to draw on their own tacit knowledge this can then work as a trigger for the creative process since it sparks the other's embodied knowledge.

When asked about methods utilized in the design process the responses were self-conscious whereas as when they did the more reflective part of the exercise the visual aids worked as a distraction and made the process more informal and authentic. The designers then were able to reflect more on their creative process by having to map it out and discuss which steps were missing or ask for clarification, some of the time even responding emotionally to the prompts. Overall everyone mentioned sketching as the primary method of communicating an idea. However one should never underestimate the importance of the facilitator as someone with a bird's eye view of the process and an understanding of the overarching goals and how to steer the process into particular directions as a guide not a director of creativity.

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