CAN VISUAL FACILITATION BEAT VERBAL FACILITATION?

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Abstract

This paper analyzes the effect of visual and verbal facilitation in an interdisciplinary design setting. The depending variables were (the process of gaining) cross and shared understanding in the group, the outcome variable was design creativity. Based on literature research and a field study, a visual facilitation protocol materialized as a set of rules has been developed which guides a facilitator. The protocol has been tested by conducting twenty between-group experiments with (non-design) Master students following visual and verbal facilitation. In the visual facilitation condition, the groups were guided by means of sketching and in the verbal condition the groups were guided verbally. The results show significantly higher shared understanding when working with the visual facilitation protocol. However, visual facilitation resulted in lower creativity—in particular, novelty. These findings suggest that visual facilitation might be an effective method for constructing shared understanding during interdisciplinary design collaboration, but at the same time the high level of sharedness between team members negatively relates to design creativity.

Keywords: Creativity, Sketching, Collaborative design, Design process

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1 INTRODUCTION

Designers increasingly work in collaborative settings and act with stakeholders from other disciplines (non-designers). Thus, designing is a social process which can take various kinds of communication and coordination activities (Bucciarelli, 1988; Smulders ey al., 2008; Smulders and Subrahmanian, 2010) in order to fulfill the different functions of the design team; one specific kind of a collaborative design setting are interdisciplinary creative sessions where the team represents multiple disciplines with the aim to generate new ideas. The sessions are guided by a facilitator with special emphasis on designerly methods such as sketching, brain mapping and customer journey mapping. Due to the multidisciplinarity, there is a variety of expertise and perspectives in the team, however, as most of these stakeholders are non-designers, each actor has his/ her own mental model, and own object world (Bucciarelli, 1988) which includes own models and methods (sketches, charts, etc.). The own object world comprises also the specific language; research has shown that design language is often jargon-laden and difficult to understand for non-designers (Kleinsmann et al., 2007). If design language brings difficulties for the common understanding in the team, then the creation of a shared understanding will become difficult. However, a certain extent of shared understanding in a team is important, as it influences the design process and the outcome (Valkenburg and Dorst, 1998; Valkenburg, 2000; Dong, 2005; Song et al., 2003).
A common and instrumental design activity for articulating individual mental models is sketching. Designers use sketching to generate ideas in the early phases of the design process but also to communicate ideas to each other and to stakeholders such as clients explaining their ideas. Thus, sketches are often the "highway" to create a shared understanding in a collaborative design setting. However, there is little research done on sketching as continuous drawing activity in a collaborative setting with non-designers. This paper is about a study which aims to clarify the role of sketching within interdisciplinary creative sessions.

2 LITERATURE REVIEW

2.1 Collaborative design

One specific kind of collaborative design are interdisciplinary creative sessions. These interdisciplinary creative sessions typically aim at generating new ideas or innovations in a short period of time, involving stakeholders from different disciplines who are mainly non-designers). Each actor is representing the company he/she is part of, which brings different perspectives and interests to the project.
These situations obviously need to be coordinated or at least facilitated to reach a common ground and support the exchange of "mutual knowledge, mutual beliefs and mutual assumptions" (Clark and Brennan, 1991). This common ground, or shared understanding, has influence on the design process and outcome (Kleinsmann and Valkenburg, 2008). A lack of shared understanding could delay the design process (Valkenburg, 1998).
Huber and Lewis (2004) argue that cross understanding has to come before shared understanding, can be reached. The authors define cross understanding as the extent to which team members have an understanding of each other's mental model. Cross understanding is seen as a prerequisite of shared understanding, as participants first need to learn and understand the mental model of other participants before (partly) integration of these mental models can take place. Learning about each other's mental model happens for example with demographic cues, information which usually is provided early in the process (e.g., introductory round) and repeated interaction (Huber and Lewis, 2004). The base level of cross understanding of the team members influences the further growth of cross (and thus also, shared) understanding.
A sketch is able to function as an externalized mental model because of its similarities with mental models. A sketch is able to represent both implicit and (indexes to) explicit knowledge (Henderson, 1991), which is the same for mental models. They are both dynamic and change over time; a mental model changes with new experiences, while a sketch changes till a final drawing is reached. A mental model is a simplified (internal) representation of reality, which also applies for sketches (Tversky, 2002), although external. Both are repositories, full of references and (visual) clues. Because a sketch allows collaboration with multiple actors, it can be seen as an externalized mental model with an invitation to be shared.

2.2 Mental models

Mental models are defined as "internal representations that humans build about the world around them" (Badke-Schaub et al., 2007). These internal representations are simplified models, based on cognitive processes. Mental models not only consist of knowledge but are also "activity repositories that enable the owners to act and react effectively on what is happening in their environment" (Smulders, 2007). Mental models are constructed throughout the years of a lifetime, and become ingrained with knowledge, beliefs and assumptions from experiences, education, work etc. Mental models are dynamic and evolve over time by new experiences.

Because mental models are deeply rooted structures within humans, a mental model consists not only of explicit, but also of implicit knowledge (Smulders, 2007). Implicit knowledge is referred to as tacit and thus not accessible knowledge, while explicit knowledge is more accessible. Explicit knowledge is able to be codified and communicated to others.

Mental models play an important role in team communication (Klimoski and Mohammed, 1994). Smulders (2007) illustrates the differences in mental models between creative and operational teams. Besides the differences in knowledge, creative teams have a more explorative approach while operational teams tend to be exploitative. If both teams would come together in a creative session a clear difference in approach would be visible. Each actor will think and act according to his/her own mental model, which could go against the beliefs of the other actor. The consequence would be unnecessary iterations, or even conflicts could occur and impede an efficient design process.

To develop a shared understanding different mental models need synchronization (Smulders et al., 2008).

2.3 Collaborative design and sketching

Sketches are useful to sell ideas to clients or to communicate ideas to other domains (Pipes, 2007). Henderson (1991) argues that sketches are not representing tacit knowledge, but rather provides indexes to larger stocks of tacit knowledge. It is this information which could be useful in a collaborative design setting as it tries to make implicit knowledge explicit. Sketches are tangible design artifacts actors may interact with by using gestures. Sketches are often visualizations combined with textual annotations. These semantics may help non-designers in understanding the sketch.

Sketching is a continuous drawing activity throughout a design task, where detailing, explaining and transferring activities support to make the ideas more transferrable to a design team (Ariff et al., 2012). This can be done either solitary or within a group. These drawing activities are different for each stage of the design process, where it is more unstructured and ambiguous in the early phases of the process (Purcell and Gero, 1998). Not only the drawing activity, but also verbal communication is important, as language seems necessary to transfer details to others (Ariff et al., 2012).

Goldschmidt (1991) defines the drawing activity as a dialogue of design reasoning as sketches are not only mental representations an individual has but are visual displays full of visual clues. However, she also mentions that the search for visual clues may only be for designers and not necessarily for non-designers, who tend to externalize images from the mind. Designers also sketch to lower the cognitive load by externalization (Purcell and Gero, 1998).

2.4 Collaborative sketching

In 1988 Bucciarelli mentioned sketching as a solitary activity. In 2002 Bucciarelli extended his view on the object of sketching and describe sketching in a collective setting as boundary object. This difference in statements shows the transitions throughout the years of sketching as a solitary activity to a collaborative, social, activity. Literature that looked into the collaborative aspect of sketching, Heiser et al. (2004) and Neumann et al. (2009), explored sketching in a collaborative setting. Heiser et al. (2004) mentions positive aspects related to collaborative sketching, such as a shared task focus, a joint product and interacting with the sketch by using gestures to convey spatial temporal information. However, little research has been done on collaborative interdisciplinary sketching. The design setting in most research on collaborative sketching lies on multiple designers sketching on one common sketch. For this research, collaborative sketching is not necessarily seen as sketching with one common sketch, but with multiple actors sketching together. This could be individual sketches or common sketches; the focus lies on multiple actors sketching their ideas to communicate it to other actors during an interdisciplinary creative session.

In this study the focus is on two research questions:

1. In how far can the development of shared and cross understanding be supported by verbal or visual facilitation?
2. In how far will verbal and visual facilitation influence the creativity and feasibility of a product?

3 RESEARCH STUDY

The research study comprises two studies, the first study is the field study which was used to develop a more standardized protocol for creative sessions in interdisciplinary sessions. The second study refers to the experimental study where the intervention has been applied and proven with students.

3.1 Field studies

Three field studies, see Table 1, have been observed and evaluated. These were conducted at three different consultancies which led to differences in amount of sessions, time per session, number of participants and/or facilitators but allowed for more diverse insights.

Table 1. Overview of field studies

No.	Amount of sessions	Time per session	Participants per session	Facilitators per session
1	3	6 hours	6	1
2	1	2 hours	15	2
3	2	1,5 hours	10	4

These three field studies led to a list of most important observations. These observations will function as a base for developing a sketch-focused facilitation protocol **system**. This protocol provides guidelines to a facilitator for utilizing sketching in order to enhance the development of shared understanding.

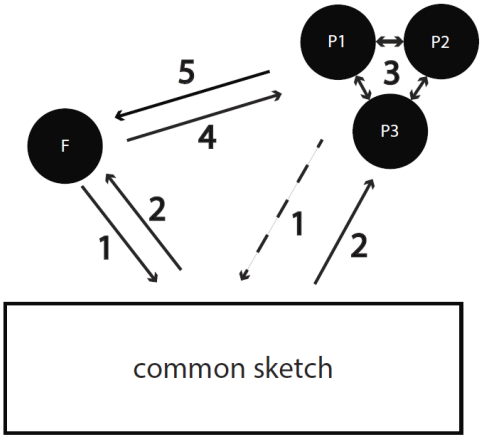

Figure 1. Visual facilitation protocol. F=facilitator, P=participants

The arrows in Figure 1 represent interaction and communication between participants, facilitator and the common sketch. The numbers in Figure 1 are explained below, where the dotted arrow (1) is of importance as it indicates the facilitator taking the lead in the sketching actions.

1. Sketching actions (external representation of design content)

The facilitator constructs and adapts the common sketch, based on his interpretations of the communication with the participants. Participants are allowed to make revisions to the sketch.

2. Reflection

The participants and the facilitator consider the common sketch on a meta-level.

3. Design content construction

The participants develop design content by communicating with each other about the design task, and reflect on the common sketch.

4. Verification and stimulation

The facilitator asks questions in order to adapt the common sketch to the mental model of the participants.

5. Extract and comprehend design information

The facilitator comprehends the design content developed by the participants as they communicate with each other.

3.2 Experimental study

3.2.1 Participants

Forty people participated in the experiment with an age ranging from 22 to 34, 65% of them were male. To simulate both a non-design background and interdisciplinarity, participants were recruited from different non-design faculties of Delft University of Technology and placed in two-person interdisciplinary teams. All participants were master students, 20 (50%) students from faculty of Applied Sciences, 19 (47,5%) from the faculty of Technology, Policy and Management and 1 (2,5%) from Medicine.

One facilitator was recruited for guiding the participants through all creative sessions. The facilitator was a 25-year-old male master's student at Delft University of Technology in the school of Industrial Design Engineering. He had received formal training in drawing and had experience as a freelance design drawer at a visualization company.

3.2.2 Experimental Design

The study had a single independent variable in a between-group design with 2 conditions; visual facilitation (A) vs. verbal facilitation (B). Participants were assigned to 20 teams of two members; each team consisted of a mix of disciplines. Each team responded to a self-explanatory design brief in 60 minutes. In the first condition the facilitator followed a visual facilitation protocol which required the facilitator to create a common sketch as a boundary object, while the latter condition relied on the facilitator verbally stimulating participants to create the common sketch themselves. Figure 2 shows this clear difference between conditions, mostly by arrow 1 which is represented as a dotted line in condition A (facilitator sketch) while the arrow is a straight line in condition B (participants sketch). In both conditions one common sketch was used for consistency.

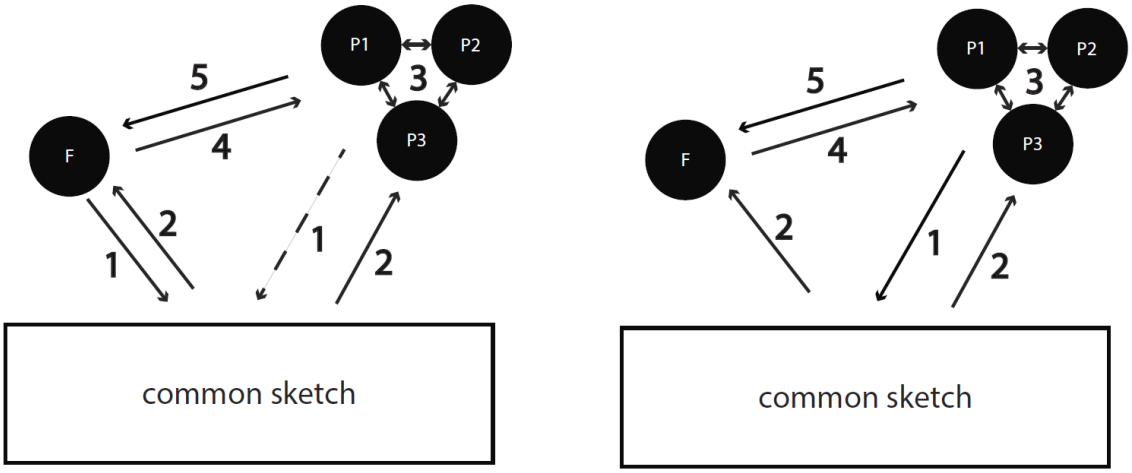

Figure 2. Left: Visual facilitation (A), Right: Verbal facilitation (B)

The dependent variables are cross- and shared understanding, novelty and feasibility of the design outcome.

3.2.3 Measurement of dependent variables

A self-assessment questionnaire which measures cross- and shared understanding was used (Eris et al., working paper), in total 22 questions were asked to rate on a 7-point Likert scale. In order to investigate the influence of the independent variable during the design process the self-assessment questionnaire was administered twice; after exploring the design problem (20 min., A in Table 2) and at the end of the session (60 min., B in Table 2). In contrast with the first questionnaire, the second questionnaire included an open question to explain the final solution in 250 words. A fixed team of two design researchers within the faculty of Industrial Design Engineering at Delft, University of Technology were used as

experts to individually evaluate similarity between written solution descriptions and rated the design outcome on novelty and feasibility. Concept evaluation mapping, based on Shah, Vargas-Hernandez and Smith (2003) has been used as an additional method rating novelty of design outcome between groups. An inter-rater reliability test, Cronbach's α, is conducted for the experts' rating and indicate a low agreement between experts. The evaluations are highly dependent on the level of experience and knowledge the experts have regarding (product) novelty and feasibility. Expert 2, in contrast to expert 1, had a design engineering background with novelty scores for both measurements having a similar p-value (.067 and .059) in the same direction, which led to excluding the ratings from expert 1 from the analysis.

4 ANALYSIS AND RESULTS

There are two classes of depending variables which should be answering the two research questions; the first question relates to the design process and the influence of visual or verbal facilitation on the amount of cross- and shared understanding (see Section 4.1). The second research question referred to the influence of verbal and visual facilitation on the outcome in terms creativity and feasibility of the generated solutions (see Section 4.2). All results are presented in Table 4.

4.1 Cross understanding and shared understanding

Participants exposed to visual facilitation reported no changes in cross understanding after the intervention, while participants exposed to verbal facilitation reported a significant increase in cross understanding. A significantly higher shared understanding was reported by participants exposed to visual facilitation, as well as a significantly higher increase of shared understanding during the experiment. Participants perceived a significant increase in cross understanding when they were asked to sketch. In contrast, participants perceived a significant increase in shared understanding during visual facilitation. As cross understanding is seen as a prerequisite for developing shared understanding, this might indicate that the participants exposed to verbal facilitation were still in the phase of developing cross understanding, possibly because inaccurate perceptions on participant's mental models needed more time to be refined (Huber and Lewis, 2004). The results are presented in Table 2.

Table 2. The impact of visual and verbal facilitation on cross- and shared understanding, Mean (M), Standard Deviation (SD)

	Visual facilitation	**Verbal facilitation**
A. Cross understanding after 20 min.	5.01 (.89)	4.64 (1.19)
B. Cross understanding after 60 min.	5.05 (.94)	5.19 (1.07)
Significance	.83	.00
	n.s.	p>0.1
A. Shared understanding after 20 min.	5.95 (.59)	5.69 (.57)
B. Shared understanding after 60 min.	6.36 (.65)	5.82 (1.20)
Significance	.00	.25
	p>0.1	n.s.

4.2 Novelty and feasibility of design solutions

The novelty of design solutions is rated higher when generated during verbal facilitation, but as p-values are close to .06 they could be taken as very cautious interpretations. The feasibility of design solutions are rated significantly higher when generated during visual facilitation than verbal facilitation. The results are presented in Table 3.

Table 3. Novelty and feasibility in the condition of visual and verbal facilitation, Mean (M), Standard Deviation (SD)

	Visual facilitation	**Verbal facilitation**	**Sig. (one-tailed)**
Novelty rating expert 2	2.80 (0.33)	3.60 (0.31)	.07
Novelty concept evaluation mapping	16.90 (7.42)	23.90 (11.20)	.06
Feasibility rating expert 2	4.50 (0.24)	4.15 (0f.41)	.01

Even though the visual facilitation creates a better shared understanding among the participants, the generated design solutions were not more novel, a result which has been shown also by Neumann et al. (2009).
A possible reason for more novel design solutions when exposed to verbal facilitation could be caused by the lack of ambiguity in sketches generated by the facilitator during visual facilitation. The visual facilitation protocol asks the facilitator to generate visualizations which matches the participant's mental model as close as possible in order to visualize an external shared mental model. However, sketches should still be ambiguous, to a certain degree, as ambiguity facilitates creativity by enabling reinterpretation (Stacey and Eckert, 2003, p.153). Another possibility why design solutions were rated more novel in the verbal facilitation setting might be the lack of direct interaction with the common sketch during visual facilitation. Goldschmidt (2003) makes a distinction between ready-made sketches and self-generated sketches. The latter often holds tacit knowledge, biases and preferences from the sketcher (Goldschmidt, 2003). Although a non-designer is not trained in interpreting a sketch as a designer or architect, interpreting self-generated sketches for information is inherent and already happens at a young age (Goldschmidt, 2003). Therefore, interpreting self-generated sketches (in the verbal facilitation condition) compared to interpreting sketches which are not self-generated (in the visual facilitation condition) might explain the lower creativity of design solutions under the condition of visual facilitation.

Table 4. The impact of visual and verbal facilitation on dependent variables

	Visual facilitation	**Verbal facilitation**
Process		
Cross understanding	Yes	Yes
Shared understanding	Yes	No
Output		
Creativity (novelty)		More novel design solutions
Feasibility	More feasible design solutions	

The cycle of interpreting and visualizing the facilitator undergoes during visual facilitation might explain the more feasible design solutions. It is in this cycle that parts of design information are sensitive to reframing by the facilitator in something implementable (feasible) in order to make it easy to understand to participants.

5 CONCLUSIONS

In relation to the theme of the ICED 2017 conference "Resource-Sensitive Design", this paper aims to stress the relevance of optimal use of human resources in design practice. It is not only a matter of getting all different stakeholders in the same direction during a creative session, but also optimizing the outcome which are the generated (design) solutions. The study shows that sketches are able to become boundary objects in interdisciplinary creative sessions. Participants in the visual facilitation condition were faster in the construction of cross understanding which resulted in a significant higher self-reported shared understanding.
The evaluation of the generated solutions show that novelty was higher rated for the condition of verbal facilitation instead of visual facilitation. Possible reasons for a lower novelty of generated solutions when exposed to visual facilitation could be lower sketch ambiguity and lack of interaction with the sketch. Taking these data to the next application level we can assume the following connection: verbal facilitation leads to more sharing during solution development, what might be a result of more question asking and listening to each other due to the high ambiguity of the sketch.
The design solutions were rated more feasible when generated in the visual facilitation condition. This result could be caused by unconscious reframing of the facilitator. These solutions are more easily accepted due to a positive group climate what then is less individual oriented but more group minded what then lead to more acceptance of each other. These findings indicate that a higher shared understanding doesn't necessarily lead to a more novel design outcome and that the type of facilitation might be depending on the preferred outcome of the interdisciplinary creative session.

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