

‘DESIGNERLY’ ANALYSIS OF PARTICIPATION STRUCTURES

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ABSTRACT

With the inclusion of not only users but stakeholders of many different kinds, design processes turn into complex collaborative challenges. Thus, improving design practices requires research into how people participate and contribute in social interaction. But research methods for understanding such activities tend to be highly analytical and hence difficult for design researchers to engage with, if results are meant to be actionable. Through a series of experiments we develop tangible support for a ‘designerly’ interaction analysis of one important aspect of collaborative design activities: the *participatory structures*.

INTRODUCTION

Interaction analysis draws increasing attention as a powerful research method for understanding the social processes in design. With its origin in ethnomethodology and conversation analysis this method focuses on making sense ‘from within’, i.e. by relying on how members themselves categorise actions, rather than by imposing external theories on what can be observed. Jordan and Henderson in their seminal 1995 paper turned interaction analysis into a concrete, collaborative format centred on *Interaction Analysis Labs* as a way to bring multiple perspectives into the analysis while at the same time avoiding distortions given by possible preconceptions (Jordan & Henderson 1995). Besides arguing what makes video valuable for understanding interaction, they provide a set of foci that help researchers finding entry points for analysis. We will take one of these foci, *participation structures*, as a starting point for developing tangible support for the analysis of participatory design practices.

PARTICIPATION STRUCTURES IN DESIGN

Jordan and Henderson (1995) use the term *participation structures* to describe how participants interact with each other and how they co-create patterns of participation in a group as seen in the face-to-face communication (e.g. a group brainstorming in contrast to independent reflective work, or the exclusion of a person from an activity). In the physical actions it is visible how the social structures in a group are maintained, and how artifacts and space support or distract these structural frameworks. Participation structures are important to understand what happens in participatory meetings where groups design collaboratively by interacting with each other and with design objects. Participation structures describe the interrelations between facilitation strategies, participants, and artifacts.

In design, video analysis has been introduced successfully to learn about ‘users’ with a view to designing products that fit better, or to innovating new solutions with a focus on ‘user practices’. For this purpose, it has been argued that video can be regarded as a ‘design material’ with which designers collaboratively ‘build meaning’, rather than as ‘hard data’ that supports design decisions through appropriate analysis (Buur et al. 2000). A range of authors have since expanded this notion of ‘design material’ and proposed exciting practices for turning analysis into collaborative sense-making activities with tangible materials, games etc. (Brandt et al. 2008).

When focusing on research into the design activity itself, however, the goal is to establish understanding, rather than creating new products or technologies. Ultimately the goal may be to suggest improved collaborative design practices, but here is a legitimate place for ‘analysis’ that leads to description.

DESIGNERLY APPROACHES TO ANALYSIS

Conversation analysis looks at naturally occurring social situations and explains what happens by asking how people interact (Sacks, H., Schegloff, E. & Jefferson, G. 1974; Heritage, J. & Clayman, S. E. 2010). Conversation analysts prefer to work from detailed transcripts of what people say, and how they say it. Such transcripts do not sit well with design researchers for several reasons. For one, transcripts, while recording

well how people talk, are very difficult to expand to the broader interaction patterns so typical for collaborative design: the handling of objects, the pointing, gesturing, moving in space. For two, the analysis activity itself tends to turn into an abstract, cognitive effort when working from transcripts and video observation – with little room for physical manipulatory skills, handling of objects etc.

In this paper we present our experiments of bringing the ‘design material thinking’ into interaction analysis and providing supportive tangible techniques that help researchers set a focus for their analysis and employ their bodily skills to complete it. We aim to establish a ‘designerly’ practice of interaction analysis. By a ‘designerly’ approach we understand an alternative to both the analytical, objective means of natural science, and the subjective, imaginative ones of the human sciences (Cross 1982). ‘Designerly’ processes involve reflective investigation, hypotheses formulation, and a focus on the details of specific, contextualized situations rather than abstract, universal theories (Stolterman 2008). Designers utilise tools that do not rely on verbal formulation: sketches, models, and objects. They help bringing knowledge that is less language-based into play, and facilitating exploration of diverse perspectives and patterns of relationships. In relation to this, Cross (ibid.) refers to objects as supportive of human reasoning and cognition, both as containers of knowledge, tools for thinking and for communicating.

We suggest that a ‘designerly approach’ can be of help in approaching the analysis of design process video for two reasons. Firstly, an analysis supported by materials engages our bodily skills in reconstructing the situation under study and empathizing with the participants, thus bridging the gap between a highly embodied, physical activity such as collaborative design, and a verbal one such as interaction analysis. Secondly, transforming an exclusively analytical activity into a dialogue with the data (Schön 1983) provides a starting point for finding key elements and patterns of interaction for later, more detailed analysis. Again, objects play a role here providing a frame through which, coherently with Jordan and Henderson’s idea of ‘foci’ of interaction, we can find ‘entry points’ to approach our data. Expanding a predominantly verbal analysis with tools that help focus on the material, physical, and tacit interactions typical for collaborative design, could support our thinking and reasoning during the analysis.

OBJECTS AS RESOURCES

Lucy Suchman (1987, 2000) introduced the notion that the interaction with objects and their surroundings defines the activities of people. The influence of objects on people’s actions has been recognized as valuable in workshops in which tangible material is used and has an impact of the outcomes. Interaction analysts studied how objects are referred to during discussion and idea generation (Fasulo and Monzoni 2009), and documented how they act as drivers for creative processes and



Figure 1. Three researchers analyse video recordings from the Value Chain project using wooden figurines and role cards in an Interaction Analysis Lab session.

innovation (Nevile 2011). In participatory design, it is a common objective to establish a shared workspace, in which all participants have an equal chance to participate and collaboratively find opportunities to explore: the use of material supports this issue by offering an accessible platform on which everyone can participate – even silently (Heinemann et al. 2011).

Physical things stimulate hand and body movements (Hornecker 2005), the thinking and communication process of participants and more generally the entire creativity flow of a group (Giaccardi & Candy 2009; Harrison & Minneman 1996). When talking about things collaboratively, participants tend to connect thoughts and develop complex concepts around them (Hindmarsh and Heath, 2000), support group dynamics and help to ‘coordinate’ innovative workshops (Luck 2007). Especially because objects can carry information (Ishii & Ullmer 1997) and people create this meaning collaboratively, objects can act as information sources for discussions. Such objects can be of different sizes and can have different features depending on the purpose of the activity. Tangible objects tend to ‘address human perceptual-motor skills’ (Djajadiningrat et al. 2004) and consequently trigger workshop participants to include them into their thoughts and discussions in different ways. The features of the objects influence how participants use and involve the objects (Atelier 2011). It seems as if objects “talk to us” (Hunt et al. 2011) in a way and engage us in the process. The objects we are talking about here can be seen as ‘things’, ‘materials’, ‘artifacts’, ‘tangibles’ (Heinemann et al. 2011), ‘material objects’ (Luck 2007), or ‘intermediary objects’, that carry information given by the participants and advance the process (Boujut and Blanco 2003). ‘Boundary objects’ (Star and Griesmer 1989) help participants from different backgrounds share knowledge and thus activate thoughts concerning different attitudes and perceptions towards an object. This provokes and promotes the innovation process (Luck 2007). Recently, an interesting perspective has been offered by Eriksen (2012). He demonstrated how ‘non-human’ materials can act and participate in ways similar to humans in co-design events. Objects do so not just by being present in processes of negotiation and



Figure 2. Project participants discuss future plans at the end of a design workshop in the Value Chain project. Left to right: R&D director, company employees 1 and 2, consultant, project manager, company employee 3, marketing director, technology consultant, assistant, user innovation expert 2 (user innovation expert 1 is behind camera).

meaning making, but also by acting as ‘mediators’ and encouraging actions of different kinds. Drawing on Latour, Eriksen further explores this idea of participating ‘mediating’ materials as ‘delegates’ fulfilling various roles. An interesting set is what she defines as the *Content Material* that, whether or not designed, can for example act as *delegated playmates* “participating in exploring, framing and reframing the topic/issues/problems in the specific situation.” (p. 213). To use physical material for video analysis has previously been explored in the ‘Video Card Game’ (Buur & Soendergaard, 2000) that employed cardboard cards as representations of video clips to allow participants to physically cluster groups of similar video clips on a table top.

RESEARCH APPROACH

This paper is based on experiments with tangible objects in interaction analysis lab sessions with design researchers. In particular we will report on a simple set of tools that help researchers focus on the *participation structures* when analysing collaborative design sessions. We have run about 10 lab sessions with these tools, each of those have been video taped for interaction analysis, Figure 1. So, a slightly incestuous method of interaction analysis of video recordings of researchers, who do interaction analysis of video recordings of real life design...

We focus our analysis both on how participants interact with the objects, and on what happens before and after interactions. The passive movements and positioning of the objects play also a major role in the analysis, how participants use them in conversation and what kind of emotions, gestures and other actions they release. All in all it is an emic approach that focuses on the participants’ “actions produced in interaction” (Luck, 2007) to find out how the objects are being used and treated in such situations. We have selected two instances of interaction analysis labs that help expand how these tangible tools work. The video data that the researchers analysed in the interaction analysis labs were recordings of design workshops in a project titled ‘User-Driven Innovation in Value Chains’ (in short the

Value Chain project). It was a 2-year project with the goal of strengthening innovation in an entire company value chain through the involvement of users. Value chain here understood as a string of companies that trade with each other to produce customer value. The partners were the Danish ventilation systems manufacturer Novenco (500 employees), several of its suppliers (of electronic controls, motors), and customers (building contractors). The responsibility of SPIRE colleagues in the project was to study and involve users, and to organize participatory workshops between the partners. Novenco’s main product is a ventilation unit that combines ventilator, filters, heat exchanger, and electronic control in one enclosure. Ventilation units are sold via building constructors to be installed in plants, schools, office buildings etc. The project was organised as a Participatory Innovation effort (Buur & Matthews 2008) with emphasis on participation of not just users but stakeholders in a broad sense and with a focus on the business side of innovation.

Our analysis ‘tools’ devised to help the researchers focus on the roles people take and how they participate when analysing video from the project workshops are very simple: We offer a non-descript wooden figurine for each person visible in the video segment, and a ‘role card’ that inspires the researchers to name and briefly describe the roles and participation patterns they observe. We ask the researchers to pick a person each and concentrate on what they are doing, while moving around the figurine to mirror how the person acts on the video screen, Figure 1.

DATA 1: WORKSHOP PLANNING

In the first instance, we analysed planning discussions across a range of design workshops. Planning often comes on the agenda towards the end of design workshops, when all the ‘exciting’ activities with user material, design scenarios, mock-ups etc. are over. Participants sit back, reflect on the outcome of the day and make arrangements for what to do next and when to meet again. In the Value Chain project, the segment we focus on here happened at the end of the third project workshop, organised in a large company meeting hall.

The participants – five company representatives, two consultants (of which one is the project manager), a technology consultant, an assistant, and two user innovation experts (from now on called ‘participants’) – have gone through a programme of watching user studies videos, working with ‘issue cards’, brainstorming opportunities, and discussing which of them to prioritize. Now the project manager takes the floor after the user innovation specialists and opens the discussion about what to do next, Figure 2.

INTERACTION ANALYSIS LAB 1

The group of six researchers in the Interaction Analysis Lab session – 2 years after the event – combine different disciplines: Interaction design, interaction analysis, management (from now called ‘researchers’ R1, R2 etc.). We have chosen two 15 min video segments, one from this project, one from another, and act as facilitators (F1, F2). The researchers split two group, who each work with one case, then switch videos. At the end the researchers present to one another what they have seen. The facilitators have placed wooden figurines on the table in front of each video screen in a configuration roughly similar to the way participants are seated in the video. When watching the video clip, the researchers are encouraged to fill in a ‘role card’ for each person they observe, describing their character and way of interacting with the group.

FACILITATING CAMERA

In the Value Chain video group, the researchers fill in the cards, then suddenly realize that there is one figurine too many. After a bit of discussion they realize this must be the cameraman. As they start focusing on this role, they observe that the camera plays a much more active role than at first noted. The person behind the camera is actively both attending the workshop and apparently directing some of the discussion. They replace the figurine with a larger one, probably because they identify with this particular role: The cameraman is also the facilitator, the design colleague, who does the kind of things ‘we’ do: studying users and organizing workshops in the project. Every now and then he asks questions to all participants and also turns the camera to the person who speaks or a person he challenges to answer or comment. Traditionally, camera recorders take a passive role and do not participate actively in discussions whereas this one even leads the conversation by turning the camera onto the next person to speak. It seems as if the camera has a role by itself and joins the conversation as it turns its ‘eye’ back and forth in the group like a participant and more specifically like a facilitator. This is what Blauhut & Buur (2009) called *‘The Engaging Camera’*. Like every other participant, the cameraman shows his attention by looking directly at the current speaker, but as this is also where he points the lens, everyone in the circle will know that his ‘attention’ means they are now recorded on video.



Figure 3. A researcher swaps a small figurine for a bigger one to indicate the special status of the cameraman/ facilitator.

As they discuss, one of the researchers grabs the ‘cameraman figurine’ and swaps it with a bigger one, indicating that this role is more dominant than others, Figure 3:

R1: *“What about this big one?”* (touching the only big object on the table)

R2 takes it and places it on the other end of the table;

R1: *“The cameraman?”*

R2: *“Ya.”*

The different sizes of objects on the table help the researchers to think about structural hierarchies.

Later, when the other researcher team comes to work with the same video sequence, they have problems identifying which figurine represents whom in the video. After some discussion of who is who, they ask the facilitators for help:

R1: *“This represents this one, right? It’s a direct representation, right?”*

F1: *“Yes, it is a direct representation, but I am not sure if this is the camera? So, one, two...”* (counting from the biggest figurine while pointing).

F2: *“This is the camera position. (touching the biggest object) and this is him. (video-object connection)”*

R1: *“Okay. Yeah.”*

R2: *“Ya.”*

The facilitators refer first to the biggest object to show its role in the video. The big figurine is easy to connect to the video as the previous researcher team placed it right in front of the screen to provide the same viewpoint as the video watcher. So, with the help of the simple figurines, the researchers have established the *facilitating camera* as on participation structure in collaborative workshops. The figurines become reference objects to present analysts’ points of view and to explain the dynamics observed in the video.



Figure 4. One researcher uses the figurines to point out a conflict between two company managers and the project manager.

CENTRIFUGAL PARTICIPATION

When the researchers present their observations to each other, one researcher uses the figurines to clarify the roles of the characters in the video, and to summarize their position. In the example shown in Figure 4, he points at two of the figurines (A and B), noting how their personal positions are aligned, but in conflict with that of the project manager (figurine C). In this Value Chain workshop, the project manager (C) seems keen on inviting both users and more company partners to the next event, but both the R&D director and the marketing director of Novenco are concerned that the project doesn't have enough results to ensure they will be able to motivate their business partners to come. Researcher 1 directly re-enacts the dynamics, using the figurines as actors:

R1: *"They (figurine A and B) want to involve people from workshops, and he is into planning (points to figurine C, the 'planner') so 'how much time' and 'how would they come'..."*



Figure 5. A researcher points both at a figurine and at the video to draw attention to a particular pattern of interaction.



Figure 6. A researcher moves figurines to present a hypothesis and opportunity for further research.

Pointing at figurine A, R1 then enacts the quote from the related character:

R1: *'yes, but there is a conflict!'*

Pointing back at the 'planner' figurine, R1 answers:

R1: *"no no, we just need to plan!"*

Following this, all researchers focus their attention on the interaction between the characters represented by figurines A, B and C. They constitute a focus point for the conversation, in which the researchers continue comparing their observations of the three characters' interactions. Even when reviewing the video, the researchers continue to use the figurines as reference points, while pointing also to the screen to explicate the interactions in which the characters are involved, Figure 5. For example, R4 explains an episode while pointing both at figurine C and at the screen:

R4: *"He says something at that moment, and the mediating camera (points at the corresponding figurine) goes into a discussion with him..."*

The researchers come to talk about the participation structure in this group as *centrifugal*, as opposed to a *gravitational*. In the video one can observe how workshop participants gradually disengage from the conflictual discussion. This is visible not only in the direct interactions, but also in body postures and spatial positions. While the conversation (troubled by the difficulty of two poles negotiating consensus) goes on, less active participants physically move further away from the table. One of the researchers calls this the *'I'm not here expression'*.

TRIANGULAR PARTICIPATION

Towards the end of the interaction analysis lab session, one of the researchers uses the figurines to suggest a possible future line of research. In this case, figurines are not just pointed at, but are directly manipulated to formulate hypotheses. R2 is interested in the apparent formation of 'triangles' of conversation that are established during the discussions in the video. She rearranges the figurines to show her idea, Figure 6. She first gathers a set of three figurines in a corner.

R2: "Yes, and if you had a triangle here, right... so everyone else would be..." (moves the other figurines away from the corner with the triangle, gathers them on the opposite side)

R2: "Why is it this triangle? Why is it this triangle?" (points at another cluster of figurines), and it could be something stupid as 'who says something first' and who then... " (moves the figurines closer to another).

R2: "It could be interesting."

The figurines provide a space that can be filled with imaginary lines. R1 picks up the idea of hypothetical triangles:

R1: "In a sense is as if we have it [a triangle] here between the consultant and this guy, and this one here (points at the figurines when naming the characters). And the others there are, sort of around" (draws invisible lines connecting various figurines)

The physical objects help to imagine and create structures they observed earlier –*triangular participation structures*. The tangible material visualises these shapes and integrates them in the discussion, Figure 7.

DATA 2: BUSINESS MODELING

In the second instance, we analysed the use of tangible design materials for initiating business model discussions. The video recording stems from a workshop held a year later in the Value Chain project. At this point the project participants are concerned with what business potential an increased user focus and collaboration across the value chain might yield. The circle of participants has now widened to also include representatives of Novenco's customers (building contractors) and suppliers (electronic controller



Figure 7. A researcher draws invisible lines between figurines to show power relations.

manufacturer). The activity we analyse here included five participants building a 'tangible business model' for how they could utilize the coordinated force of the companies in the value chain. For this they were given a box with a wooden toy train set, Figure 8. The building took 14 min. plus additional 6 min. for presentation of the result to the rest of the workshop participants. The members of this team are the marketing director of Novenco, the project manager, two business consultants, and a process consultant. SPIRE members acted facilitator and observers.

INTERACTION ANALYSIS LAB 2

This video has entered several interaction analysis labs, where researchers themselves have tried to recreate the train structure while discussing roles and filling in role cards, Figure 9. When analyzing the video material we observe that the participants pick quite distinct patterns in the building process. They use their hands and utilize



Figure 8. Through building a model train five workshop participants discuss a new business model for selling ventilation units through a coordinated value chain. Left to right: Business consultant 1, project manager, marketing director, business consultant 2, and process consultant.



Figure 9. Researchers analyze the video recording using role cards and the original train set materials.

material in different ways; and first and foremost they add meaning and make sense of elements in various ways (Heinemann et. al 2011). We will try to describe the activity through characterizing the specific roles they take when building the business model.

The *Builder* is the first one to start building. She assembles pieces into sub-assemblies like the “standard solution segment” with a “decision-making junction”.. She readily cooperates with others and shares material, but she also builds quietly by herself without explaining what she is building. In real life she is a process consultant engaged in this project to report on collaboration between the companies. In an activity just prior to this she – along with the Organizer next to her – acted the role of supplier in a value chain.

The *Organizer* groups material into well-sorted piles on the table. He listens attentively to the plans others suggest while helping out with his pieces from his storage. He also steals pieces if they fit into his collection. In real life he is a business consultant.

The *Director* plans for everyone and ‘owns’ a lot of material. She draws others into the building process and is herself actively constructing what at the end of the activity will be called the ‘requirement specification loop’. She is the marketing director of Novenco and obviously used to directing people.

The *Space Keeper* is more or less inactive, tries to overcome different physical barriers and keeps things inside his space. He also creates new barriers, attracts and collects other material. He is an industry consultant recently employed with the project manager’s organization.

The *Box Owner* hands out material from the box and seems in control of distributing who gets which parts to work with. He is the only one standing (with both hands on the box) and starts many discussions on how to make sense of the construction. He is the consultant in charge as project manager.

SILENT PARTICIPATION

Depending on their personalities participants interact differently with the tangibles. Some construct silently whereas others talk more than they build. One can

observe different roles in the use of material. Participants for example look at stuff, construct individually with concentration, while others point and discuss, Figure 10. As the tracks lend themselves to being connectd, the material seems to keep the hands busy throughout the workshop. Some participants ‘defend’ the space around them and sort objects while thinking. Aside from that there are participants who apparently dislike touching the material and show that demonstratively through their body language. Participants mostly pick discussing themes that relate to the objects they are handling. The option of not attending discussions verbally shifts the importance of the conversation towards the material (Hornecker, 2005), in the way that also shy participants can contribute to the results achieved in the end. The Builder in particular touches, plays and interacts with objects even when not talking about them and in that way contributes to the group process silently. We have come to see this participation structure as *silent participation*.

CONCLUSIONS

In collaborative design objects have been recognized as playing important roles in human activities, and not just as inert material. The figurines in our Interaction Analysis Labs facilitate an exploratory, but focused study of videos and provides access to the data for deeper analysis. The figurines encourage researchers to concentrate on one character a time, whilst also considering all participants: they start with the relevant figurines, and continue locating the remaining characters even if not directly engaged in the conversation. As demonstrated in the case of the *facilitating camera*, the figurines’ physical characteristics such as size make the researchers think about differences between the people represented, the interactions with the other characters, and the hierarchical differences underlying these interactions. It is interesting to note how finding a place for the ‘big figurine’ helped highlighting the camera as an object that, through participating, has an influence in framing discussion by supporting the person behind the camera itself. The figurines’ spatial configurations play a role too: managing and organizing the figurines in



Figure 10. One participant contributes by building silently.

accordance with the video helps the researchers understand the relations between participants, but also what is important when attending such sessions and how to facilitate them. "It visualizes the energy of meetings and makes them comparable" said a researcher when reflecting on an analysis session: "It makes one co-create a language to describe interactions and group dynamics."

While naming figurines might be seen as a gross simplification, the challenge to define which role a particular actor plays in a situation can become a tool for encouraging debate and exchange of opinions in the Interaction Analysis Lab. This resonates with the idea of 'designerly': the application of a 'code', or a meta-structure that acts as a temporary theory to understand the relations between elements, individuate possible patterns of interactions and evaluate and discuss them with other researchers. Naming the figurines helps the researchers to focus on key events, while providing a quick overview of the actions in the video and specifically of the roles people take. Once the researchers have organised and named the figurines these serve as a way to explore different hypotheses through moving and manipulating the material, and help to easily convey findings to other researchers. In this way the material challenges the singular attention to verbal interaction in conversation analysis to include other forms of interactions more relevant to design research.

When comparing our Interaction Analysis Labs with figurines to the Video Card Game (Buur & Søndergaard 2000) we can see that the two methods serve different purposes: While the Video Card Game offers a mechanism for grouping rather large numbers of (short) video clips, creating grounded structures for further analysis, the figurines in the Interaction Analysis Labs challenge researchers to investigate a particular foci in their analysis of one (longer) video sequence. The two methods are not mutually exclusive.

In the analysis of the Business Modeling data, reconstructing the movements of the train track pieces around the table and their use while building helped reveal how the same objects triggered very different participation structures with the actors. In this example, a 'tangible' approach to analysis helped the researchers uncover patterns and behaviours that would have been impossible to record on transcripts and difficult to analyse with language and verbal descriptions only. Moving objects on the table engages bodily skills, and allows the analysts to understand the challenges relating to reachability of objects, ownership of material, or the material 'backtalk' when pieces do not come to fit in the desired configurations.

As we have hopefully demonstrated, the integration of material, objects, figurines, and tools in the analysis process can help make explicit the limitations and opportunities given by spatial configurations, role of artefacts in interaction and in particular the participation

structures as foci of analysis. At the same time, they provide an 'entry point', to the analysis of very complex and multi-layered material such as recordings of interactions among people and between people and objects. Focusing on particular characters or configurations provides the possibility to investigate several perspectives through the manipulative character of the material itself. In both these cases, a 'designerly' analysis helped uncover several participation structures: The 'facilitating camera', the 'centrifugal' vs. 'gravitational participation', the 'triangular participation', and the 'silent participation'. They might prove to have important influences on understanding collaborative design activities. One issue to reflect on further, is that the figurines only help set the analysis foci on what the (human) participants do and say, and much less on participation structures of the (non-human) materials in the situations analysed. Here is a point for development of the method.

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REFERENCES

- Telier, A. Binder, T., De Michelis, G., Ehn, P., Jacucci, G., Linde, P. and Wagner, I., 2011. *Design Things*. Cambridge: MIT Press.
- Blauhut, D. and Buur, J., 2009. What Video Styles can do for User Research. In: *NORDES, Proceedings of the Nordic Design Research Conference*. 30 Aug-1 Sept, Oslo.
- Boujut, J.F., Blanco, E. 2003. Intermediary Objects as a Means to Foster Co-operation in Engineering Design. In: *Computer Supported Cooperative Work: Journal of Collaborative Computing* 12, pp. 205-19. Netherlands: Kluwer Academic Publishers.
- Brandt, E., Messeter, J. and Binder, T., 2008. Formatting Design Dialogues – Games and Participation. In: *CoDesign: International Journal of Co-creation in design and the arts* 4(1), pp. 51-64.
- Bødker, S., Ehn, P., Kammersgaard, J., Kyng, M., and Sundblad, Y. 1987. A UTOPIAN experience: On design of powerful computer-based tools for skilled graphical workers. In: Bjercknes, G., Ehn, P., and Kyng, M. ed. *Computers and democracy: A Scandinavian challenge*, Brookfield, VT: Gower Press, pp 251-78.
- Buur, J., Binder, T., and Brandt, E., 2000. Taking Video beyond 'Hard Data' in User Centred Design. In: *PDC '2000, Proceedings of Participatory Design Conference*, 28 Nov-1 Dec, New York.

- Buur, J. and Soendergaard, A., 2000. Video Card Game: An augmented environment for User Centred Design discussions. In: *DARE 2000, Proceedings of Designing Augmented Reality Systems*, New York: ACM, pp 63–69.
- Buur, J. and Matthews, B. 2008. Participatory Innovation. In: *International Journal of Innovation Management* 12(3), pp.255-273.
- Cross, N., 1982. Designerly ways of knowing. In: *Design studies* 3(4), pp. 221-227.
- Djajadiningrat, T., Wensveen, S., Frens, J. & Overbeeke, K. (2004): Tangible products: redressing the balance between appearance and action. *Pervasive and Ubiquitous Computing* 8: Springer-Verlag. pp. 294- 309.
- Eriksen M.A., 2012. *Material matters in co-designing: formatting & staging with participating materials in co-design projects, events & situations*. PhD Dissertation, Malmö University.
- Fasulo, A., & Monzoni, C., 2009. Assessing mutable objects: A multimodal analysis. In: *Research on Language and Social Interaction* 42, 362–376.
- Giaccardi, E. and Candy, L., 2009. Creativity and Cognition. Materialities of Creativity. In: *Leonardo* 42(3), pp. 194-196.
- Harrison, S., and Minneman, S., 1994. A Bike in Hand: a study of 3D objects in design. In: Dorst, K., Christiaans, H., Cross, N. ed. *The Delft Protocol Workshops: Analysing Design Activity*. 20-22 Sept, Delft, pp. 205-18.
- Heinemann, T., Boess, S., Landgrebe, J., Mitchell, R. and Nevile, M., 2011. Making sense of "things": Developing new practices and methods for using tangible materials in collaborative processes. In: *DESIRE '11, Proceedings of the 2nd Conference on Creativity and Innovation in Design*. New York: ACM, pp. 221-225.
- Heinemann, T., Mitchell, R. and Buur, J., 2009. Co-constructing meaning with materials in innovation workshops. In: Darras, B., and Belkhamza, S. ed., *Objets et Communication, MEI* 30-31. Paris: Aujourd'hui, pp. 289-304.
- Heritage, J. and Clayman, S. E. 2010. *Talk in Action: Interactions, Identities and Institutions*. Boston: Wiley-Blackwell.
- Hindmarsh, J. and Heath, C., 2000. Sharing the tools of the trade: the interactional constitution of workplace objects. In: *Journal of Contemporary Ethnography*, 29(5), pp. 523–62.
- Hornecker, E., 2005. A Design Theme for Tangible Interaction: Embodied Facilitation. In: *Proceedings of ECSCW'05, 9th European Conference on Computer Supported Cooperative Work*, 18-22 Sept. Paris, pp. 23-43.
- Hunt, J., Midal, A. and Antonelli, P., 2011. *Talk to Me: Design and the Communication between People and Objects*. New York: Museum of Modern Art.
- Ishii H. and Ullmer B., 1997. Tangible bits: towards seamless interfaces between people, bits and atoms. In: *Proceedings of the CHI'97 conference on human factors in computing systems*, Atlanta, Georgia, pp. 234-41.
- Jordan, B. and Henderson, A., 1995. Interaction Analysis: Foundations and Practice. In: *Journal of the Learning Sciences*, vol. 4(1), pp. 39-103.
- Luck, R., 2007. Using artefacts to mediate understanding in design conversations. In: *Building Research and Information*, 35(1), pp. 28–41.
- Mitchell, R. and Buur, J., 2010. Tangible Business Model Sketches to Support Participatory Innovation. In: *Proceedings of the 1st DESIRE Conference on Creativity and Innovation in Design*, Aarhus, 16-17 Aug 2010, pp.29-33
- Nevile, M., 2011. The Real Thing: Artifacts, Action and Authenticity in a Student-led Stakeholder Session. In: *Proceedings of Participatory Innovation Conference*, Sønderborg 14-16 Jan 2011, pp. 84-90.
- Sacks, H., Schegloff, E. and Jefferson, G., 1974. A simplest systematics for the organisation of turn-taking in conversation. In: *Language*. 50(4), pp. 696-735.
- Star, S. and Griesmer, J., 1989. Institutional ecology, 'translations' and coherence: amateurs and professionals in Berkley's Museum of Vertebrate Zoology. 1907–1939. In: *Social Studies of Science*, 19, pp. 387–420.
- Stolterman E., 2008. The nature of Design practice and implication for interaction design research. In: *International Journal of Design* 2(1).
- Suchman, L., 2000. Organizing Alignment: A case of bridge building. In: *Organization* 7(2), pp. 311-327.
- Suchman, L., 1987. *Plans and situated actions: The Problem of Human-Machine Communication*. Cambridge: Cambridge University Press.
- Wittgenstein, L., 1958. *Philosophical Investigations*. Oxford: Basil Blackwell.