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# Abductive sensemaking through sketching

A categorization of the dimensions  
in sketching capacities in design

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## Abstract

This paper proposes design sketching as a way to make abductive reasoning manifest and concrete. Through sketching, the abductive sensemaking leaves the domain of abstract logics and becomes part of the researchers or practitioner's reflective practice. This practice is especially evident through incorporating sketching as more than a specific technique, but also as ways of applying design thinking through acting upon the world. The paper presents sketching as an integral part of the design epistemology. Furthermore, a categorization of different dimensions in which sketching can be represented is presented. The main contribution is a discussion of whether this broader view on sketching capacities in design leaves room for further exploration into extended sketching capacities for design.

## Introduction

In recent years, the academic field of design research has had an increasing interest in the role of sensemaking in the creative and constructive process of scientific inquiry (Krippendorff 2006, Koskinen et al 2011,). Klein et al. define sensemaking as "a motivated, continuous effort to understand connections in order to anticipate their trajectories

*and get detailed inquiries into the nature of human culture”* (Klein et al. 2006). The methods and techniques of design-oriented sensemaking varies. However, most seem to be based upon the abductive logic of reasoning (Kolko 2010, Martin 2009). Unlike most other schools of thought, the field of design research applies methods which approach the abductive sensemaking process of adopting new hypotheses as pursuing ‘what if’ and ‘why’ questions to a given problem space (Brown 2009, Nelson & Stolterman 2012 Markussen & Knutz 2013). The designerly epistemology sees the act of ‘doing’ as the foundation for acquiring knowledge and meaning. This echoes Maitlis and Hernes (2010) perspective on sensemaking as a way of reasoning about the future when confronting, confusing or surprising situations in an organizational praxis.

This paper aims to discuss and categorize the ways designers use sketching to test and challenge assumptions about both current and possible future states of the world. The categorization positions sketching as being broader than a mere set of techniques. The paper examines different expressive dimensions in which designers use sketching to think about and explore problem spaces. Finally it will be argued that the exploration of both existing as well as extended capacities of design sketching can be seen as an integral element for the epistemology of design thinking.

### **Designerly ways of thinking**

In regards to the studies of design Nigel Cross states *“there are things to know, ways of knowing them, and ways of finding out about them, that are specific to the area of design”* (Cross 2007<sup>1</sup>). Cross frames design thinking as a specific way of knowing about- and finding out about matters, creating one of the first framings of design as a specific epistemology. Furthermore, this is supported by an emphasis on Herbert Simon’s work on how the ontological domain of design is centered on the artificial ‘built environment’ (1969). Adding to this framing of design Richard Buchanan made an interpretation of Rittel and Weber’s concept of ‘wicked problems’ into the field of design thinking (Buchanan 1996). Buchanan showed how designers has a special way of approaching the ill-defined, contradicting, and ever-changing problems of design, by embracing the fact that the subject matter of design is by itself designed and framed by the designer. Given its performative nature of its epistemology, design also carries a sort of ‘ontological politics’ concerning what is being made (Gaver 2012).

With Cross and Buchanan's examinations, design thinking emerges as a distinctive epistemology for creative and solution-focused ways of exploring Simon's 'preferred future states' (Simon 1969). It initiates its inquiry by framing a (often fuzzy) goal for the preferred state, creating a space to be explored instead of a clearly defined problem to be solved.

Jon Kolko (2010) emphasizes the abductive logic as being directly linked to how designers work. The abductive logic relates to Klein et al's (2006) notion of sensemaking as an action oriented process that people automatically go through in order to integrate experiences into their understanding of the world around them. Kolko uses the notion of abductive reasoning to describe how the designer adds new sets of disparate knowledge into the existing parameters of a problem space. Through experimentation with the conditions, the designer explores the basis for claiming that a given idea 'might' be a feasible path to a solution. Unlike deduction or induction, abductive logic allows for the creation of new knowledge and insight through qualified guesses that are not part of the original set of premises, but are added through past experiences with related or intertwined situations.

The abductive logic's role in design thinking sums up the designer's sensemaking process as a phenomenological approach to use past experiences and seemingly unrelated knowledge to ask 'what if?' questions. Kolko describes these experiences as the marks left by the individual designers lived experience in everything designed (Kolko 2010). Furthermore, abductive sensemaking is done only through actually acting upon the world - by making some sort of expression of the 'what if' when we abductively add new set of data to the existing parameters of the problem.

As Cross already noted in 1982, the process of design thinking often happens in the built artificial environment - based upon the creation of artifacts (Cross 2007). However, modern design discourse does not limit itself to the view of design as aimed towards artifacts as an end-goal. With the emergence of disciplines such as interaction design (Moggridge 2007), experience design (Hassenzahl & Tractinsky 2006) and service design (Stickdorn 2011), modern views of design thinking aim at using the processes of abductive sensemaking in areas where the end-result is not necessarily a 'product'.

But if sensemaking through design thinking is driven by abductive reasoning initiated by exploring and experimenting with the given parameters and constrains of the problem space, it seems reasonable to claim that the multitude of design fields also might adhere to a common way of, in Cross' words, *finding out* about possible solutions to the design problem. This calls for a broader definition of what the role of creating artifacts or expressions has for inferring the best explanations for the preferred future states.

The following section will seek to discuss some of the foundations for using the concept of 'sketching' as this common definition of how the designer applies design thinking in various contexts of doing.

### **Design thinking through sketching**

Traditionally in design, the concept of 'sketching' has been approached and described as either a specific stage in the design process (Simon 1969) or as a specific set of techniques used throughout the design process - mostly represented by pen and paper sketching (Jones 1992). In a more broad perspective Goldschmidt's (1991) studies indicated that we might see sketching as a more integral and inseparable part of design thinking. Goldschmidt argues that sketching is broader than a technique or phase, since it represents the way designers reflect through the act of actually doing concrete visual exploration of a material. Donald Schön (1986) made similar claims in his studies of reflective practice, and lately Bill Buxton (2007) popularized this way of interpreting sketching within the HCI community. Buxton argues for a strategic value in adopting sketching as a mindset for design through both examining what the *right design* might be and *the right way* of designing a solution. Contrary to other approaches like prototyping (ibid) the point of sketching is to make non-committal explorations of both the problem itself, and the possible ways of dealing with this problem, in order to deal with the wickedness of the design problem.

Sketching takes cues from both the pragmatic perspectives of learning through practice (Dewey 1909), and constructivist perspectives of reflective conversation with materials (Schön 1992). Sketching is not concerned with abstractions over the world, but with concrete manifestations of 'what future possible states might be'. This effort of creating manifestations of what might be is what makes

design thinking, and sketching as an act of 'doing' in particular, a pragmatic discipline. This is further supported by the constructivist act of iterative reflection-in-action when sketching. If these principles are accepted as part of broadening the concept of sketching, it allows for sketching to be described as being more than a mere technique or phase. Buxton presents eight criteria for sketching that may act as our focal point: *evocative, suggestive, explorative, questioning, proposing, provoking, tentative* and *non-committal* (Buxton 2007). Derived from these criteria I propose that we might interpret sketching as a mindset through which we apply different techniques, more than being a specific set of techniques by itself. Thus, sketching becomes one of the clearest manifestations of how to think and communicate design. By emphasizing the acts of proposing, provoking, and not committing to one idea, sketching explicitly manifest a speculative sensemaking. Through sketching, sensemaking becomes an abductive inquiry, in which we do not explore what must be or what is, but rather create a reflective practice of speculating, pruning and manipulating the conditions for what might be. Again, this implicates that we must broaden our view of what we actually 'do' when we apply the mindset behind sketching in our inquiry into a problem space.

Here sketching is both the processual way of doing design thinking from Buxton's criteria, but is also the communicative output from which our understanding of the problem evolves and becomes refined. Thus, sketching is a way of both expressing and reading ideas, and through this dialectic relationship, the abductive sensemaking takes place.

We now have the foundation to categorize how sketching manifests itself as an act of applying the abductive logic in practice through a variety of approaches. Thus, in Cross' words, we are able to categorize the "*...ways of finding out*" when applying the epistemology of design through a sketching mindset.

### **Dimensions of designerly sketching**

Buxton's set of criteria indicates that sketching cannot be described as a single technique. Instead, it must be considered in a broader sense as a way of acting upon the world. Through a reflective conversation with both the material at hand, and the context of the design space itself - sketching both has a reflective and communica-

tive output. In order to categorize the ways of which sketching represents abductive sensemaking we need a new typology for sketching. One that considers the space in which the sketching is applied as well as the enabling mediums or technological praxis. In this regard inspiration has been taken from Gillian Smith's attempts to describe and categorize the essence of interaction design according to its 'dimensions': 1-D, 2-D, 3-D and 4D (Smith in Moggridge 2007). The original typology is oriented towards deconstructing designed products, but the categories are also suitable in a more general view of ways of doing design. In the following, the typology is adapted to the domain of sketching, in order to generate a framework for a more broad view on design sketching.

### **1-Dimensional Sketching**

In the adaption of Smith's original typology, we must first consider how sketching can be considered from a 1-dimensional perspective. In Smith's original typology, 1-D includes the spoken words of language. Applied in the context of sketching this dimension can be used to express the 'what if' questions that characterize the abductive logic, and thus in a sense 'sketch through language'. Not hereby saying that the spoken word is always characterized by the criteria of sketching, just that it can be applied this way. The important thing to consider is that the expressive capacity of words is intrinsically an indirect representation as opposed to a more direct depiction when using spatial dimensions to express an idea. Words are articulated, but has no other expressive capacities than how we might interpret the semantics of the chosen words. Lerdahl (2001) uses the indirectness of language as way to sketch early ideas by proposing 'principal sentences' which drive the fuzzy front end of creative processes as a base sketch of the design space. This base can then be explored further through other sketching capacities. Lerdahl's approach and other attempts to adopt a sketching epistemology through words alone shows that words can in fact be used in a way that fits Buxton's criteria of sketching. Moreover, the lack of depictive qualities does not justify leaping to the conclusion that 1-dimensional sketching is inferior to depictive representations. The abstractions of language, the multitude of meanings, and the sense of wonder and imagination are often better expressed through the indirectness of language. Moreover, in the early stages



of design this ambiguity is often exactly what we need to expand the boundaries of the problem space. However, it also seems fair to assume that for the purpose of more concrete and inter-subjective purposes of sketching, a need for more spatial and temporal depictive qualities are needed.

### **2-Dimensional Sketching**

The ambiguity of 1-dimensional sketching is countered by adding a spatial dimension, and move into the 2-dimensional category of sketching. 2-dimensional sketching is the easiest to identify as sketching because it is the space where many of our existing prepositions about sketching as a depictive technique exists. The 2-dimensional space includes the use of typography, diagrams, pictures, icons, and the general ability to visualize what was initially just a word or thought, which enables the feedback loop of reading sketches to be clearer and more concrete. With a 2-dimensional sketch, it is difficult not to interpret and add our own visual experiences of different tropes and metaphors into the reading of the expressed idea (McKim 1973). Furthermore, the enabling mediums of pen and paper, paint and canvas, and later screen-based electronic medias has been well explored and mastered for sketching purposes. This ranges from creating (abductive) synthesis' of form (Alexander 1964), rapid prototyping (Wasserman & Shewmake 1982) or visualizations of information too abstract to capture in 1-dimensional words (Tufte 1997). Thus, 2-dimensional sketching can fittingly be seen as the archetype of sketching, being above the abstract thoughts expressed by words alone, but are also limited to one spatial dimension. This sketching capacity reaches its limits for expressiveness when more complex experiential and dynamic aspects are needed, in order to reflect upon the proposed idea. Thus, we need to add another dimension to the categorization of sketching capacities.

### **3-Dimensional Sketching**

An extra spatial dimension is added when we consider 3-dimensional sketching capacities. In this dimension, the mindset of sketching is applied to manipulating physical form or sketching within a physical space. This type of sketching is composed by situations where the designer applies abductive sensemaking into creating a certain form of expression - a model for an example - as a physical



manifestation of the 'what if' question that drives the synthesis. Again the technological practice has enabled us to sketch back and forth between e.g. 1-D and 2-D sketching capacities. As when we imagine and discuss a new concept for a physical product, which we sketch in multiple iterations of paper and digital sketches, and afterwards rapid prototype through technologies like Computer Numerical Control manufacturing (Reintjes 1991) and 3D printing (Hopkinson & Dickens 2006). Other more low fidelity capacities of 3-dimensional include quick mockups of objects or contexts in order to explore the possibilities or consequences of the 'what if' speculation (Ehn & Kyng 1992). This sketching capacity seems quite broad, but the categorization hits a barrier when we consider new forms of 3-dimensional sketching via physical elements such as 'material storytelling' (Jørgensen & Strand 2013). In these cases, the sketching is not just concerned with the output sketch as a static 3-dimensional representation, but is also concerned with the *sequence* as an element of the sketch.

#### 4-Dimensional Sketching

The above is an example of 4-dimensional sketching capacities - where the temporal aspects are considered, manipulated or captured as a transitional part of the design inquiry. This consist of actively sketching aspects of the time through which a given phenomenon is experienced - such as bodily enactments (Oulasvitra et al 2003), sound (Ekman & Rinot 2010), and video (Ylirsku & Buur 2007). Video has had an exceptionally strong influence in this category as a 4-D language for sketching. In twenty seconds, a video clip can tell a complex story understood by almost everyone. Filmmakers have been developing the language of film for more than a century, and with very limited resources, they can express plot, emotion, anticipation, and action over the course of a certain timeframe. These same qualities are shared when the video language is used for video sketching (ibid) - making a visualization over time, speculating how a certain problem space might be handled through the addition of a new set for premises. The 4-D capacity has its strength in not just capturing the different states of an idea, concept or problem space, but also expressing the transition between the different states - the in-between which we might claim is where we actually express the experiential qualities in design.

However, video as a sketching capacity is also somewhat limited in terms of the number of parameters the designer is able to modify. This is due to the limits of video to the spatial conditions of the context of the problem space as it was when it was recorded. Through editing and movie language, we may reach a higher level of expressiveness but we seem to hit a wall in terms of simulating more complex phenomenon that would radically change the existing parameters. Löwgren et al (2010) proposes that we look in the direction of the digital domain and consider exploring design problems via interactive code, enabling a feedback loop in which we may sketch real interactions over time. While this technique is both novel and expressive, sketching via interactive code limits itself to problem spaces, where digital technology is front and center, and does thereby not enable us to apply 4-dimensional sketching beyond either digital problem spaces or the experiential limits of the current context.

### **Room for extended sketching capacities?**

Based on the discussion of the abductive sensemaking through sketching, and the categorization it is suitable to take the adaptation of Smith's description of the 4-dimensional category a bit further. This category has room for expanding the range of approaches to design that we might categorize as 'sketching'.

I propose that we further expand the dimensions of which sketching enables sensemaking by adding 'animation' as the most current extension of the 4-dimensional sketching space. While still in the 4-dimensional sketching space, like bodystorming, video sketching etc., animation differentiates itself by adding more depth to the temporal, spatial and experiential aspects of sketching (Jacob et al. 2008). Stephenson (1973) differentiates animation from classic video with the ability the producer/designer has to claim 'full control' of the transitional material of which the animation consist of. From this point of view, we may frame animation as an extended 4-dimensional sketching capacity, able to simulate and manipulate both the spatial and temporal parameters of the problem space. Adding an animated dimension to sketches can then be seen as a way to express richer transitions in the sketching process, and thus potentially enabling a more clear feedback loop of the sketching process. Thus, animation in sketching is more capable to express the never-

thought-depictions that new and novel ideas often require to be understood. This happens while still adhering to the core characteristics of sketching from Buxton.

Since animation remains a largely unexplored area as a sketching capacity in the 4-dimensional category, the question for further research is; *in what ways can animation be appropriated from the traditional animation film to fit the criteria of sketching?* The first criteria to investigate is how to apply 'animation based sketching' without abandoning the rapid and iterative nature that characterizes the criteria of sketching from Buxton. As we have discussed, various sketching approaches can cycle back and forth between the four sketching dimensions - creating hybrid formats. The same might be the case for an extended sketching capacity as animation. The next step would then be to initiate a more elaborate analysis of which capacities from animation we might use to catalyze the sketching processes in different problem spaces, and compare these insights to the more well-described capacities of the 1-D, 2-D, 3-D and 4D sketching capacities. In the end these insights will help further develop the notion of how sketching can be seen as an integral centerpiece of applying the epistemology of design thinking to praxis. This would in turn broaden our insight into how abductive sensemaking can be used to make inquiries by representing and depicting ideas throughout design process.

### Perspectives

This paper has discussed abductive reasoning in relation to sensemaking in design. Furthermore, it has proposed that this type of sensemaking is driven mostly by reflective acting upon the world, which can be broadly characterized as different ways of adopting sketching as the centerpiece of a design epistemology. By taking Smith's original typology for interaction, and adapting it to a 1-4D typology for sketching capacities a new frame of reference has been established for further studies into approaches for conducting design sketching. When exercising the sort of speculative sensemaking that design enables, we are faced with multiple choices of which capacities of sketching to apply, and how to combine the languages of each dimension. The typology of sketching dimensions provides a way to compare aspects of these different approaches in regard to which actions the approach actually enables. This is important since

few design processes leaves time or budget to explore all sketching capacities when pursuing an idea. Thus, we must facilitate a more clear way of discussing and evaluating which dimensions we need to operate in to explore a given design idea in the most feasible way. Therefore, for further studies we must collaborate and engage with new previously disparate fields into our own abductive inquiry of how design sketching 'might be'. This paper has proposed the capacity of animation as the most apparent and still largely unexplored capacity of sketching to be explored, and thus also a potential field to be included into the broader research into sensemaking in design sketching.

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### Note

- 1 The cited text is the newest edition from 2007, however the original seminal work was first published in 1982