Sketching sounds — Kinds of listening and their functions in designing

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In this work, the use of sketching in sound design was studied. Based on Schon and Wiggins' model of how designers use sketching to see, move, and see again, we suggest that sound design evolves through a similar process requiring listening, moving, and listening again. This is facilitated by considering sounds as sketches. A case was followed in which six designers were asked to design a sound logotype. Processes and interactions were studied. The results suggest that sound design can be considered as a listen — move — listen process. Sound design is a conversation with sounding material, crucially dependent on listening. To assist in this, a computer interface was developed. Analysis of its use suggests that it supported co-designing.

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Industrial design takes all senses into account in the design of products. However, most literature on product design has focused on vision and visual design and there is a lack of tools for handling product sound in the design process. There are several studies dealing with the design of auditory displays, and general guidelines on the design of auditory displays can be found in, for example, Blattner, Sumikawa, and Greenberg (1989) and Brewster, Wright, and Edwards (1995). In 1986, Gaver wrote the following visionary description of how sound could be imagined to be used in the future:

> One can imagine how a single sound could be used to give information about a file arriving in a message system. The file hits the mailbox, causing it to emit a characteristic sound. Because it is a large message, it makes a rather weighty sound. The crackle of paper indicates a text file — if it had been a compiled program, it would have clanged like metal. The sound comes from the left and is muffled: The mailbox must be in the window behind the one that is currently on the left side of the screen. And the

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echoes sound like a large empty room, so the load on the system must be fairly low. All this information from one sound! (Gaver, 1986)

Today, these kinds of sounds can easily be generated in most human-machine interfaces. The limitation does not lie in the generation of the sounds, and the quality of designed signal sounds has become more dependent on creativity and good processes than on technology. There is a need for more research in the perception of sound, especially with a focus on multisensory human-machine interactions. However, as Easterby stated for the design of visual symbols in machine displays in 1970:

> The application of psychology to problems of equipment design requires the development of new skills to exploit current knowledge from "pure" research. One aspect which needs attention is the narrowing of the gap between the elucidation of some theoretical principles and their utilization in some practical design task. (Easterby, 1970)

The design of signal sounds is today in a similar state of development as the design of visual symbols for machine displays was in the 1970s. In addition to exploiting knowledge from research within psychoacoustics and perception, there is a need for further development of processes and methodologies. This development process can gain from studying the far more developed theories from industrial design.

1 Literature review

Descriptions of the industrial design process are found, for example, in Baxter (1995), Cagan and Vogel (2002), and Ulrich and Eppinger (2004). The processes can be adopted for product sound design without modifications because the process is not dependent on which senses are being designed for. It should be possible, therefore, to identify critical actions in the industrial design process and to use them to develop methods specific to sound design. Sketching has traditionally been considered to be a fundamental tool in the industrial design process (Buxton, 2007; Jonson, 2005; Pearson & Logie, 2015; Tovey, Porter & Newman, 2003). Casakin and Goldschmidt (1999) showed that providing designers with visual displays increased the rated creativity of their design solutions, and Goldschmidt (2003) further referred to sketches as self-generated displays. Bilda, Gero, and Purcell (2006) claim that sketching is a learned procedure during design education where architects learn to think with drawings, develop their ideas and solve complex problems with them. Sketches therefore play an essential part in knowledge acquisition and representation.

1.1 The storing sketch, the talking sketch and the thinking sketch

Sketching as an externalisation procedure helps the designer store solutions and reduce memory load. van der Lugt (2005) refers to this as the storing