Exploring Perception using Design as Research Method and Fostering the Design of Multisensory Data Physicalisations

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In this position paper we are going to present two projects which both address, utilize, or incorporate different senses. The first project investigates perception using design as a research approach. The outcome of this design research is a multisensory toolbox with the aim to re-sensitize the user by creating conscious experiences of different, connected or translated sensory impressions. The second project provides multimodal instantiations of mental models. Incorporated in a toolkit they are meant to be utilized in the design process of physical data representations with the aim to foster multisensory, more intuitive, and more innovative design ideas.

CCS CONCEPTS • Human-centered computing • Visualization • Visualization design and evaluation methods

Additional Keywords and Phrases: sensory design, design research, data physicalisation, image schemas

1 Background

Coming from a background in design, I did my Master's degree in Information Design. This design discipline deals with the question how to design information in the most adequate and comprehensible way. In my Master's thesis I explored the field of sensory design and investigated the multimodality of human senses, in order to communicate and receive information more consciously. Still seeing great potential in going beyond vision and doing design research in the field of HCI, I started my PhD. Together with my supervisors Jörn Hurtienne and Carolin Wienrich, I'm engaging now with the field of data physicalisation.

2 Previous and actual work

2.1 Master's Thesis: PERCEPTION

For my Master's thesis *PERCEPTION – Aspects of a conscious perception*, I engaged with human perception. Digitalization and increasing use of media led to a flood of visual information and visual oversaturation. While consuming visual media primarily via touchscreens, the other senses get neglected. To investigate the full range of perception, I started to explore my own sensory impressions using design as research tool. I did different design

experiments like sketching and comparing visual landscapes and sound-landscapes (Figure 1a and b), collecting sensory experiences of different (public) places in a perception diary (Figure 1c), catching different textures visually using frottage technique (Figure 1d) or collecting and physically sketching tactile impression by creating, e.g., clay tokens and iron structures (Figure 1e). Further I did a row of small workshops and questionnaires to investigate other people's perception and how they experience the physical artefacts, I created before (Figure 1f).

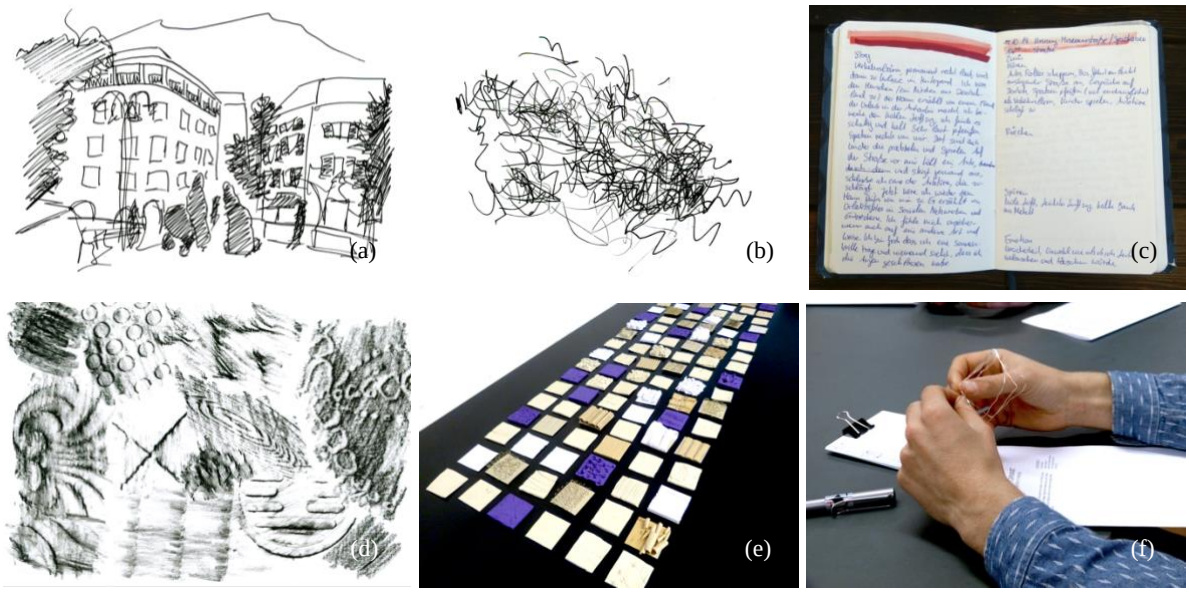

Figure 1: (a) sketch of visual landscape, (b) sketch of sound landscape, (c) perception diary, (d) tactile experiences captured by frottage technique, (e) different tactile experiences made of clay, cardboard, iron and play doh, (f) workshop to investigate other people's perception and how they experience the artefacts.

Out of this research process I developed a toolbox which helps people to re-sensitize. The different tasks, tools and artefacts foster the experience of different sensory modalities more consciously and investigate the connections, translations, and interchanges between senses. The wooden box (Figure 2) contains a considerable number of artefacts which offer different sensory experiences and tasks, e.g., drawing the sound of a singing bowl, mapping smell probes to colours, translate different tactile probes into shapes and colours, or explore tactile artefacts which make taste accessible for sight and touch.

Figure 2: Box of perception.

2.2 PhD: Image Schemas for the Design of Data Physicalisation

In my PhD project I engage together with my supervisors with the field of data physicalisation. A data physicalisation is an artefact which encodes data by its geometry or material properties [1]. A particular class are multisensory data physicalisations, which encode data by multiple representational modalities, and require at least two senses to fully interpret and understand the represented data [2]. Data physicalisations bare the potential to address different modalities and to map data also to physical and spatial properties. For example, temperature data, can be mapped to physical warmth, softness, colour, or vertical space like in a thermometer. Data physicalisations aim to enhance cognition, communication, learning, problem solving and decision-making [1, 3] and showed for this positive effects [4-10]. But when data are not mapped to visual properties, it becomes difficult to read the represented data in an accurate way. Actual data physicalisations were found to often address primarily vision, to be static and passive [2].

The aim of my PhD project is to address these deficiencies by incorporating image schemas in the design process of data physicalisations. Image schemas are abstract representations of recurring dynamic patterns of bodily interactions, that structure the way we understand the world [11]. These subconscious representations of human knowledge derived from basic sensorimotor experiences [12, 13], like the image schema UP-DOWN which we recurrently experience because of gravity or the image schema CONTENT-CONTAINER which we encounter in our everyday life as boxes, bottles, rooms or buildings. Image schemas can be instantiated in language, in behaviour or in graphical or tangible interfaces [14] where they showed to enhance intuitive use, inclusiveness, and the innovativeness of the design [15]. These properties are also relevant for physical data representations. Further, image schemas are multimodal and able to represent visual, aural and tactile qualities [12, 15] as well as kinaesthetic experiences [12, 16]. This is promising to foster the design of multisensory data physicalisations. Also, more (inter)active and dynamic data physicalisations could be fostered by some image schema groups.

We chose 15 image schemas and created in an iterative design process different sets of image schema instantiations. First, we created a set of visual representations (Figure 3a). In a second design cycle we created physical representations (Figure 3b) focusing on shape and texture of the artefacts. In a third design cycle we created interactive objects (Figure 3c) which require the user to explore and interact with, to be fully understood.

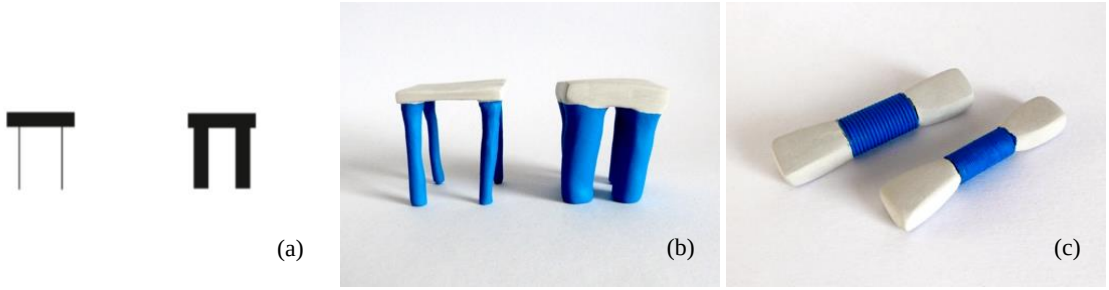

Figure 3: (a) visual representation of the image schema STRONG-WEAK, (b) physical representation of the image schema STRONG-WEAK, (c) interactive representation of the image schema STRONG-WEAK, which requires the user to push the handles apart to feel which object represents weak and which strong.

The toolkit will contain a selection of these instantiations and address multiple sensory modalities. The exploration of the objects should work as inspiration, with the aim to foster the design of multisensory data physicalisations, which address other modalities than vision or use different physical properties to encode data, like weight (e.g., addressed by the image schema HEAVY-LIGHT), or tactile properties (e.g., addressed by the image schemas SMOOTH-ROUGH or HARD-SOFT). Tasks and exercises with the aim to connect the experiences triggered by the artefacts to abstract data could further enhance the toolkit.

3 Contribution to the workshop

To this workshop I can contribute the perspective of an information designer. Initially educated in visual design, I investigated the field of sensory design and engaged with perception and the connection, translation, and exchange of sensory modalities, in an explorative way, using design as research approach. In different design related experiments, I collected and created experience as well as artefacts. Further I can contribute insights regarding the multimodal character of image schema theory and knowledge about data physicalisation to the workshop and bring all this together with the goal to foster the design of multisensory physical data representations.

4 Conclusion

The translation of data to different sensory modalities is central to create a multisensory data physicalisation. So, I am highly interested in exercises and practices which could encourage the designer of data physicalisations to cross sensory modalities and map abstract data do different senses. Beside the artefacts working as inspiration and triggering different experiences, such exercises would round off the toolkit. Furthermore, I'm curious to engage more with my own perception, collecting more multi- or trans-sensory experiences and to exchange with other researchers regarding this topic.

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