

Towards A Vocabulary Of Prototypes In Interaction Design - A Criticism Of Current Practice

Arne Berger, Michael Heidt, Maximilian Eibl

Chemnitz University Of Technology
Strasse der Nationen 62, 09107 Chemnitz, Germany
firstname.lastname@informatik.tu-chemnitz.de

Abstract: A methodological framework and a constructivist meta theory for formulating a vocabulary of prototype characteristics in interaction design are presented. Motivation for this research approach is drawn from cognitive psychology which hypothesizes that the aesthetic cognition of artifacts lies outside the scope of verbal appreciation. First, the shortcomings of the related design research literature are discussed in an attempt to frame a suitable methodology for overcoming these issues. It is also shown how the analysis of existing literature, protocols and observations will fit into this research scheme. Second, an accompanying meta theory building on Latours [15, 16] account of artifact–subject relations within the actor network theory, is described.

Keywords. Key words: aesthetic cognition, ANT, design theory, prototypes, methodology

1 Motivation

The German »Entwurf« is farther-reaching than the two english terms »draft«, as in preliminary version, and »design«, as in final artifact. Every final design is the draft of a new design. This circle is fundamentally endless and as much based on the professional agency of designing as it is based on conscious and subconscious processes of aesthetic cognition. This dualistic peculiarity of the »Entwurf« may be one of the reasons, why German writing design researchers find it arcane to partake in English publications. Solely embracing professional agency, the very idea of »Entwurf« would be fundamentally incomplete. This dualism is, however, more than linguistic quibbling. The alternation of aesthetic cognition of existing artifacts, subsequent designing of future artifacts and subsequent aesthetic cognition is their very focus.

Design activities of professional individuals and groups have been studied quite extensively since Donald Schöns seminal book »The Reflective Practitioner« [27]. Schöns initial insights into reflective practice are still the main anchor points [2] for contemporary design research. What Schön coined as »reflective practice« is nowadays mainly investigated with the help of interviews, protocol- and observation stud-

ies. See e.g. [7, 22]. Schön's depiction of design work as a »conversation with the material« is particularly well studied by e.g. Goldschmidt [10, 11] or Gero [9].

However, within the scope of design research, the role of aesthetic cognition in the before mentioned circle of »Entwurf« following »Entwurf« without hard boundaries between draft and design is barely researched. Among the few noteworthy are Petruschats [24, 25] remarks on the cognitive similarities between the decisions of designers while designing artifacts and those of users when choosing and using said artifacts. This resonates well with Whitfield's [29] account of aesthetics as pre-linguistic knowledge. Hence aesthetics are not conceived as an »artistic« aspect of design, »but rather as a fundamental process for acquiring and creating knowledge« [29] which depends on the aesthetic perception of every involved individual and not the designer alone. While both Petruschat, a cultural scientist, and Whitfield, a psychologist, refer back to Damasio [5] somatic marker hypothesis, they both alike close the circle between draft and design, thus moving the artifact and its aesthetic cognition into the centre of attention.

If both Damasio and Petruschat are right, design research needs to take a step aside from investigating how designers work to researching the very characteristics of design artifacts, including said aesthetic processes, once again acknowledging Daley [4]. This presumption moves the focus from investigating design processes to the research of the aesthetic cognition of design artifacts. This may be approached from two main directions that inevitably inform each other. With cognitive psychology being the first, design research can contribute to the understanding of the very characteristics of design artifacts. Both disciplines need to inform each other, albeit are quite different to be embraced in a single scientific endeavor. Hence, the paper at hand concentrates on the description of an evolving methodology for characterizing design artifacts, especially those in interaction design, which in particular receive little interest.

2 Related Work

Design artifact centered research ranges from the discipline independent investigation of, e.g. pivotal qualities of sketches [10, 11] to the very particularities of design artifacts in product and engineering design, where e.g. Pei [23] counts 37 different kinds of design representations. This growing and ongoing interest to describe what design artifacts are and what they do slowly expands to the specifics of prototypes in interaction design. Most remarkably and simultaneously singular is Lim et al. [19] recent approach to an anatomy of prototypes. Thus moving forward from an exhaustive body of literature, e.g. [8, 13, 28] that exclusively describes the utilization of prototypes in software engineering and interface design but not their inherent specifics.

Accordingly, we share Lim's view that current research into the dimensions of prototypes in interaction design is not sufficient because it deals only with »what to do with prototypes without understanding what they actually are« [19] However, Lim's ap-

proach to »establish a fundamental definition of prototypes« [19] is limited for a couple of reasons.

First, their approach »is not meant to be complete; it is, however, meant to be useful« [19]. Thus, the anatomy of prototypes is a somewhat simplified version of what prototypes in interaction design are, limiting it to a tool for designers only [19]. Second, their approach is based »on the fact that prototypes are not the same as the final design« [19]. Because of this assumption, this constrained collection of preliminary prototype attributes may not be extended to those of interaction design artifacts in general. Consequently, those limitations severely restrict the usage of this collection of attributes. Neither it is suited for facilitating communication between stakeholders, nor is it sufficient for a complete description of prototypes from the direction of other stakeholders, nor from the direction of the artifact itself. On these grounds the proposed list of attributes is ultimately not useful as a framework for investigating aesthetic cognition of said artifacts.

Lastly, and furthermore problematic, the methods Lim et al. applied, have not been clearly described, making it hard to replicate results in more exhaustive settings. We aim to address those issues with a substantial meta theory and a clearly defined methodology in the prospective building of a vocabulary for prototypes in interaction design. The focus of this short paper is the proposition of a meta theory and an operation breakdown of the applied methodology.

3 Methodology And Applied Methods

The approach to form an exhaustive definition of dimensions of prototypes is building on four stages of analysis. The first stage is a meta theory that will be described in depth in the next chapter. The meta theory is based on Latour [15, 16] who developed a symmetric view of how artifacts and subjects are interrelated forming a framework for further analysis. In the second stage, this framework is used to categorize existing dimensions of prototypes from three bodies of literature. The first corpus of categories emerges from efforts of Floyd [8] and Houde et al. [13] among others who aim to describe entry-points into the perception of design prototypes for different stakeholders. The second corpus of categories has been gathered from various sources discussing »fidelity«. Quite remarkably, the overwhelming body of literature about prototypes in interaction design is still in the middle of a debate about this very fidelity [1, 3, 17, 21]. This discussion aims at finding a definite model for categorizing the varieties between low fidelity sketches vs. high fidelity models and between non-functioning vs. working prototypes. However, this body of literature is a rich resource for categorizing concepts that researchers used to describe attributes of prototypes. In that way the fidelity debate can, after all, indirectly inform our research about what prototypes are. A third corpus of emerging categories is provided by researchers who are trying to establish vocabulary lists to precisely describe specific aspects of prototypes. Most noteworthy among them are the interaction attributes proposed by Die-

fenbach [6] and Lim [18]. In a third stage, the thereby evolved preliminary categories are validated and advanced with the analysis of protocols of discussions between interaction designers and software engineers about the evolution of different mobile interaction applications. The fourth and final step is set to validate the completeness of the emerged categories. In design research this is usually accomplished via the analysis of expert interviews or observation studies. This feedback may instead very well derive from an analysis in cognitive psychology of appropriate design actions.

Following the tracks of socio and cultural research and protocol studies in design research, e.g. [10, 22], Mayrings [20] qualitative content analysis method is being applied. The method is particularly qualified to establish a corpus of categories where none existed. It is also well suited to analyze both text, as in interviews and protocols, and image, as in sketches or prototypes.

4 Fundamental Specification Of Subject-Artifact-Relations

A robust meta theory is prerequisite for a legit vocabulary of interaction design prototypes. Therefore our research is based on a meta theory of fundamental artifact-subject relationships. We adopted Latours [15, 16] proposition for the approachability of its symmetric view of artifact–subject relationships. However, Latours proposal is empirical sound in its very nature and thus fundamentally grounded in practice. A possible future meta theory may as well be based on the data provided by cognitive psychology. According to Latour the state of artifacts within the agency of human subjects is usually seen as fundamentally binary. The artifact may as well change the subject as the subject may change the artifact [15]. This oversimplification suggests ontological contradictions, thus four distinctions of this amalgamation are more likely. They are proposed by Latour as translation, composition, blackboxing and delegation.

Translation: Neither the subject nor the artifact act on their own. Instead a subject-artifact or an artifact-subject is being composed as a hybrid »actant« that follows a third objective that is different from the aim of the artifact (its inscription) or the subject alone [16].

Composition: Agency is usually a combination of interleaved artifact-subject-relations that are taking effect together. Effective user agency can only be achieved by using those connected actants. Those actants include already inscribed means of agency that enable future activity. Thus activity is a combination of actants [16].

Blackboxing: Consequently time and space are folded as they interweave multiple subject artifact agencies. In turn they concurrently unfold those underlying cascades. Artifacts are as well single elements as they are compositions of multiplexed artifact-subject-configurations [16]. An artifact is as well a singular component as it is the

sum of folded artifact subject configurations. The interweaved nature of those complex and nested subroutines stays implicit as long as an artifact is properly operating or as long as the subject refuses detailed appreciation. However, the moment an artifact breaks, its enclosed cascading blackboxes are unfolding.

Delegation: These accumulations continue to delegate actions of absent subjects [16]. An artifact contains coagulated work of other actants that in turn transform the artifact into an actant on its own. Latour exemplifies the concept of delegation with a »sleeping policeman« a speed bump designed to slow down motorists in urban areas [16]. The moral goal to safeguard pedestrians is translated to the car drivers selfish goal to safeguard his vehicle. This translation is not apparent, as the ultimate goal remains unchanged. In turn the goal may have been accomplished by other means, as e.g. traffic signs. In both cases the manifestation in concrete material changed while the intended goal remains unchanged [16]. Additionally the changed material may result in driver reactions that are unforeseen by the designers of the speed bump or the traffic sign alike. The initial intention may permanently remain unknown.

Latours propositions are relevant, as they explain that those bonded aspects need to be taken into account when discussing the role of artifacts in human agency. Artifacts are not only relational objects with a locked-in meaning, that is activated whenever triggered. Instead artifacts can very well delate an inscribed meaning of now absent subjects. However, this connection of delation and absent is the base for a broad interpretation by currently present subjects. In relation to artifacts in interaction design, as the topic at hand, a shift between the designers intention and the users interpretation occurs. This once again seconds the very concept of aesthetic cognition.

There are other concurrent research approaches for a proposed application of these theoretical findings in a practice-oriented context. Schäffer [26] e.g. generalizes Latours propositions to an in-between of artifact and subject, that very well may help the understanding of facilitated human agency. However, focusing on the in-between considers this connection as a mere »contagion« of subjects by artifacts, thus disguising the discussion of concrete dimensions between artifact and user. An antithesis is proposed by Janlert [14]. Their radical description merely sees artifacts as »things in themselves« [14 p.3]. The lack of practical relevance of this account is apparent, as the author himself is an interpreting subject that is observing other interpreting subjects. Hence the »thing in itself« may very well exist but can never be experienced without human interference.

We have chosen a middle ground different from these accounts by Schäffer and Janlert. We do not exclude human agency of intention and interpretation. In addition, we do not intertwine artifacts and subjects to an inseparable amalgamation. Hence the confrontation of artifact (sketch, prototype, product) and subject (designer, user, stakeholder) is three parted.

1. The artifact by itself is solidified intention in specific material. Some of the characteristics of intention and material are interchanging. Speaking with Latour, the speed bump made of concrete becomes a police man and the intention of the police is materialized in concrete [16]. Different processes of exchange are possible. The same intention may be manifested in different material. Interpretations of the same material may profoundly differ.

2. The designer of an artifact is following a specific intention that leads her to inscribe specific semantic aspects into the artifact. Those very aspects may be manifested in various materials. The intentions behind a speed bump or a traffic sign are fundamentally equal. Yet their specific semantic and material manifestations are fundamentally different.

3. Users interpretation of an artifact evolves from the perception of its material. Maybe the car driver will never realize the designers intention to safeguard pedestrians. He will interpret the speed bumps materialization in concrete as a threat to his car. He as well may interpret the traffic sign as beautifully colored or yet another patronization. Still, at least in theory, both artifacts may lead to safer roads.

These three aspects differentiate between artifacts intentions and interpretations, thus shaping a nuanced approach for the analysis of their aspects. The concept of artifacts as black boxes explains different interpretations of an artifacts intention. To a lesser extend it also explains its semantic body between intention and its material. Different stakeholders are interconnected through the artifact as a) their interpretations are based on the artifact, b) their intentions and their knowledge are inscribed into the artifact and c) their interpretations are once again based on the artifact (sic).

5 Interpreter, Intention, Content, Material

Following these theoretical accounts four base categories may be deducted to structure the interconnection between subjects and artifacts in interaction design. The distinction between professional designer and utilizing user falls short considering our meta theory and considering aesthetic cognition. The artifact for reducing speed has multiple dimensions. The first dimension being its specific material. The materialization of the artifact is foremost following technological considerations. To a certain extend decisions about the material are subordinate to the semantic body of the artifact. The speed bump may very well be a steel construction, as the traffic sign may be an image on a display instead of a drawing on a steel plate. The artifact always bonds the material and the designers intention. We specifically imply that the material may not have been consciously chosen but found or recombined as long as it complies with the designers intention. The designers intention may temporarily or permanently remain unknown. Maybe the car shall be damaged after all. Once again, the material is only an afterthought. The car may be damaged with steel or concrete as pedestrians may be safeguarded with symbols on signs.

There is another layer of differentiation between material and intention, especially considering professional design activity. We propose the concept of »semantic body« as a working hypothesis. Body describes how the artifact is build to achieve the designers intention. This is different from a manifestation in concrete material, as outlined below.

Body describes which actions, data, functions and interactions the artifact embodies. We reach the limits of the scope of the speed bumps as an example: made of concrete or steel, the speed bumps function is very simple. It may as well be an interactive device that automatically reacts to the volume of traffic. Its functionality as well as its interactivity would fundamentally differ; still it may be manifested in unchanged material. This can as well be expanded to the traffic sign at the roadside. It may be a screen, fixed to display a permanent speed limit, it may manually be set to different speed limits, automatically by a timer switch or interactive by a traffic surveillance system. All four possibilities leave the materialization unchanged but incorporate more information to achieve certain levels of interactivity.

The dimension of the artifacts body characterize the aspects of function, interaction, semantic and appearance. They enable the artifact to take effect and lie in-between the intention and the material. The dimensions of the body are implemented in specific material, while the intention lies behind both body and material, qualifying the designers objective.

6 Future Work

Within the scope of this work, an exhaustive application of the described methodology is pending. It is currently being applied on relatively small samples to show its usefulness and the resulting »completeness« of the vocabulary. Sample size being an issue, consequently this methodology may be adapted for a larger scale for some of the experiments. Outside the scope of this work, an application of the vocabulary within cognitive psychology is pending, subsequently responding in a follow-up application in a design research setting.

7 References

1. Buxton, B. 2007. *Sketching User Experiences*. Morgan Kaufmann.
2. Chai, K.-H. and Xiao, X. 2012. Understanding design research: A bibliometric analysis of *Design Studies* (1996-2010). *Design Studies*. 33, 1 (Jan. 2012), 24–43.
3. Coyette, A. et al. 2007. Multi-fidelity Prototyping of User Interfaces. *Human-Computer Interaction – INTERACT 2007*. C. Baranauskas et al., eds. Springer Berlin / Heidelberg. 150–164.
4. Daley, J. 1982. Design creativity and the understanding of objects. *Design Studies*. (1982).
5. Damásio, A.R. 1994. *Descartes' error: emotion, reason, and the human brain*. (1994).

6. Diefenbach, S. et al. 2010. Ein Interaktionsvokabular: Dimensionen zur Beschreibung der Ästhetik von Interaktion. *Usability Professionals*. (2010), 27–32.
7. Dorst, K. 2006. Design problems and design paradoxes. *Design Issues*. 22, 3 (2006), 4–17.
8. Floyd, C. 1984. A systematic look at prototyping. *Approaches to prototyping*. 1, (1984), 1–18.
9. Gero, J.S. 1990. Design prototypes: a knowledge representation schema for design. *AI magazine*. 11, 4 (1990), 26.
10. Goldschmidt, G. 1992. Serial Sketching: Visual Problem Solving in Designing. *Cybernetics and Systems*. 23, 2 (Mar. 1992), 191–219.
11. Goldschmidt, G. 1991. The Dialectics of Sketching. *Creativity Research Journal*. 4, (1991), 123–143.
12. Berger, A.: Design Thinking for Search User Interface Design. In: Wilson M.: Proceedings of the 1st European Workshop on Human-Computer Interaction and Information Retrieval. Workshop in: 2011 British Computer Society Conference on Human-Computer Interaction (BCS-HCI 2011). New York, NY: ACM (2011)
13. Houde, S. and Hill, C. 1997. What do prototypes prototype. *Handbook of human-computer interaction*. 2, (1997), 367–380.
14. Janlert, L.E. and Stolterman, E. 2010. Complex Interaction. *ACM Transactions on Computer-Human Interaction*. 17 (May. 2010), 1–32.
15. Latour, B. 2002. *Die Hoffnung der Pandora*. suhrkamp taschenbuch wissenschaft.
16. Latour, B. 1999. *Pandora&s hope*:. (1999).
17. Lim, Y. et al. 2006. Comparative analysis of high-and low-fidelity prototypes for more valid usability evaluations of mobile devices. Proceedings of the 4th Nordic conference on Human-computer interaction: changing roles. (2006), 291–300.
18. Lim, Y. et al. 2009. Interactivity attributes: a new way of thinking and describing interactivity. Proceedings of the 27th international conference on Human factors in computing systems. (2009), 105–108.
19. Lim, Y.-K. et al. 2008. The anatomy of prototypes. *ACM Transactions on Computer-Human Interaction*. 15, 2 (Jul. 2008), 1–27.
20. Mayring, P. 2010. *Qualitative Inhaltsanalyse: Grundlagen und Techniken*. Beltz.
21. McCurdy, M. et al. 2006. Breaking the fidelity barrier: an examination of our current characterization of prototypes and an example of a mixed-fidelity success. (New York, NY, USA, 2006), 1233–1242.
22. Paton, B. and Dorst, K. 2011. Briefing and reframing: A situated practice. *Design Studies*. 32, 6 (Nov. 2011), 573–587.
23. Pei, E. 2009. Building a Common Language of Design Representations. (Oct. 2009), 1–689.
24. Petruschat, J. 2005. *Das Leben ist bunt*. Technical Report #21. form+zweck.
25. Petruschat, J. 2011. *Wicked Problems*. practice based research.
26. Schäffer, B. 2007. „Kontagion“ mit dem Technischen. Zur dokumentarischen Interpretation der generationenspezifischen Einbindung in die Welt medientechnischer Dinge. Die dokumentarische Methode und ihre Forschungspraxis. R. Bohnsack et al., eds. VS Verlag für Sozialwissenschaften. 45–67.
27. Schön, D.A. 1983. *The reflective practitioner: how professionals think in action*. Basic Books. (1983).
28. Virzi, R.A. 1989. What can you Learn from a Low-Fidelity Prototype? Proceedings of the Human Factors and Ergonomics Society Annual Meeting. (Oct. 1989), 224–228.
29. Whitfield, T.W.A. 2005. Aesthetics as Pre-linguistic Knowledge: A Psychological Perspective. *Design Issues*. 21, (Dec. 2005), 3–17.