Chapter 5
Ways of Drifting in Design Experiments

In Chap. 4, we presented a Knowledge-Relevance model (K-R) that maps design activities in terms of evaluation and hypothesis construction, and knowledge and relevance interests. We analyzed some of the ways in which hypotheses construction takes shape in the four traditions we have identified in Chap. 3. In this chapter our focus will be at the very heart of the model: how design experiments articulate research interests, how drifting happens in experimentation, and how drifting happens between design experiments. Based on the corpus of PhD dissertations that form the foundations of this book, we provide a typology comprised of five types of design experiments. We will label these as *accumulative*, *comparative*, *serial*, *expansive* and *probing*.[1]

Our typology accounts for relations between and across major cases, iterations and immediate thoughts embodied in sketches and prototypes. The purpose of the typology is to provide an overview that respects and accounts for the characteristic ways in which constructive design research happens: process-loops where hypothesis, experiments, and insights concurrently affect one another. We argue that when knowledge from experimentation is continuously fed back into the research, it drifts, but through a pattern captured by our typology. The argument against formal strict methodologies is an often-encountered theme throughout the dissertations that we draw upon. Most writers argue that design research is more than problem solving because design challenges and problems tend to change significantly during the design process.

[1] This work is based on the five ways of drifting' paper (Krogh et al. 2015) and provides a general outline of the characteristics which point to the methodological roles that design experiments and design work may contribute in constructive design research.

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5.1 Drifting in Constructive Design Research

In classical scientific methodology, researchers are encouraged to create interesting and novel hypotheses, but use well-known methods in pursuing knowledge. 'Drifting' is seen as a flaw because it introduces method variance that makes the results of the study unreliable. Redström (2011) also points to this. In design, however, 'drifting' is usually seen as a positive quality measure. It tells the story of a designer capable of continuous learning from findings. This, in turn, signals sensitivity to adjusting conditions and a good 'nose' for hunches. Likewise, constructive design research that does not drift misses this general hallmark of recognized professional excellence, and may fail to gain respect from fellow designers. Yet, tolerating 'drifting' raises another built-in dilemma between whose criteria leads research, designers' or researchers'. For the latter, the question is the degree in which researchers can trust the results of constructive design research.

When examining the existing research literature, one is left almost empty handed when searching for detailed accounts on processes and basic constituents of design experiments. As noted by Redström (2017) they take up many forms. Zimmerman and Forlizzi (2008) attempt to develop a formal account of methods used in constructive design research. They suggest that a foundational distinction should be made between two different methodological approaches:

i. A philosophical approach, where researchers wish to 'investigate a previously articulated theory through a process of making' (e.g. 'ludic interaction', 'rich interaction', 'aesthetics of interaction', etc.); and
ii. A grounded approach, where researchers focus 'on real-world problems by making things that force a concrete framing of the problem.'

This meta-level classification tells how practitioners see experiments. It remains abstract, however, and provides few insights into how design practice and experiments are conducted in either of these approaches.

In order to align the methodological foundation of constructive design research with the practices of professional design Brandt and Binder (2007) and Redström (2017) suggest that design experiments in design research can be better understood as being framed by a 'program' and 'research question.' They assume that research-through-design (which we here term constructive design research) can be modelled in the same way as a design project where a program or brief is typically used by a client to formulate an assignment for a professional designer. While they put much effort into defining the notion of the program and research question, they say little about the design experiments themselves. According to them *experiments* in constructive design research are examinations of *questions* residing in *research programs*. Bang et al. (2012) point to the act of hypothesizing as a fruitful and 'direction-providing' activity in design. Whereas the work of Zimmerman and Forlizzi (2008) articulates design research as being theoretically, technically or empirically inspired, Bang et al. (2012), Bang and Eriksen (2014) follows the line of Brandt and Binder, and Zimmerman et al. (2010).

Along the taxonomy of 'Question, Program and Experiment' promoted by Brandt (2006), Brandt and Binder (2007) and Redström (2017), Bang and Eriksen (2014) point to the changing characteristics of experiments as they are conducted at different times during a constructive design research process. In their account experiments may serve three different purposes, including being framing vehicles of the research; being testbeds of the limits of the research interest/ program that may cause the research to drift; and being exemplars of knowledge production. While Bang and Eriksen point to the varying roles and characteristics of experiments in constructive design research, they give little guidance to how experiments interrelate and how experiments are developed over time.

In line with Bowers and Gaver (2012) we believe it can be of great importance to declare how one got there — how the design project drifted and gained insights unintended by its original pursuit — and the knowledge one developed in doing so. In line with Gaver (2012) and Koskinen et al. (2011), our point of departure is that knowledge production in constructive design research is characterized as fallibalistic.[2] For example, any sketch can be seen as a question examining provisional hypotheses in the manner of Piercean 'abductive reasoning' (1979).[3]

5.2 Drifting Through Design Experiments: Five Methods

The heart of the K-R model in Chap. 4 is design experiments. We argued that the model enables researchers to continuously map and re-map their research activities as a conversation between hypothesis construction, experimentation and evaluation, assessed in relation to both knowledge theory and impact, in the ambition of being relevant and producing knowledge. Here, we build on this model and provide a typology of design experimentation. The typology is originally derived from the analysis of 10 PhD dissertations (Christian Dindler 2010; Ott von Busch 2008; Kristina Niedderer 2004; Linda Worbin 2010; Ambra Trotto 2011; Philip Ross 2008; Majken Fogtmann 2011; Joep Frens 2006; Aviaja Lynggaard 2012; Anne Louise Bang 2011) and in this book complemented by the corpus of dissertations included in Chap. 10.

[2] We use the term in line with Richard Feldman (2003) that knowledge do not require certainty and that claims and theories are to be considered provisional and open to change and revision.

[3] Here we bridge the design practice of sketching with C.S. Pierce' notion of abduction (1979). In our terms a sketch is the physical manifestation in any material of a design concern, which enters into conversational dialogue with the designer as suggested by Schön (1983). Sketching in this way is neither inductive or deductive, by may be considered abductive in the sense that it is a bold suggestion of a likely structure/ pattern at hand. Dorst (2015) suggest the notion of 'designerly abduction' pointing to the designers concern of making suggestions for a potential future; bridging the gap of logic reason and creative proposals. In Chap. 7 we get back to the various notions of bridging reason and creative suggestive practice in the context of constructive design research.

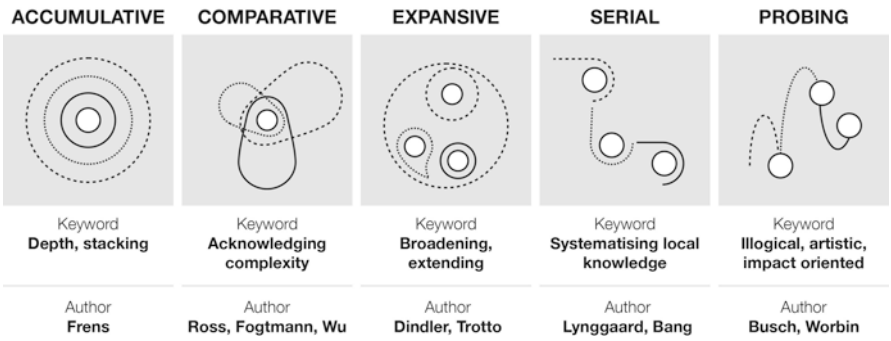

Fig. 5.1 Ways of drifting

As we have pointed out in the introduction of this chapter, the typology of drifting describes five distinct methods of knowledge production through design experiment: *Accumulative*, *Comparative*, *Expansive, Serial* and *Probing.* Fig. 5.1 includes a graphical model of each of the methods accompanied by characteristic keywords and author names of PhD theses that exemplify the methodology. All the presented methods call for 'drifting,' but to a varying degree. The first category 'accumulative' is the least forgiving and 'probing' allows for the largest degree of 'drifting.'

5.2.1 Accumulative

The accumulative method of experimentation is particularly well illustrated by the work of Frens (2006). His design experiments study how tangible interaction might enrich the experience of using a camera (see Fig. 3.3).

The design sketches and models are focused on testing specific parts of the camera and the rich interaction framework. His work is carried out in a laboratory setting in which he evaluated his camera variations to learn about their impact on the users' cognitive qualities rather than for contextual appropriateness. The work shares many similarities with what happens in technical lab settings where one particular variable is studied, and potentially disturbing elements are excluded for the sake of clarity and rigor in the study. What the study loses in relevance it gains in depth. The increasing depth of knowing derived from every experiment is iteratively build (layered, stacked) into the next generation of the same version of the camera. A way of stacking knowledge where the final artefact embodies the total knowledge accumulated through the constructive design research process.

5.2.2 *Comparative*

The method of comparative experimentation is an often-deployed merhod and can be found in the work of Ross (2008); Fogtmann (2011); and Wu (2017). They all explore their subject by means of a number of design cases — working from or towards a shared platform of comparison.

Whereas Ross is interested in ethical and aesthetic aspects of interactive products (in particular lamps), Fogtmann describes the concept Kinaestetic Empathy Interaction (KEI) through a series of design cases each highlighting distinct and overlapping qualities of KEI (Figs. 5.2a, b). Wu wanted to transgress a paradigm that sees services as products to be delivered, and proposes to see services in discursive and provocative terms. When drifting happens in the comparative method it is mostly relate to the shaping of cases. The strength of the comparative method is that it makes it possible to cover areas and aspects not yet dealt with in previous experiments and to expand knowledge gained in them.

Each design experiment should reveal as-of-yet undocumented additional qualities of a concept and confirm some previously found qualities. In totality, the comparative experiments ideally describe a novel concept, qualify phenomena, unseen quality or add a theoretical distinction to known theory. A good keyword to characterize this model might be 'acknowledging complexity,' which expresses the idea that the design experiments explore a concept by embedding it in many different environments. Furthermore, the method reveals that a lot of experimental design work done to shape a case — the characteristic of drifting in the methodology – will not necessarily find its way into knowledge production.

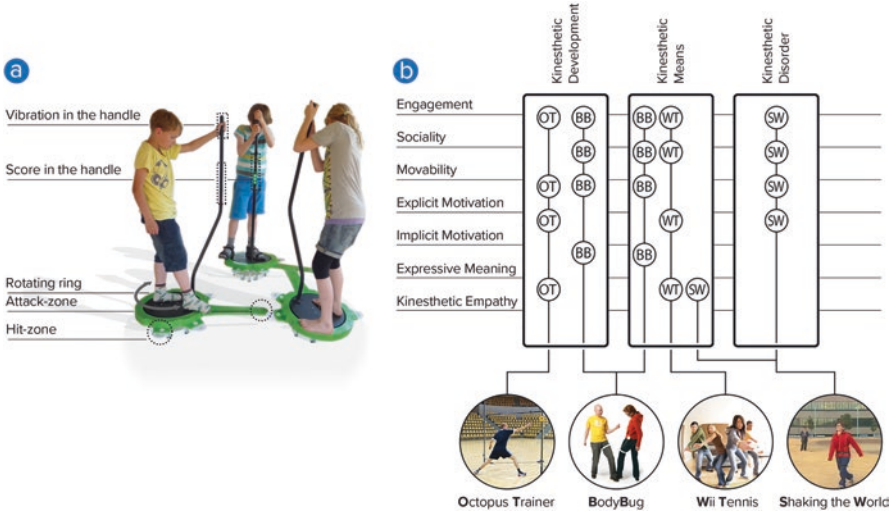

Fig. 5.2 Fogtmann's framework of KEI

5.2.3 *Expansive*

This method articulates the identification of an area as-yet-uncovered with the ambition to reveal its qualities. This mode of investigation resembles the work of nineteenth Century geographers and biologists mapping unknown areas. The work of Christian Dindler and Majken Kirkegaard Rasmussen (2015) serve as good illustrations. Unlike in accumulative experimentation, there are no strict successive or linear research designs to follow. Rather, a more complete picture emerges as mapping goes on and new data comes in.

The keywords we like to use to characterize this method are 'broadening' and 'extending.' Rather than deepening our knowledge of a domain, the method widens our perspective and extends the concerns designers should include in their praxis. For example, Majken Kirkegaard Rasmussen (2015) explores concerns and experiential qualities of what she uniformly terms 'Shape Changing Interfaces' (Fig. 5.3) through four design studies including initial form exercises, mock-ups, 'wizard of Oz' concepts and prototypes of interactive actuated shape-changing products. Christian Dindler expands our idea of what 'engagement' might mean in interaction design through three diverse experiments. For these experiments, he designed engaging artefacts and developed participatory design methods to understand engagement.

Fig. 5.3 Top left: coMotion, top right: ReFlex, bottom left: KnockKnock, bottom right: CAREss

5.2.4 Serial

The method of serial design experimentation builds on a practice designers are well aware of, seriality. In serial experimentation, design objects as well as contextual variables evolve over the course of the study. The main difference to accumulative and comparative experimentation is that in those two forms of experimentation, researchers want to vary contextual variables, but leave the basic design object as stable as possible. The aim is to study how it changes as a function of changes in contextual variables. In serial evaluation, this possibility is ruled out. The method is more akin to product development than science; in the former, each generation of products typically introduces many improvements.

In serial method, knowledge generated in a design experiment is integrated in the following experiment. In the work of Aviaja Lynggaard (2012), for example, we see how each successive experiment builds upon its predecessor. Each study generated insights that pushed the work forward. These pointers provided large and small contributions to the overarching interest in 'homing tactics.' More specifically, on the basis of a series of ethnomethodological studies, she identified a set of tactics for 'making home' — or 'homing' as she called it. Rather than following a strategic approach, she adopted an opportunistic and pragmatic approach where the results from each experiment were explored in successive design experiments. These were based on pragmatic concerns (time, technical request, budget, company interests etc.) but also on the experiments' capacity to yield additional contributions to the overall research interest.

Likewise in the work of Anne Louise Bang (2011), we find a series of experiments in which each experiment continually builds on the previous one. She was mainly interested in exploring the emotional value of applied textiles from three perspectives: 'textiles as material'; 'textiles as part of an object'; and 'textiles as part of an object in an environment.' She invited a variety of stakeholders to participate in her exploration. Her objective was twofold. One objective was to develop an in-depth knowledge of emotional aspects of textile design. Another objective was to build stepping stones helpful in developing a structured approach to inviting stakeholders to participate in industrial textile design processes (see also Bang and Eriksen 2014). A key characteristic of this method is 'systematizing local knowledge.'

5.2.5 Probing

Exploiting opportunities and exploring design ideas as they emerge through design work is also what characterizes the final method described here: probing. This method is even more radical than the serial method. In serial experimentation, there was a path from one study to the next, even though both the design piece and the environmental conditions could change. In probing, there is no need for even this

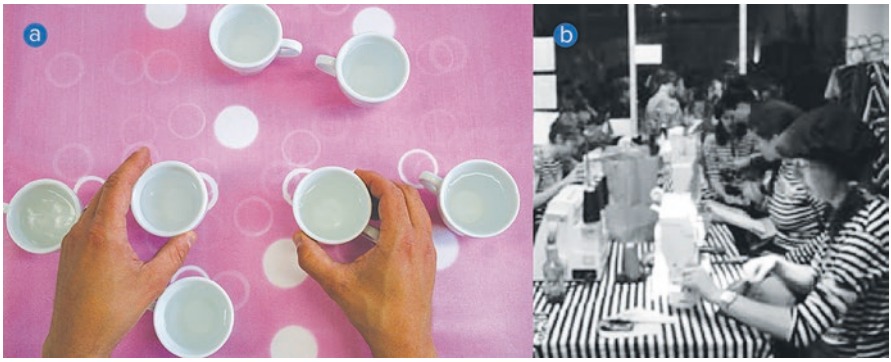

Fig. 5.4 (**a**) Worbin experiment on thermochromic textile dye, (**b**) von Busch DYI fashion workshop

amount of consistency; the method is more akin to the way design firms work. They cannot predict and expect much consistency from one project to another. Probing accepts this fact; in it, both the design and the environment can change from one study to another. A research world equivalent is *a fortiori*, the method of a case that through similarity borrow the argument of a stronger case. The success of this method depends on whether the designer can find a red thread that binds all the different arguments together.

The approach is widely used in arts and crafts oriented design research and it is well documented in Linda Worbin (2010) and Otto von Busch (2008). Yet, it is only when we examine probing in relation to the other four methods that its methodological value for design research can be fully grasped. What often characterizes this methodological approach is a personal motivation and engagement in the research pursuit, where the research activities are points of impact in a research field larger than what a single research project can be expected to cover. The choice of experiments by Busch (2008) and Worbin (2010) can be characterized as 'illogical', 'artistic' and 'impact oriented.' (Fig. 5.4).

Worbin is interested in the merging of IT and textiles in the very broad sense. Through a number of experiments she highlights recurring and important aspects of this mélange of material and experiential properties and qualities. Busch is interested in hacktivism as part of democratizing fashion production. Both the theses and, presumably, their doctoral studies are logically structured endeavours exploring the qualities of a field. However, these two are characterized by selecting in an almost eclectic manner wicked, ir-reductive and self-contradictive design settings derived from pursuing opportunities in the environment (as a professional designer would do). From both a practice and research point of view this strongly test their subjects. On the basis of such experiments they make contributions valuable to design research and foster curiosity for the field itself and its neighboring areas.

The method is typical to another context too. In dissertations done with industry, researchers may not expect full control over their research design. These dissertations

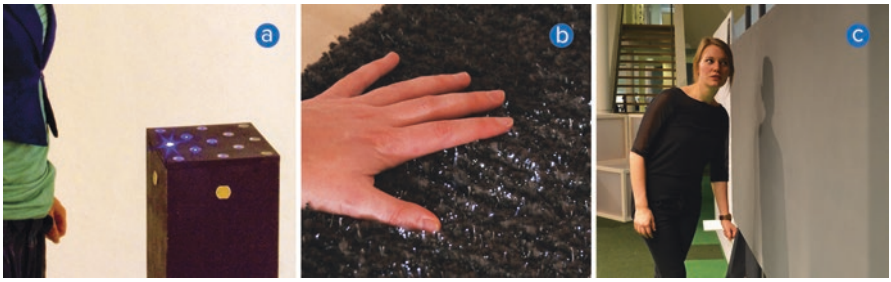

Fig. 5.5 Eva Deckers's PhD thesis: (**a**) PeP, (**b**) PeR, (**c**) PiA

typically become jump from one study to another, and the creative task of the researcher is to find a storyline that binds them together. Good examples are Katja Battarbee's by now classic dissertation *Co-Experience* (2004), which built on a miscellaneous set of studies that finally came together when she discovered the concept of co-experience, which became the thread that gave coherence to her case studies. Another example is Simo Säde's *Cardboard Mock-Ups and Conversations* (2001), which told the story of user-centered method development for a design firm. The methods were developed in client projects with a company.

5.3 How the Methods Work Over a Design Process

So far, we have talked about drifting as is it consisted of a set of distinct methods. However, many researchers have used several methods in their work. In the following we will show this by analyzing two cases: *Perceptive Qualities in Systems of Interactive Products* by Eva Deckers (2013) and a short master thesis project carried out in Denmark during 2017 by Thomsen and Schnedler (2017). The latter was also used as case in Chap. 4 to illustrate the K-R model.

5.3.1 Comparative — An Example

Deckers (2013) was interested in 'perceptual crossing,' a phenomenological concept she wanted to clarify and evaluate. She was in particular interested in how designed artefacts could be perceived as being perceptually aware of the presence and the activities of human beings. Her work is a good example of how design research can be grounded 'empirically' and 'philosophically' (Zimmerman and Forlizzi 2008). This continued interaction of perspectives and activities is also what Deckers (2013) term 'Leitmotiv' in her dissertation (Fig. 5.5).

The first two cases of her study were the Perceptual Pillar (which she calls 'PeP') and the Perception Rug ('PeR'). Both were developed in an accumulative manner. She was confident and well aware about the phenomenological starting point of both studies, and directed her efforts to refining and detailing the basic qualities of the artefact. The design of both PeP and PeR can be considered as platforms for theoretical explorations with regard to the concept of Cross-Perception. The description of PeR is complemented by Surfacing Sound, a closely affiliated student project called PiA (an intelligent audio system), which adapted the concept of perceptual crossing to listening music at home. By including this student project, Deckers includes an auditory experience into the otherwise visual argument about perception.

Throughout the dissertation Deckers talks about her activities in the dissertation as 'designing.' Indeed, she reports her design outcomes, but also those theories that informed her analysis. The models and conceptions are intended to inform designers in the future. From a methodological point, the inclusion of the PiA student project gave her method an 'expansive' form. From the perspective of Decker's argument, Surfacing Sound also showed that her framework could be used by third persons. She could argue that models and conceptions are indeed useful for designing cross-perceptual qualities into products because of the student project.

5.3.2 Accumulative — An Example

Based on the master thesis of Thomsen and Schnedler (2017), we point to how the adoption of the drifting methodology perspective helps declare the character of constructive design research work happening also at a detailed level. Whereas the work of Deckers (2013) covers larger ground and reports on years of research and includes the reporting on several design artefacts, Thomsen and Schnedler's contribution was based on the development of a single case (Fig. 5.6).

The thesis set out to explore complementing theoretical aspects to socio-spatial qualities identified by Krogh et al. (2017). Thomsen and Schnedler did this by providing interactive means for doctor-patient consultations in oncology. The design result of the thesis work was an interactive table facilitating audio recording of the consultations tagged by the use of physical tokens. The tokens furthermore served as means for structuring the consultation. Through a detailed account on activities Thomsen and Schnedler were able to point to a drift in their research question, and analyze how and what activities caused the drift.

The methods that informed the drift were observations of consultations; interviews; workshops with patients, relatives, and healthcare professionals; literature studies; and provotypes. More than 25 observational sessions and interviews were conducted 'comparatively' in dialogue with literature studies. These studies showed that the study had to explore 'the exercise of power' to understand the configuration of healthcare personnel, patients and relatives during consultations. This framing was explored in an 'expansive' manner through initial prototype sketches in order to understand the specific character of the situation. Key qualities were then

Fig. 5.6 (**a**) Interactive Consultation Table, (**b**) initial observations, (**c**) provotype, (**d**) mock-up of table tokens

deepened through 'serial' sketching producing a set of provotypes (Preben Mogensen 1992) that were explored in an expansive manner in a variety of meetings with grouped stakeholders. It was this methodologically well-documented process that enabled Thomsen and Schnedler to transparently argue for the drift from asking how can we use IT to support doctors in the orchestration of a consultation to how can an interactive interior comprising connected intelligent surfaces and objects facilitate a more equal relationship between doctor and patient?

The process of sketching and developing the actual artefact oscillated between 'serial' associative flows of idea generation. It also integrated 'comparative' discussions. As the design concept became more and more clear, well-argued aspects were developed *accumulatively* in order to gain further depth in argument.

5.4 What the Typology of Drifting Methods Reveals

This chapter has described five methods of drifting. We believe that this typology will help constructive design researchers to understand better their research processes. The reason for adopting a typological perspective was that we wanted to articulate how research is pursued.

However, the key contribution of the typology presented here is to help researchers plan research processes and experiments — what will the experiments bring and how to plan for certain experiments to unpack concerns? The typology also helps to define whether the researcher wants to:

- Increase depth (accumulative);
- Stress collective and individual characteristics (comparative);
- To learn from experiments to thicken a concept (serial);
- Broaden the scope of the study (expansive);
- To discover and unpack a research interest and how one may imagine connecting diverse experiments when the topic is ill-defined (probing).

Thomsen and Schnedler's study is relevant for us in another way too. It shows that in order to gain trust among healthcare professionals, it was particular important to be able to document how the results were created. The drifting methodology facilitated this exchange of knowledge and paved the grounds for appreciation and open discussion of proposed framing and design ideas.

The typology contributes to the existing body of knowledge in at least three respects:

- The typology of methodological processes serve as a tool for clarifying design experimentation. As pointed to in the above the methodologies serve different exploratory pursuits that complement each other and helps declare shifts between different experimental *modus operandi*.
- It allows for a concise description of different knowledge outcomes that may result from design experimentation: depth or stacking of knowledge; acknowledging complexity; extending knowledge of a certain area, and so on. Typically, in the research literature we have consulted such descriptions are not given. Rather, knowledge outcomes are classified generally in terms of for instance, 'nascent theory,' 'conceptual frameworks,' 'guiding philosophies,' or 'design implications' Zimmerman and Forlizzi (2008).
- Beyond providing a means to distinguish methods of experimentation in design research, the above typology also depicts a spectrum of methods that have a strong or light foothold in the wider world of science and technology. Accumulative, comparative and expansive experimentation have a strong foothold within technological research, which usually builds on the idea that knowledge comes from controlled experiments. Serial and comparative experimentation are more typical to the social sciences.

In many ways, we see design experiments as turns in conversation. They start form a base in literature, run through iterations that take researchers from knowledge to society and back, and finally end up adding something to existing knowledge. Things designers create during this process are boundary objects that help people to find a common language, but they are also more than that. They are heuristic devices that observations made lead during the process often lead researchers to question their theoretical assumptions. Their conceptual outcomes are obviously not models in any formal sense; they do not build on clear axioms. Rather, they are

like physical, virtual, spatial and processual descriptions of theory that match the intuitive ideas of the original theory. We believe this is what the logician and philosopher Patrick Suppes (1960: 9) might have said about them in his philosophical treatment of models in empirical science if he had talked about design. In design, we tend to think, this is a permanent state: We find it hard to believe that design, a discipline built on things that exists, one day would be able to find a true axiomatic or even paradigmatic base.

In this chapter we have first described the typology of drifting native to design experimentation. We have then showed how drifting in design, knowledge interests, and research contributions happens at a more detailed level. The ability to describe the ways in which they drift, we think, will help the constructive design researcher to collaborate better with other disciplines. This ability gives them flexibility to adopt different perspectives, see similarities between seemingly diverging ideas, and find ways to create solutions that are acceptable to several stakeholders. Drifting in a sense becomes a useful negotiation tactic when there are divergent and even conflicting perspectives on issues in the studio, product development department, or in research. The ability of designers to articulate their visions in terms of physical and virtual things also gives them ways to bypass ingrained patterns of argumentation. The danger to avoid, we think, is to leave products on their own without a narrative that gives people tools to talk about them. The typology of methods presented here also helps to track and plan the ways in which design experiments happen. It finally contributes a visual way to make sense of the epistemological ground of research practices in design, but also artistically inclined and aesthetic practices.