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## Ways of Drifting – 5 Methods of Experimentation in Research through Design

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**Abstract:** Design experiments are claimed to be a core means of inquiry in the research tradition of research-through-design. However, it is rarely articulated how the experiments were carried out in order to test a hypothesis, to begin a fruitful journey into unexplored design terrain or just gradually build knowledge. On the basis of the analysis of ten PhD theses we provide a typology comprised of five forms of design experiments in research-through-design. This provides a general outline of the characteristics which point to the methodological roles that design experiments and design work may acquire in research-through-design.

Our typology of design experiments in research-through-design accounts both for relations between major cases and iterations embodied in detailed sketches and prototypes. The purpose of the typology is to provide an overview that respects and account for the less-than-ideal way design research actually happens: process-loops where hypothesis, experiments, and insights concurrently affect one another and result in a drift of research focus and continued adjustment of experiments to stabilize the research endeavour.

**Keywords:** *Research-through-design, Methods, Experiments*

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### 1 Introduction

Research-through-Design (RtD) is increasingly practiced across engineering-informed and artistic-based design research. Classical processes of research regard “drifting” as a failure since measures and grounds of evaluation can be said to be in flux. In design, however, “drifting” is a quality measure as it tells the story of a designer capable of continuous learning from findings and of adjusting causes of action. Design Research that does not account for this professional hallmark will fail to gain respect from or build a better basis for design practice. Tolerance of “drifting”, however, points to a built-in dilemma of Design Research and, in particular, RtD when sharing knowledge across research disciplines: to what degree can one trust the results of RtD?

Based on 10 exemplary and well-cited PhD theses developed in environments emphasizing artistic quality we describe continued design experimentation in processes

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of research, and how such chains of experimentation and sketching follow a methodological rigor and how it can be modelled. The selected theses have been developed and written in the Dutch-Scandinavian-Anglo-Saxon tradition and submitted for evaluation in art schools, universities and academies exemplifying the heterogeneity of design research in this tradition. The theses represent the full spectrum of the “Lab, Field, Showroom” taxonomy described by Koskinen et al. Thus the selected theses also exhibit the full spectrum of classical research traditions though they are committed to aesthetic and artistic assessments in design and design research.

Maturation of the theoretical foundation of RtD provide grounds for better-designed research projects and programs. Such work will also help declare the qualities, strengths and weaknesses of RtD in the general landscape of research approaches facilitating interfaces to other research disciplines without adopting a whole set of theories developed in classical research areas and enable design researchers’ participation in the language game of research across other disciplines.

This paper is intended in particular to help PhD candidates and applicants, assessors of applications and PhD supervisors in RtD. Although not complete, the typology we present offers a perspective on how case design, actual design work and exploratory sketching as knowledge-building activities can be better substantiated, declared and delimited in the early phases of research work and descriptions. **The typology we present is comprised of five forms of design methodologies that we have labelled *accumulative, comparative, serial, expansive and probing*.**

In this paper we are concerned with the actual internal work activities of RtD processes – designing stuff. We are concerned with how the work itself can be said to exhibit the essential transparency of research, rather than how described knowledge flows in communities and is used to substantiate a research contribution. Thus we are dealing with building and sustaining the trustworthiness of results developed by the single design researcher adopting the RtD methodology, and not how others build upon the generated knowledge.

## **2 Related work**

RtD is coming of age and numerous researchers have made great and valuable efforts in describing and establishing the foundational theories, methods and approaches of the research area [e.g. 1, 7, 13, 18, 22, 33, 33, 34].

Although many of the fundamentals of the research area are well described they also impact different research communities with limited overlap, and yet lack the pervasiveness that research fundamentals need in order to work on equal grounds with other research disciplines and traditions. In recent times there have also been suggestions of using endless and inconsistent prepositions in order to distinguish the methodological role of design experiments from other more established research methodologies [31]. Thus, research *through* design has been defined as different from “research *on* design”,

“research *into* design”, “research *in* design”, “research *for* design” and “research *by* design” [29]. As the expanded use of prepositions has only led to obscuring the understanding of RtD, Koskinen et al. [19] has recently argued for settling on the term “constructive design research” as the fundamental epistemology. However we will, for the sake of clarity in tradition, stick to the use of “Research-through-Design” (RtD) as conceptualizing research done by means of the skilful practice of design activity revealing research insights.

## 2.1 On the details of working in RtD

In RtD and the definition of its foundations there appear to be two major strands: one that defends the specificity and, compared to other research disciplines, capacity to deliver results that one does not find in other fields e.g. Cross [7], Gaver [16], Seago & Dunne [27] and, to some extent, Zimmerman & Forlizzi [33]. The second strand models the foundations of design research upon already identified research traditions, notably the natural sciences, social sciences and art e.g. Koskinen et al. [18] and Steffen [30].

By the work we present here, we argue that a proper account of the fundamentals of RtD must begin with a close scrutiny of design experiments. In so doing, we agree on the one hand with Gaver and others that this is a prerequisite for acknowledging the specificity of RtD. But, on the other hand, we agree with Koskinen et al., insofar as we argue that we should be careful not to put so much emphasis on its specificity that its possible cross-disciplinary connections and exchanges with other forms of research are lost. This can be avoided if we use the classical vocabulary of research (hypothesis, motivation, research question, experiment), in the development of a methodological explanation of design experiments.

When examining the existing research literature, one is left empty handed when searching for detailed accounts of the process and basic constituents of design experiments. Zimmerman and Forlizzi (2008) attempt to develop a formal account of methods used in RtD and 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”. However, such a meta-level classification is too abstract, and it does not provide insight into how design practice and experiments are used in either of these approaches.

In order to align the methodological foundation of RtD with the practices of professional design Brandt and Binder [5] suggested that design experiments in design research can be better understood as being framed by a “program” and a “research question”. In so doing Brandt and Binder assume that RtD can be modelled on the same conditions as a design project where a program or brief is typically used by a client to formulate an assignment for a professional designer. While Brandt and Binder expend

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much effort in defining the notion of the program and research question, they end up saying surprisingly little about the design experiments themselves.

In the 2012 paper by Bang et al. [3] it is argued that it is counterproductive to the development of RtD to use concepts from outside research to define its foundations and it is more beneficial to provide an account of the knowledge production of the field based on established concepts e.g. hypothesis, experiment, evaluation while declaring how and to what extent design work is similar to and different from more classical scientific disciplines. Such differences are also dealt with in Redström's paper "Some notes on program/ experiment dialectics" [25] in which he discusses how design research has a nature of "drifting" that in other research disciplines would be regarded as watering down the research contribution. Traditionally, in science literature, drifting is regarded as bearing the touch of randomness, the uncontrolled, illogical and inconsistent. However, in design research and in particular the professional practice of design, drifting or pursuing alternative opportunities in the vicinity of one's work is an embedded way of arriving at relevant and high quality work. The work we present in this paper is very much in line with these concerns. However, we argue for maintaining the use of classical terms, as they are sufficiently spacious to accommodate the way RtD develops knowledge.

Furthermore there is a slight tendency in design research to also be mostly interested in the final product of a design case. However, in line with Bowers and Gaver [4] we believe it can be of even more importance to declare how one got there – how the design project drifted through and gained insights unintended by its original pursuit – and what knowledge one developed doing so. In line with [16, 18] it is our point of departure that knowledge production in design and RtD can be characterized as fallibilistic. As such any sketch is a question examining parts or the whole of a provisional hypothesis, not in a Popperian sense where a hypothesis is substantiated or falsified, but in a Piercean manner qualitatively informed or questioned through "abductive reasoning" [24] or "bold suggestions" which design experiments and sketches can be characterized as. According to Brandt and Binder [5] experiments in research-through-design are examinations of questions residing in research programs. As such Brandt and Binder do not relate their framework to hypothesizing and accept design research is also a way of describing the urge to explore an interesting concept without a well-defined hypothesis. Bang et al. [3] formulate the act of hypothesizing as a fruitful and "direction-providing" activity in design. Whereas the work of Zimmerman [33] articulates design research as being theoretically, technically or empirically inspired, Bang et al. [3] follows the line of Brandt and Binder [5] and Zimmerman et al. [34] in voicing the need to include aesthetically and artistically inclined research interests.

### 3 Typology

As stated in the beginning of the paper, the purpose here is to provide design researchers an extended footing when participating in the language games of research in general. At the same time the intention is to avoid losing the specificity and unique quality that design research has to offer in research in general and society as a whole.

Building on the work of Bang et al. [3] we present a typology depicting how discreet but linked experimental activities in RtD can be described in terms of how they facilitate building knowledge by acting in combination. The classical foundational activity of design is “sketching”. It is the dominant means by which ideas are described and evaluated for their quality and appropriateness in responses to a design challenge. Sketches are a (materialized) means for dialogue between the designer and her design challenge. Sketches also act as boundary objects for the designer and stakeholders in a design process [8, 20, 28]. Sketches can be temporal materializations of ideas subject to rapid changes, incremental as well as radical changes; sketches can also be materializations of ideas of parts of a whole. As this indicates, experimentation in design research is often intimately linked to evaluation – not necessarily formal and thorough evaluation but at the level of sanity checking. There is no second sketch without even the most rudimentary, theoretical, experiential or aesthetically inclined evaluation of the first. It is, however, beyond the scope of this paper to go deeper into discussing evaluation in RtD.

Processes of development through design and its constituent parts can be likened to babushka dolls, onion layers, ontologies of ideas, free streams of associations, arguments of logic etc. Although such descriptions carry a lot of experiential power when teaching design students the practice of design, it provides little help in enabling research peers from different scientific backgrounds understand the benefits and possibilities for co-research. Along these lines, Gaver [16] argues for annotated portfolios as tool for connecting design artefacts to theoretical concerns and design values across the domain and use of artefacts.


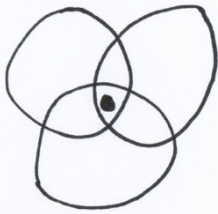
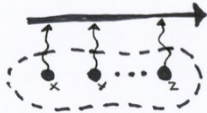

Bang et al. [3] describe a model of how experimentation is the cogwheel of RtD in dialogue with research activities such as hypothesizing, theorizing etc. We build on this model and provide a typology of experimentation in RtD. The model is derived from the analysis of ten theses (Dindler, Busch, Niedderer, Worbin, Trotto, Ross, Fogtmann, Frens, Borup, Bang) and in particular their reporting on design experimentation. The selected theses have a cultural bias towards the Dutch-Anglo-Saxon-Scandinavian approach, thus other traditions might challenge and extend the typology.

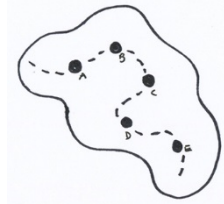
The typology describes five distinct methods of knowledge production through design experimentation: *Accumulative*, *Comparative*, *Serial*, *Expansive* and *Probing* (Table 1). Furthermore, Table 1 includes a graphical representation of each of the methods by characteristic keywords, a graphical model and author names of PhD theses that exemplify the methodology. All the presented methods allow for “drifting” –

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although to a varying degree. The first category “accumulative” is the least forgiving and “probing” allows for the largest degree of “drifting”.

**Table 1** Table of typology

Method	Graphic model	Keywords	Exponent(s)
Accumulative		Depth, stacking	Frens
Comparative		Acknowledging complexity	Ross, Fogtmann
Serial		Systematising local knowledge	Lynggaard, Bang
Expansive		Broadening, extending	Dindler, Trotto

Probing		Illogical, artistic, impact oriented	Busch, Worbin
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### 3.1 Accumulative

This method of experimentation can be found in the work of Frens [14]. His design experiments study how tangible interaction might enhance the experience of using a camera.

The design sketches and models are focused on testing specific parts and wholes and are carried out in closed lab settings where the design experiments are evaluated for their cognitive qualities, rather than contextual appropriateness. The work shares many learning and experimental similarities with what happens in technical lab settings where one particular thing 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 of knowledge on the particular. We use characterizing keywords “depth” and “stacking” to describe the design and experimental interest; 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 RtD process.

### 3.2 Comparative

The method of comparative experimentation can be found in the work of Fogtman [11] and Ross [26]. They both 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) Fogtman describes the concept Kinaesthetic Empathy Interaction (KEI) through a series of design cases each highlighting distinct and overlapping qualities of KEI. The reason for using the experimental method is in both theses to do case-relevant explorations, which cover areas and aspects not yet dealt with in other experiments and to incorporate knowledge from previous experiments. The method may comprise one central design case tried out in a range of contexts or a set of different design cases tried on both identical and different contexts. It may also comprise iterative versions of the same concept changed according to context. The basic approach is that each design experiment should reveal as-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 or add a theoretical distinction to known theory. A characterizing keyword in this model is “acknowledging complexity”, which expresses the idea that the design experiments explore the concept by pointing to how it is embedded in a

multiplicity of situations. Furthermore the method reveals that a lot of experimental design work done will not necessarily find its way into knowledge production.

### **3.3 Serial**

The method of serial design experimentation denotes how design experiments are being carried out in a certain order or logic of locality determined by how neighbouring experiments in a sequence influence one another.

Complementing the comparative method, knowledge production in the serial method is achieved on the basis of insights gained into the relationships between design experiments that proceed chronologically. In the work of Lynggaard [21] we find each successive experiment is framed on the basis of its predecessor. Each stage generates insights or raises questions that lead the work onward. These pointers provide large and small contributions to the overarching interest in “homing tactics”. More specifically, on the basis of ethno-methodological studies, Lynggaard identifies a set of tactics for “making home” – or “homing” as she denotes it. Rather than following a strategic approach, Lynggaard adopts an opportunistic and pragmatic approach where the identified tactics are further explored in concrete design experiments based on equal measures of pragmatic concerns (time, technical request, budget, company interests etc.) and the experiments’ capacity to yield additional contributions to the overall research interest. Likewise in the work of Bang [2] we find a series of experiments, where each experiment continually builds on the previous one. In this case, the main interest is an exploration of emotional value of applied textiles from various perspectives, i.e. ‘textiles as material’, ‘textiles as part of an object’, and textiles as part of an object in an environment’. Inviting stakeholders to participate in this exploration the objective with the experiments was twofold. On the one hand they resulted in the development of an in-depth knowledge of emotional aspects of textile design and, on the other hand, they were stepping stones in developing a structured approach to inviting stakeholders to participate in the industrial textile design process. A key characteristic of this method is: “systematizing local knowledge”.

### **3.4 Expansive**

This method articulates the identification of an area as-yet uncovered with the ambition to reveal its qualities, a mode of investigation resembling the work of geographers or biologists mapping new areas. The work of Dindler [10] and Trotto [32] are exemplars of this. Unlike serial experimentation there are no strict successive or linear orders or directions to follow. Experiments and learning from this will contribute new knowledge, as the area is explored. The characterizing keyword for this method is “broadening” and “extending”. Rather than deepening our knowledge of a domain, this method widens our perspective and extends the concerns we, as designers, should include in our praxis. Trotto does this through a set of experiments, primarily workshops, that continuously explore new aspects, approaches and techniques for teaching design students to acknowledge that human rights can be enhanced or suppressed in acts of designing and



making. Dindler expands our idea of what “engagement” might mean in interaction design through three diverse experiments including designing engaging artefacts and developing methods for participatory design centred on engagement.

### 3.5 Probing

Exploiting opportunities and exploring design ideas as they emerge through design work is also what characterizes the final method described here: probing.

The approach is widely used in design research and well documented in Worbin [33] and Busch [6], for example. 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 in [6, 33] can be characterized as “illogical”, “artistic” and “impact oriented”. 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 mirage 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, theses 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 neighbouring areas.

## **4 Reflections on the typology – and future work**

Compared to previous discussions and theorizing on RtD our typology contributes to the existing body of knowledge in at least three respects.

First, the five diagrams of the models can serve as an explanatory visual tool for clarifying what form(s) of experimentation will be most relevant for the research question one wants to address. We deliberately allow for the plurality of forms. Even though we have managed here to identify a number of PhD theses that are representative of one form of experimentation, it is possible in one design research project to switch between different experimental *modus operandi*. Thus, the five forms are not mutually exclusive as can be seen in Kinch [17]. But their use demands careful consideration of what kind of knowledge interest one has and which form is deemed most appropriate for its exploration.

Secondly, our typology 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” [34]. However, it is not irrelevant to ask whether a conceptual framework is “broad” or “systematic”. For instance, Forlizzi and Battarbee’s [12] framework for understanding user experience in interactive systems is broad as it conceptualizes user experience in terms of basic psychological categories (fluent, cognitive and expressive), while Desmet’s [9] framework for emotional design is meticulously worked out as a fine-grained system of emotions defined according to a varied set of distinctive traits and thus systematic. Our typology can help to clarify the nature and generality of knowledge outcomes and eventually to set up valid evaluation criteria for assessing this knowledge.

Third, beyond providing a means to distinguish methods of experimentation in design research, the above typology also to a varying degree depicts a spectrum of methods that have a heavy or light foothold in classical research and science. Accumulative experimentation and serial experimentation have a strong foothold within natural sciences, where controlled experiments are carried out in order to gain deep knowledge of a phenomenon, while expansive experimentation and comparative experimentation are typically represented within social sciences. However, a more elaborated account of how our typology aligns with methods from other research traditions cannot be dealt with here, but is postponed for future work. This future work is aligned with previous work on hypothesizing in RtD [3] and includes a paper in preparation dealing with evaluation in RtD. The three papers are all intended for conferences and will form the basis of a book including a wider study of theses expanding and adjusting the grounds of the claims in the papers.

## **5 Conclusion**

In this paper, we have demonstrated that methodological foundations of RtD can be derived from a careful analysis of how design experiments are used during an inquiry. More specifically we offer a typology for understanding the way in which an experiment may drift throughout a research process. Obviously, since our typology is made up inductively from the analysis of only 10 PhD theses it is not in any way meant to be exhaustive, but merely indicative. It makes visible a potential route for developing a firmer epistemological ground for research practices, which exploit artistically inclined activities and aesthetic practices as their primary vehicle for knowledge production. Our hope is that this can be of help to doctoral students, their supervisors, evaluation committees and research peers who share an interest in grasping the specificity of RtD while also wanting to know how it relates to research traditions outside design research.

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