Unselfconscious Interaction in the Home: A Construct

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ABSTRACT

In this article we present the theoretical construct of unselfconscious interaction, a form of interaction with computational artifacts animated by incremental engagements leading to subjective and possibly unknown improvements in relationships among artifacts, environments, and people. The construct is particularly applicable to interactions that unfold over time like those in the home. Drawing on Christopher Alexander’s (1964) notion of goodness of fit and unselfconscious culture, we build on three concept artifacts, the Discovery-Driven Prototypes (Lim et al., 2013), the Indoor Weather Stations (Gaver et al., 2013), and our own table-non-table. We theoretically analyze and synthesize these concept artifacts to develop the construct of unselfconscious interaction. The construct is comprised of the motivation of goodness of fit that is supported by the qualities of open-endedness and lived with interaction with computational artifacts. To support this theoretical investigation, we extend related theories of interaction and design research, and more specifically elaborate on concept-driven research (Stolterman & Wiberg, 2010) and strong concepts (Höök &
Löwgren, 2012). Our contribution lies in the articulation of the interaction construct of *unselfconscious interaction* and in our methodological approach to theorizing a construct that demonstrates an alternative (and complement) to empirical knowledge making in interaction design and HCI.

1 INTRODUCTION

In this article, we define a new theoretical construct we call *unselfconscious interaction*. This notion was inspired by Christopher Alexander’s theory of unselfconscious culture and specifically the concept of *goodness of fit* (1964). Our construct enables *goodness of fit* through *open-ended* and *lived-with* qualities of interaction design artifacts. The construct is particularly applicable to the home where interactions with artifacts unfold over time. Our motivation for this theoretical investigation is that in our previous studies (Wakkary & Maestri 2007, Wakkary & Tanebaum 2009, Maestri & Wakkary 2011) we found that interaction design artifacts did not contribute to the process of *goodness of fit* in the home in comparison with non-computational artifacts and environments. *Unselfconscious interaction* theorizes how interaction design artifacts can enable *goodness of fit* in ways similar but ultimately new and different than analogue artifacts.

We describe the role for interaction design in *unselfconscious interaction* is to act as a catalyst that motivates ongoing incremental engagements. To achieve this, interaction design artifacts act as resources that are purposely designed with non-existent or weak use goals, in what we refer to as *purposeful purposelessness*.

A second contribution is a methodological addition to theory making in design-oriented research in HCI. We build on and extend the theoretical work of *concept-driven interaction design research* (Stolterman & Wiberg 2010) and *strong concepts* (Höök & Löwgren 2012) by theorizing a new theoretical construct using and elaborating on their methods. We further articulate and enact the development of a theoretical construct grounded in subjective reasoning, and the analysis and crafting of design artifacts. Our approach demonstrates an alternative (and complement) to empirical knowledge making in interaction design and HCI.

Our article is comprised of six sections. After this introduction we provide a section of related literature that includes a concise description of Christopher Alexander’s unselfconscious culture (1964) and related theories of interaction. We follow this with a discussion of constructs and intermediate level knowledge in HCI that introduces design-oriented theories in HCI, offers our analysis of the theories of *concept artifacts* by Stolterman and Wiberg (2010) and *strong concepts* by Höök and Löwgren (2012) and our proposition of the idea of *construct*. Section four presents the concept artifacts and related theories that are building blocks for our construct. These include Discovery-Driven Prototypes (Lim et al., 2013), the Indoor Weather Stations (Gaver et al., 2013), and our own table-non-table. We follow this with an in depth discussion of our construct *unselfconscious interaction* detailing the motivation, *goodness of fit* and the supporting qualities of *open-ended* and *lived with*. We also describe *tensions* that balance the relationships between supporting qualities and the motivation. We conclude this section with a description of our notion of a *purposeful purposeless* design strategy. The article winds down with a discussion of our contributions focused on the implication of a new type of design artifact and the role of theory in addressing the limitations of empirical investigations and critical design. We conclude with a summary of contributions and implications.
2 RELATED LITERATURE

2.1 Unselfconscious culture and goodness of fit

In conducting our previous research on everyday design we were inspired and found resonance with the architect Christopher Alexander’s description of “goodness of fit” and his idea of “unselfconscious culture” (Alexander, 1964). We found that elements of Alexander’s ideas were particularly relevant to findings from our studies of home life (Desjardins & Wakkary, 2013; Maestri & Wakkary, 2011; Wakkary & Maestri, 2007).

In short, Alexander views unselfconscious culture as a way of making that is learned informally and motivated by ongoing corrections that over time lead to improvements of form. This is in opposition to what Alexander refers to as selfconscious culture in which making is learned academically and governed by explicit rules and knowingly aims at improvements and innovations (Alexander, 1964, p. 36).

Alexander’s unselfconscious process is animated by ongoing fixes and maintenance of the built environment by its inhabitants. These actions are tacit and follow complex and often unspoken rules. Over long periods of time, the unselfconscious designer unknowingly creates significant improvements and changes of form. The unknowing nature of unselfconscious design does not require a skilled or highly competent maker – even aimless changes may contribute or eventually lead to a well fitting form or outcome. The idea of a “goodness of fit” is the degree of equilibrium that is achieved between the form and the context:

It is based on the idea that every design problem begins with an effort to achieve fitness between two entities: the form in question and context. The form is the solution to the problem; the context defines the problem. In other words, when we speak of design, the real object of discussion is not the form alone, but the ensemble of comprising the forms and its context. Good fit is a desired property of this ensemble, which relates to some particular division of the ensemble into form and context (Alexander, 1964, pp. 22-23).

In describing goodness of fit, Alexander draws on prehistoric building traditions and those of indigenous cultures. For example, he praises the black tents of the Bedouins, the trullo stone houses found in the Itria valley in the Apulia region, and the black houses of the outer Hebrides as exemplars of achieving goodness of fit (Alexander, 1964, pp. 46-47).

Alexander sees the distinction as anonymity of making, rather than primitive or folk versus the contemporary professions of making that are established on individual achievements and recognition (Alexander, 1964, pp. 33-34). Anonymous making does not distinguish nor reflect on design or architecture as a separate entity from daily living. As such there is no specialization of labor or expertise, each inhabitant is ones own builder. The rules are not abstracted and made into principles; they are largely embedded within traditions of making and repair and learned tacitly and experientially. These qualities give unselfconscious design a self-organizing structure that allows it to consistently achieve goodness of fit.

Alexander, as an architect, speaks mainly to buildings and our built environments and to non-computational artifacts. We argue, there are three main features of unselfconscious culture—1) resources and materials, 2) misfits, and 3) time—that, as we will elaborate, have an impact on theorizing the design of interaction design artifacts that enable goodness of fit:

1. Resources and materials are ready at hand and to be found in nearby surroundings like sod, grass and straw used by the Hebridean crofter or black goatskin of Bedouin
herder (Alexander, 1964, pp. 48-49). Additionally, there is directness in the making and repair. The unselfconscious process exploits the immediate environment for resources and they are discovered through apprehension (perceiving and understanding) and generation (making or repair), which occur simultaneously. Resourcefulness and the direct manner of making are possible since the maker inhabits the very environment in which he or she makes.

2. Adaptations are seen as the dynamic between misfits and good fit. Good fit is the aim of virtually every making culture and the constant addressing of misfits leads to an “equilibrium of well-fitting forms” (Alexander, 1964, p. 50). Misfits are those things that prevent a good fit that are expressed in negative form; they are specific and tangible enough to talk about (Alexander, 1964, pp. 22-23). What allows unselfconscious design to consistently achieve goodness of fit is the motivation to constantly attend to misfits.

3. Time is the critical condition by which equilibrium of fit occurs. Without the right amount of time a form or artifact will not engender the cumulative progress toward equilibrium – goodness of fit will not occur.

Alexander’s unselfconscious culture serves as a theoretical guide and starting point for the development of our construct of unselfconscious interaction that addresses the need to include interaction design artifacts in the process of achieving goodness of fit.

2.2 Related Theories of Interaction

Alexander’s theory of unselfconscious culture may appear distant to HCI concerns (1964). However within the view of exploring people’s experiences of living with and interacting with interactive technologies over time and in everyday contexts there is certainly prior work in HCI. Further, in this review we focus on propositions for new forms of interaction that arise from an understanding of various approaches to living with technology. We view these works as related to Alexander’s idea of unselfconscious culture and the notion of goodness of fit.

Alexander’s concern with how we live with designed artifacts as part of our everyday life is in line with the evolution of interaction design from the design of tools for the office to technologies that are lived with. Forecasting the embeddedness of technologies everywhere, Weiser (1991) coined the term Ubiquitous Computing, a vision that aims at integrating computers seamlessly into our everyday lives. Building on this, Weiser and Brown (1997) introduced calm technology looking at how technology can engage and mediate people’s attention, with an emphasis on presenting information in unobtrusive and subtle ways. AmbientRoom (Ishii et al., 1998) is an early concrete example of this concept as a personal interface environment of ambient media displays and controls subtly presenting information using light, sound and movement to office workers. Tolmie et al. (2002) discuss unremarkable computing as an investigation in understanding the model of ubiquitous computing in the home. In large part, this is a critique of the techno-centrism of ubiquitous computing. Based on ethnomethodologically-informed ethnography of routines in the domestic life of families, Tolmie et al. reframe the notion of invisible technology to be embedded in and conditioned by everyday routines such that technology becomes as unremarkable as the routines, artifacts, and environments of our everyday lives. We take inspiration from Tolmie et al’s critique and emphasis on the hybridity and ecology of actions, artifacts, and environments.

Other works in HCI and interaction design have critically examined experiences with technology in its various dimensions. Most importantly, McCarthy and Wright (2004) draw on pragmatist philosophers John Dewey and Mikhail Bakhtin to argue that "we don't just use technology, we live with it" (p.ix, preface). Technology has become deeply integrated into
our everyday lives and lived experiences. Motivated by a growing interest to design technologies for contexts outside the workplace, McCarthy and Wright critically unpack interactions with technology to allow it to incorporate the sensual, emotional, intellectual and spatio-temporal threads of felt experience. Of interest in this article are the temporal thread and the underdeveloped exploration of the trajectory of experience over long periods of time. This exploration is in contrast with common interaction design efforts that focus on immediate and short-term interactions. McCarthy and Wright’s work informs our assumptions expressed in this article of an underlying pragmatist view of experience with interaction design artifacts.

The incremental changes and slow improvements in design presented by Alexander (1964) as unselfconscious design find resonance in the concept of slow technology. Hallnäs and Redström (2001) argue in their influential article on slow technology that “creating technology that surrounds us and therefore is part of our activities for long periods of time” (Hallnäs & Redström, 2001, p. 161) aims to expand the notion and practice of creating tools to make people’s lives more efficient to a design practice for more reflection and slowness. Mazé and Redström (2005) add to the slow technology philosophy by discussing how designing computational artifacts requires interaction designers to “investigate what it means to design a relationship with a computational thing that will last and develop over time – in effect, an object who’s form is fundamentally constituted by its temporal manifestation” (Mazé & Redström, 2005, p. 11). This work reveals and explores how design things inhabit our intimate surroundings in ways that enable people to make sense of them over time, on their own terms as their ideas of what they are and what they could be evolve. The authors highlight the importance for designers to be concerned with how computational artifacts will evolve over time and space with people and within their environment. More recently, Odom et al conducted a long-term study (to appear) that placed a slow technology called ‘Photobox’ in multiple homes that randomly and infrequently prints out photos. The research explored the experiences over the trajectory of time witnessing an evolution from frustration and a desire for more control towards an acceptance and ‘pleasurable anticipation’. Our work on unselfconscious interaction is very sympathetic and aligned with slow technology and aims to contribute to this research. However we mildly resist the term but more importantly we give emphasis to other critical factors in addition to time; seek to describe a more direct engagement with artifacts, and articulate an experience that may have little or no reflection since it is both known and unknown.

3 CONSTRUCTS AND INTERMEDIATE LEVEL KNOWLEDGE IN HCI RESEARCH

In this section, we describe the epistemological underpinning and methodology that informed the development of our theoretical construct of unselfconscious interaction. Our approach in this paper is a theoretical rather than empirical contribution to understanding interaction with technology artifacts in the home. We discuss how there is growing recognition of the role of design theory in HCI and interaction and its contributions to new knowledge. We then focus on the most relevant advances in design theory for our discussion, which are Stolterman and Wiberg’s concept-driven interaction design research (2010) and Höök and Löwgren’s strong concepts (2012). We conclude the section with characteristics of a construct.

3.1 Related design research theories

Seminal works like Jones’ Design Methods (1992) and Krippendorf’s description of The Semantic Turn (2005) provide detailed accounts of design methods and design rationales that are applicable to product design, architecture, as well as interaction design. In particular, Jones (1992) argues for the need of developing more detailed and specific methods for design because we are entering an era where the products of design are increasing in complexity. Moreover, Krippendorf (2005) describes the necessity of advancing the design discourse through research and encourages writing about design, institutionalizing it within
universities that support design research, and support designers and researchers to self-reflect on the discipline.

Frayling (1994) offers a well-cited epistemological work that qualifies the relationships between research and design and the nature of the knowledge produced. He suggests the categories of research into design (or about design), research through design and research for design (Frayling, 1994, p. 5). Whereas research into design investigates various theoretical perspectives about design (such as aesthetics, historical, social, etc.), research through design is developed through the making of artifacts and writing about the specific findings of those explorations, and research for design is focused on the artefact itself as well as the knowledge that is embodied within this artefact.

Fallman (2007) also reflects on the epistemology of design research and more precisely the multifaceted role of design in the multidisciplinary field of HCI. He sees two categories of research in design: design oriented research where design is used as a means to do research and produce knowledge; and research oriented design, where design is the main goal of the activity and research is used to inform the design.

Zimmerman, Forlizzi and Evenson (2007) present a model of Frayling’s research through design in HCI and provide evaluation criteria to assess the outcomes of this type of research. The authors propose to rely on the strengths of design; specifically the ability to engage with wicked problems, to frame problems with a holistic perspective, and to use the design knowledge embedded in the form and materials of design artifacts (Cross, 2006, p. 101). Central to their model is the argument that design artifacts produced through research are representations of how a problem is framed and become design exemplars which serve as a communication medium to other researchers and practitioners (Zimmerman et al., 2007, p. 493). Zimmerman, Stolterman and Forlizzi (2010) further argue that those exemplars should be examined, replicated, used as inspiration, and seriously critiqued in order to build a more rigorous discourse in HCI and interaction design theory.

More recently, Gaver (2012) articulates the risk of bringing standards in research through design which might restrain this form of research – well known for challenging and critiquing the status quo (Gaver, 2012, p.938). He aims at tempering the perceived needs of standards for research through design and instead proposes that research through design does not need to be verifiable or extensible, since it is concerned with one of many perspectives of what the future might be and not the current state of the world as it is. The central point made by Gaver is that research through design should encourage multiple views of cohabiting potential futures through design artifacts. Similar to Zimmerman et al. (2007), Gaver claims that design artifacts embody the many choices made by designers and materialize implicit theories (philosophical, functional, social and aesthetic).

3.2 Developing a conceptual construct: concept-driven research and strong concepts
In this paper, we aim contribute to the previously presented work on design research. In particular, we build on the work of Stolterman and Wiberg (2010) as well as Höök and Löwgren (2012). Both articulate a specific type of design knowledge, one that lies between theories and design instances. They focus on the importance of intermediate-level knowledge, through strong concepts (Höök & Löwgren, 2012) and concept-driven research (Stolterman & Wiberg, 2010).

Both concept-driven interaction design research and strong concepts are related, the latter draws and expands upon the former. The two theoretical approaches are offered as complements to existing approaches in HCI research. They produce intermediate-level knowledge that mediates between instances and theories (Höök & Löwgren, 2012).
The mediation creates a link between the instances of systems and artifacts and grander theories. As such, intermediate level knowledge makes no claims to universality, reserving this for mature theories.

Arguably these types of efforts have been occurring for some time in HCI research. The aim of these approaches is to legitimize these efforts as valid forms of knowledge production and to refine and improve upon them.

Designed artifacts are at the center of both approaches yet neither is concerned with the particular outcome or artifact but rather theoretical advancements related to interaction. In the case of *strong concepts*, the authors are concerned with the artifact’s “interactive behavior rather than its static appearance” (Höök & Löwgren, 2012, p. 23); and with *concept-driven interaction design research*, the authors look for “an ordered and structured way [that] tells us something about the generic qualities and characteristics of interaction in a way that explains the range of instances of interactions” (Stolterman & Wiberg, 2010, p. 100).

Stolterman and Wiberg’s (2010) argument is mainly epistemological yet they discuss examples of concepts that illustrate their ideas. These include among others the Dynabook by Alan Kay and researchers at the Xerox Palo Alto Research Center. The Dynabook was a concept design that led to the contemporary laptop computer. In creating the design concept the researchers had to describe new forms of interaction, interfaces, physical forms, software, and technology. In addition, the authors discuss how Active Badges (Want et al., 1992) conceptualized the notion of *interpersonal awareness systems* and similar to the Dynabook spawned many instances and variations of the concept.

The basic principles of *concept-driven interaction design research* are as follows (Stolterman & Wiberg, 2010):

- “Concept design research means to design and create a concept and an artifact that manifests desired theoretical ideas as a compositional whole.
- “The final artifact has the potential power to function as an argument for the quality of the proposed concept and the intended theoretical argument.
- “The quality of the artifact as a reflection of the concept and as an argument is a consequence of the careful crafting of the underlying theoretical ideas, the concept, and the artifact.
- “The careful crafting of the artifact is a process of refining and including essential characteristics of the concept while excluding features and functions that do not add to the understanding and evaluation of the concept and the theoretical argument” (p.109).

From these principles, the authors make clear that the design of artifacts is central to the theorizing based on the embodiment of concepts that together advance theoretical arguments. The “compositional whole” of the theoretical idea is found in the manifestation of the concept in the artifact. The concept is supported by but not wholly expressed in words or descriptions. And so *concept-driven interaction design research* is a matter of simultaneous “theoretical grounding” and “artifact crafting” (Stolterman & Wiberg, 2010, p. 111). The requirement to carefully craft artifacts is shared with traditional design and design research artifacts. However, the latter are typically in the service of a use situation and subject to empirical validation whereas the design of concept-driven artifacts is in the sole service of advancing an idea and measured by its theoretical contribution. As a result, as Stolterman and Wiberg state “whether such theoretical advancements lead to improvements of a situation is of lesser interest, or maybe even of no interest at all” (2010, p. 101). The value of *concept-driven interaction design research* is the mobilization of designerly competences to research challenges not design problems.
Stolterman and Wiberg argue the need to move from concept-driven interaction research to conceptual constructs (Stolterman & Wiberg, 2010, p. 112). Conceptual constructs combine individual theoretical concepts and artifacts that can either be discovered anew through the concept-driven approach or based on earlier findings of other concept artifacts. Similar to concepts, a construct is a theoretical notion that is intellectually reasoned and logically constructed rather than empirically derived.

In our approach, we adhere to the term construct yet this bears similarities with Höök and Löwgren's strong concepts, particularly with regard to how strong concepts represent an intermediate level theory or knowledge. Höök and Löwgren cite interaction design theoretical notions like social navigation and seamfulness (Höök & Löwgren, 2012) that are of a theoretical order above concepts like the Dynabook and Active Badges.

Characteristics of strong concepts are as follows (Höök & Löwgren, 2012):

• “It concerns the dynamic gestalt of an interaction design, that is, its interactive behavior rather than its static appearance.
• “It resides at the interface between technology and people. It is a design element, a potential part of an artifact, and at the same time, it speaks of a use practice and behavior unfolding over time.
• “It carries a core design idea, which has the potential to cut across particular use situations and perhaps even application domains.
• “It resides on an abstraction level above particular instances, which means that it can be realized in many different ways when it comes to interface detailing (cf. concept design vs. detailed design)” (pp. 23:5-23:6).

These characteristics can be applied well to our use of the term construct. However, we focus, much like concept-driven interaction design research, on interaction and, in our own case, design. We would broaden the second point in Höök and Löwgren’s characteristics with a focus on design concepts rather than elements, which seems too particular for constructs. We would also add that interaction would include intended qualities as well as behaviors. In addition, our notion of a construct would reside at the abstract level above instances and concepts that would mean potential realizations in different concepts as well as particulars of an interface or artifact.

A key claim of concept-driven interaction design research is the need to theorize through design without reliance on empirical analysis. The essential reasoning is that concepts and constructs are explorations of new forms that do not yet exist and that design can concretely create new forms through subjective reasoning: “The observable world is not necessarily “there,” it is “becoming” as a result of design efforts” (Stolterman & Wiberg, 2010, p. 99). We extend this claim to our approach to constructs.

In terms of validation, Höök and Löwgren state that the last step in a strong concept is a reflective process of triangulating “empirical, analytical, and theoretical domains” (2012, p. 23:13) in which it is implied that this is a community effort and takes time. Stolterman and Wiberg explicitly argue that other researchers should take up conceptual constructs to co-construct further knowledge and “collectively build more general theories about interaction and how it can be manifested in digital artifacts” (Stolterman & Wiberg, 2010, p. 114). Yet, how do we know when a construct is valid and ready to be taken up by others? Höök and Löwgren see the need for iterations of strong concepts suggesting multiple stages in their development. Supporting this idea, the authors offer an example of a strong concept in formation, Mediated Body in which they argue the further steps required are to theoretically link the artifact to related concepts and to general theories (Höök & Löwgren, 2012, pp.)
23:14-23:15). The requirements are similar with Stolterman and Wiberg who argue that the “measure of success” of a concept is that it leads to a theoretical advancement from an explicit claim of “improvement” (2010, p. 110) and the process, or argument is convincingly made based on previous theoretical work and that the concepts and artifacts together hold theoretical insights (2010, p. 109). Given these arguments, we can infer that a construct is validated for its theoretical import and analytical rigor. We look to the field to collectively take up further validation of the construct by employing empirical and further theoretical efforts in moves to refine or build more general theories.

3.3 Developing the construct of unselfconscious interaction

In this paper, we set about developing our construct by analyzing a set of interrelated interaction design research concepts as materialized in design artifacts to advance the theoretical idea of unselfconscious interaction. The claim behind this construct is that this is a new form of interaction for lived-with interaction design artifacts that enables a goodness of fit that to date has been rare for computational artifacts. The validity of the construct is in our ability to demonstrate and argue its potential for theoretical insights and adherence to analytical rigor. This approach is jointly informed by theoretical and designerly knowledge and competences.

Informed by the work of Stolterman and Wiberg’s concept-driven interaction design research (2010) and Höök and Löwgren’s strong concepts (2012) presented earlier, we suggest the following characteristics of a construct:

- The compositional whole of each concept artifact manifests concepts that when taken together argue for or describe a construct.
- The synthesized whole of the selected concept artifacts function as an argument for the quality of the proposed construct and intended theory.
- The quality of the construct is a measure of the careful crafting of the underlying theoretical ideas, concepts, and artifacts.
- The careful crafting of the concept artifacts is to manifest the essential characteristics of the concept excluding features that do not aid the understanding, the evaluation, and the theoretical arguments of the concepts and resulting construct.
- The construct resides on an abstraction level above particular concepts, which means that it can be realized in many different ways when it comes to concepts and particulars of new artifacts.

In addition to these characteristics, a construct shares the assumptions that its concern is with the dynamic gestalt of interaction design that is its interaction qualities; and constructs are in varying degrees generalizable or transferable but hold no claim to universality.

Our main contribution in this research is to articulate an interaction construct - unselfconscious interaction - however we also see a methodological contribution in our refinement and expansion of concept-driven interaction design research and strong concepts.

4 CONCEPT ARTIFACTS

4.1 Description of the concept artifacts

In this section we describe three concept artifacts that informed our construct of unselfconscious interaction: Discovery-Driven Prototypes (Lim et al., 2013), Indoor Weather Stations (Gaver et al., 2013), and table-non-table. Lim et al. (2013) designed three prototypes for a domestic environment, which aim to support the discovery of interactions to inform the design of new technology. Gaver et al. (2013)’s Indoor Weather Stations aim to playfully engage users with the notion of sustainability in the home. The table-non-table followed an
approach of designing resources for everyday designers (Wakkary et al., 2013) in order to explore interactions with computational artifacts that leverage everyday competences.

4.1.1 Discovery-Driven Prototypes

Lim et al. (2013) designed a set of three Discovery-Driven Prototypes for a home environment (see Figure 1).

Aeng-aeng-yee is a timer that plays music when it senses light. It is a white cube with rounded edges with an on/off button, a dial to set the timer, and a light sensor indicator on the side. The prototype is described as being bulky and thus different than typical timers. The interaction is simple: people set the time for how long music should play when the light sensor senses light. Once they are satisfied with the timing they can turn the timer on.

Deol-deol-yee are two artifacts that vibrate and signal with a blinking LED light. The two objects communicate wirelessly with each other. The prototypes are shaped like smooth rocks and colored in a polished dark red or blue. Each artifact has only one button. When pressed, a wireless signal is sent to the accompanying artifact to vibrate and blink its LED light. The ostensible goal is to encourage communication between family members and the generic shape is intended to allow people to use Deol-deol-yee in different ways (Lim et al., 2013, p. 77).

Tong is a sound recorder in the form of a small neck-less bottle that is shaped to differentiate it from traditional sound recorders. The bottles are white with a colored stripe, a cork cap, and a record button at the bottom of the bottle. People record a sound for up to 20 seconds by pushing on the record button and speaking into the bottle. They can listen to the recording sound by lifting the cork cap from the bottle.

![Figure 1. The Discovery-Driven Prototypes (Lim et al., 2013) consists of three prototypes: (from L to R): Aeng-aeng-yee is a music timer; Deol-deol-yee is communication device; and Tong is a sound recorder.](image-url)

The design of the Discovery-Driven Prototypes (Lim et al., 2013) was informed by a study of daily routines and aimed at discovering functionalities of prototypes that would foster creative use. The prototypes were each designed to look different than known objects in the hopes of opening up possibilities of interpretation. The design aim is to create an interpretive open-endedness and incompleteness that allows for unpredictable explorations of unknown use scenarios and possible physical and conceptual alterations that would extend the ideas behind the prototypes.
In summary, the Discovery-Driven Prototypes pursue an open-ended, incomplete, and unpredictable design to foster discovery of uses through combination with other objects and creative interpretations. The functionality of each prototype is purposely very simple.

4.1.2 Indoor Weather Stations

Gaver et al. (2013) designed the Indoor Weather Stations, a set of three devices that represent domestic microclimates. The set consists of the following artifacts: a Temperature Tape, a Light Collector, and a Wind Tunnel (see Figure 2). The weather stations are intended to be placed around the house to allow for exploration of simple climatic events: temperature gradients, light over time, and wind currents that “highlight potentially overlooked aspects of the home environment by displaying the outputs of sensor readings taken by the device” (Gaver et al. 2013, p. 3453).

Figure 2. The Indoor Weather Stations (Gaver et al., 2013) consisting of (L to R) the Temperature Tape, the Light Collector, and the Wind Tunnel.

The Temperature Tape consists of two 2.5-meter long fabric ribbons that can be extended from the spool to span an area of the home and visualize or uncover temperature gradients across the span. Each attachment contains a temperature sensor, which are connected to the spool with wires that run along the ribbons. A needle on the side of the spool moves towards the side that is warmer based on the readings from the temperature sensors. Also, on each ribbon, the stripes of screen printed thermochromatic ink change color depending on the temperature, shifting from yellow (15 degrees) to red (25 degrees).

The Light Collector is a cylindrical container topped with a funnel lined with copper leaf. The Light Collector presents a history of how the color of light changes over the course of the day. A light sensor at the bottom of the funnel collects the data every five minutes, which is then represented on a small screen on the cylindrical base as a one pixel thick line of the color sensed. The screen displays the colors of the past two hours.

The Wind Tunnel consists of a small forest of paper film trees enclosed in a clear plastic casing. At one end, a vertical pipe holds a wind sensor, and a small fan recreates the wind sensed and makes this visible by blowing on the paper film trees.

The Indoor Weather Stations aimed to playfully explore environmental matters that contrasted with utilitarian or persuasive approaches to sustainability.

4.1.3 Table-non-table

Our third concept artifact is the result of our own approach to designing for everyday competences. In previous studies, we looked at everyday practices of design and their composition of material, competences, and meaning. Everyday design relies on the
resourcefulness of home dwellers, the ability to creatively repurpose common artifacts in the home and an ongoing process of adaptation. The table-non-table is one of the artifacts that we designed based on those studies. It is a slowly moving stack of paper supported by a motorized aluminum chassis (see Figure 3). The paper is common stock that is similar to photocopy paper. Each sheet measures 17.5 inches by 22.5 inches with a square hole die cut in the middle to allow it to stack around a solid aluminum square post that holds the sheets in place. There are close to 1000 stacked sheets per table-non-table. The chassis lifts the stack about a half-inch from the floor. The wheels are small and set toward the center of the chassis hidden from view giving the appearance that the stack is floating. The chassis and motors are strong enough to support stacking heavy objects on it and even a person sitting or standing on it. The paper sheets can easily be removed to be drawn on, folded, cut, or manipulated like any new paper. Of course, new sheets of paper can also be added. The table-non-table is powered through an electrical cord plugged into a wall socket. The movement is random yet it stays within an area of less than a meter square. The movement is almost imperceptible, however, over a period of time, it becomes noticeable.

Figure 3. The table-non-table, a stack of close to 1000 sheets of paper on a moving aluminum chassis.

4.2 Interaction theories and the concept artifacts

Each of the prototypes presented are designed to exemplify a theoretical concept: ludic design for the Indoor Weather Stations, discovery and openness for the Discovery-Driven Prototypes and everyday design for the table-non-table. In this section, we describe those theoretical concepts.

4.2.1 Ludic design

Ludic design was elaborated to provide an alternative model for computing and a way to move beyond usability (Gaver, 2009). Ludic design is an approach that sees people as playful creatures who are characterized by “our curiosity, our love of diversion, our explorations, inventions and wonder” (Gaver, 2009, p. 165). Gaver argues that playfulness is not about frivolity and mindlessness, it is instead a valuable and rich way to learn about the world and
to engage with it. Ambiguity as a resource for design and supporting multiple interpretations (Sengers & Gaver, 2006) are strategies that support a playful approach by allowing multiple perspectives to form depending on who is interacting and in what context. In ludic design, surprise, improvisation, and exploration are valued as critical elements to engage with complex and serious issues (Gaver et al., 2013).

4.2.2 Discovery and creativity

Discovery is presented as an approach to learn meaningful interactions of users that can inform the design of interactive artifacts. Inspired by cultural probes and the value of uncertainty (Gaver, Dunne, & Pacenti, 1999), Lim and her colleagues’ approach is based on the idea that designers do not assume to know what people will value, rather they support the discovery of these values through user-driven creativity. The goal of the discovery approach is to allow users to explore and discover what they need and like themselves, through their interactions with a prototype in situ. This primary goal of this approach is the uncovering of “human-centered application ideas or usage ideas” (Lim et al., 2013, p. 75). Since discovery and creativity are at the center of the relationship between the users and the artifacts, Lim et al. (2013) argue that designers should not establish or prompt a predetermined “right” way of using the artifacts.

4.2.3 Everyday design

The table-non-table, informed by the notion of everyday design, manifests an approach that sees interactive artifacts as resources for creative use and reuse. We have articulated the concept of everyday design in previous studies of various everyday practices such as family life (Wakkary & Maestri, 2007), repair (Maestri & Wakkary, 2011), sustainability (Wakkary & Tanenbaum, 2009; Wakkary et al., 2013), and hobbyists (Desjardins & Wakkary, 2013). In essence, we argue that everyone is a designer. As such, design is comprised of a multiplicity of practices that share in their need to manipulate their designed worlds to improve fit and quality through ongoing transformations and adaptations. The implications of this shift include the design of technological artifacts as resources, the simplification or minimization of interaction to fit the competences, materials and motivations and meanings of the respective practices such as home life; and the notion that interaction design outcomes are assessed for their interpretive potential as much as their promised utility.

5 THE CONSTRUCT OF UNSELFCONSCIOUS INTERACTION

In this section, we discuss how the analyzed concept artifacts form a theoretical construct that we call unselfconscious interaction. Informed by the work of Stolterman and Wiberg’s concept-driven interaction design research (2010) and Höök and Löwgren’s strong concepts (2012) we developed characteristics of a construct that we presented at the end of section 3.3. We reiterate these here with a brief discussion of how our construct addresses each characteristic.

The compositional whole of each concept artifact manifests concepts that when taken together argue for or describe a construct. We selected the concept artifacts Discovery-Driven Prototypes, Indoor Weather Station, and table-non-table that embody theories of creativity, play, and everyday design as conceptual elements in the construct of unselfconscious interaction.

The synthesized whole of the selected concept artifacts functions as an argument for the quality of the proposed construct and intended theory. In our case, we utilize our analysis of the concept artifacts to make explicit qualities and aspects of our construct of unselfconscious interaction.
The quality of the construct is a measure of the careful crafting of the underlying theoretical ideas, concepts, and artifacts. We carefully selected the concept artifacts and theoretical arguments to use as building blocks for our theoretical construct. We analyzed the relationships and drew upon salient, common, or exemplary characteristics to develop our construct. We do not present or analyze these concept artifacts for their empirical value, i.e. evaluation of user experience, rather as theoretical proofs for argumentation.

The careful crafting of the concept artifacts is to manifest the essential characteristics of the concept excluding features that do not aid the understanding, the evaluation, and the theoretical arguments of the concepts and resulting construct. In our case, we analyzed the concept artifacts solely for the purpose of how they represent and make the theoretical case for our construct. For example, we do not present the concept artifacts as improved means of representing indoor weather patterns or as a computationally enhanced table, nor do we present the construct as guidelines for designers to design to this new form of interaction. Our aim is to describe and precisely argue on behalf of our theoretical construct.

The construct resides on an abstraction level above particular concepts, which means that it can be realized in many different ways when it comes to concepts and particulars of new artifacts. In our case, this characteristic is one that will hopefully follow the successful arguing for our construct. We can, however, look retrospectively at the prototypical concept artifacts we utilized to infer the many ways concepts and artifacts can be realized with respect to unselfconscious interaction.

It is important to note that what follows is a theoretical argument for a type of interaction that we labeled unselfconscious, inspired by Christopher Alexander’s idea of unselfconscious culture (Alexander, 1964). The qualities of the artifacts and concepts serve as building blocks for our argument. We discuss and analyze the existence of concept artifacts in homes yet the qualities and tensions we describe are theoretical observations rather than empirical observations.

5.1 Definition of unselfconscious interaction

Unselfconscious interaction is a form of interaction with computational artifacts that is animated by incremental engagements that over time lead to subjective and possibly unknowing improvements in the relationships of artifacts, environments, and people. The subjective improvements can be described as “goodness of fit” (Alexander, 1964) that is the degree of equilibrium that is achieved between the form and the context. The interactions are simple and tacit and typically occur over time in which significant improvements and changes of forms or environments may occur. The unknowing nature of unselfconscious interaction means it does not require a skilled or a highly competent interactor— even aimless changes may contribute or eventually lead to a well fitting form or outcome.

The role for interaction design within this construct is to act as a catalyst that motivates ongoing incremental engagements. To achieve this, interaction design artifacts are purposely designed with non-existent or weak use goals.

5.2 Description of the construct

Unselfconscious interaction as a construct is composed of a motivation and two supporting qualities (see Figure 4). The motivation is what we describe as goodness of fit. Based on Alexander (1964), this is the degree of equilibrium between things, people, and contexts. As we would expect of a motivation, goodness of fit is what explicitly or unknowingly animates and motivates the interactions with and among things. Specific to the construct is the theoretical goal to include interaction design artifacts in the process of achieving goodness of fit. Supporting qualities of the construct include open-ended and lived-with. These qualities
are desired theoretical attributes, which are manifested in the artifacts and are critical to the construct.

Figure 4. The construct is comprised of a motivation, \textit{goodness of fit}, and supporting qualities, \textit{open-ended} and \textit{lived with}.

The relationships between the motivation, \textit{goodness of fit} and the supporting qualities of \textit{open-ended} and \textit{lived-with} are not static but dynamic. This is expressed by what we refer to as tensions among supporting qualities and the motivation of the construct (see Figure 5). The tension between \textit{open-ended} and \textit{goodness of fit} can be described as the balance between an artifact being familiar and alien with respect to interaction. The tension between \textit{lived-with} and \textit{goodness of fit} can be described as the balance between an artifact being passive and active.

Figure 5. The relationship between supporting qualities and motivations are described as tensions in which opposing attributes are balanced.

Lastly, in understanding the crafting of an \textit{unselfconscious interaction} artifact, we present the idea of \textit{purposeful purposeless}. This notion expresses the need for purposeful design, crafting, and aesthetics that creates an identity that expresses the value of the potential of an artifact even when its purpose of use is unclear.

5.2.1 The Motivation: Goodness of Fit

The \textit{goodness of fit} speaks to the degree to which artifacts, environments, and people can be “fitted” together to create a desirable setting. In some sense this is the very definition of home, that is a place that is uniquely and comfortably one’s own. As Alexander (1964) makes clear, it is often the inhabitants who \textit{dwell} in the environment they change that best achieve \textit{goodness of fit}. For example, the arrangements of a living room exemplify the process of
goodness of fit in the classical sense. Home dwellers may purposely set out to design the living room by choosing furniture, curtains, rugs, wall colors and so on within the constraints and opportunities of their particular situation. However, it is often over time, after a period of settling in or having been lived with, that the living room takes on the desirable qualities sought after. This is a result of incremental additions, subtractions, and adjustments, whether it is changing the angle of furniture or replacing a single item or combining items. Each action often goes unnoticed but the cumulative of change will eventually make itself known.

Goodness of fit is not an attribute of any one thing rather it is a composite result of myriad combinations of actions, things, and people. Further, it is dynamic and even once known there are always further improvements to be sought. Lastly, to add unequivocally to its elusiveness, at the level of unselfconscious interaction it is subjective. It can be collective but then it is collectively subjective, among family members for example, and the values may not be felt or noticed by outsiders. Arguably, it can collectively emerge on a cultural level as Alexander (1964) argues with indigenous architecture to the point that it is recognizable to an outsider with a level of adequate social and cultural knowledge.

Goodness of fit is the motivation behind our construct yet it is a subjective process that is difficult to articulate in particular instances. However, we can look for positive signs that goodness of fit is being sought and that unselfconscious interaction is at play. One such sign is the combination of interaction design artifacts with other artifacts as forms of interaction and engagement. This is evidence of incremental modifications and transformations. These signs were clear in all of our selected concept artifacts. For example, the Light Collector from Indoor Weather Stations was situated in a room with stained glass windows to record the shifting colors of filtered daylight (Gaver et al., 2013, p. 3456). The table-non-table (see Figure 6), books and other objects are readily placed on top of the artifact. And the deol-deol-yee of the Discovery-Driven Prototypes is attached to a TV remote control with a rubber band in case it is lost or used together with a seatbelt to keep a driver alert (Lim et al., 2013) (see Figure 7).

Figure 6. Books and other objects on the table-non-table
In the case of unselfconscious interactions, it is the simplest of functionality that becomes a starting point for interaction that holds the potential to contribute to goodness of fit, e.g. placing objects on top of the table-non-table. This is critical and without it, unselfconscious interaction would not be possible. As discussed earlier, Alexander (1964) argued something similar for unselfconscious culture, in which there is a directness of making and the need for materials to be ready at hand. For our construct, we can interpret this as the need for interaction design artifacts to be ready and quickly allow to be put to use as a resource. If this need is not met a ready alternative will be found. Additionally, the directness of making suggests that interactions are by hand and infrequently require the simplest of tools that are also readily available, e.g. the rubber band in Figure 7. Further, we expect that no learning is required to use the artifacts or if so it is quick and informal. This means that interaction design artifacts are mapped to existing competences and skills that are of the simplest and everyday kind.

This design approach of simplicity mapped to everyday competences is evident in the concept artifacts. For example, the simplest is the table-non-table that has no user interface. All that is required is for its electrical cord to be plugged into a socket. One of its owners added to it an electric power bar to give it an easy switch for turning it on and off. The most involved interface among the Discovery-Driven Prototypes (Lim et al., 2013) is the Aeng-aeng-yee music player that includes an on/off button, a timer dial, and a light sensor indicator (see Figure 8). The Light Collector from the Indoor Weather Stations (Gaver et al., 2013) has a screen that makes it among the most complex of all our concept artifacts yet only two buttons, one to playback the day's data collection on the screen and the other to pause the display while still collecting light data (see Figure 9).
Simplicity is such an obvious concept that it is often overlooked or considered without precision. Designers argue that they design for simplicity of use or aim for simplicity of an interface. However this often refers to the elements of the interface or tasks and sub-tasks with the intention that the cumulative addition of many simple elements will remain simple in its entirety. However, this is not typically the case. Our concept artifacts strive for a holistic simplicity or simplicity in its entirety. As a result, the artifacts are minimal and seemingly single-purposed despite, as we shall see their open-endedness and long-term livability.
5.2.2 Supporting Qualities: Open-Ended and Lived With

Simplicity mapped to everyday competences and skills together form a critical design criterion for unselfconscious interaction. This necessary but not sufficient criterion sets the basis for two supporting qualities of interaction that altogether enable the potential for unselfconscious interaction: open ended and lived with.

5.2.3 Open-ended quality

Open-ended interaction shifts the nature of the interaction design artifacts to be resources for new and unknown interactions rather than prescribed means to an intended interaction. This speaks again to Alexander’s idea (1964), which equally applies to unselfconscious interaction, of readily available materials and resources for unselfconscious culture. Like many things in the home that become appropriated for new uses, consider a chair used as a coat rack or a ledge that becomes a shelf, the designed artifacts are utilized for their potential to be reinterpreted and manipulated into a new or modified end. The notion of adaptation that is central to unselfconscious culture plays out with unselfconscious interaction through interaction design artifacts that are resources to be adapted or enable adaptation in achieving goodness of fit. Interaction design artifacts can support an open-ended quality of interaction through being designed for interpretation and manipulation.

Interpretation is central to the Discovery-Driven Prototypes. The names of each artifact utilize Korean onomatopoeias to encourage discoveries of meaning and use (Lim et al., 2013, p. 77). Lim and her colleagues argue for a quality of incompleteness that allows room for interpreting the use of the forms and their meaning. The Tong sound recorder was used as a sound amplifier for a family member who is hard of hearing in interactions between a grandparent and grandchild (see Figure 10). The Indoor Weather Stations explore representation and output in that its displays play between accuracy and ambiguity. Rather than numerical output, the displays utilize color gradients on the Light Collector and fabric tape striped with thermo chromatic ink. The Temperature Tape also allows for simple manipulations with hooks on either end of the tape (see Figure 11).

Figure 10. The Tong used as a sound amplifier (Lim et al., 2013)
The table-non-table is simple in its form and purposelessness and this invites interpretation. Its presence, sound, and subtle movement constantly puzzle the owners. For example, in one home, owners allowed their pet cat to explore the table-non-table and documented the interaction in numerous photographs (see Figure 12). The cat became a surrogate for their own curiosity and its manipulation of the table-non-table by tearing and removing sheets of paper gave the owners permission to remove sheets to fold and cut into large paper snowflakes (see Figure 13)!
Figure 13. "We remembered how to make snowflakes" says an owner with a paper snowflake made from the table-non-table

5.2.4 Lived with quality

Lived with quality supports the idea that unselfconscious interaction requires time to emerge and take shape. The idea in terms of design is to consider the experience of living with an interaction design artifact similar to how someone might live with furniture or even simple items like a ceramic bowl or a lamp for years, possibly decades, or even a lifetime. Such artifacts become resources with which we co-inhabit and jointly dwell within our homes. As we discussed in section 2.1, time is a critical condition for goodness of fit and the cumulative progress toward equilibrium and transformative designs in Alexander’s unselfconscious culture (Alexander, 1964). This is equally true of unselfconscious interaction.

Designing for unselfconscious interaction means to focus on the experience of being lived with. For example, a key consideration is how an artifact would co-inhabit in the home. For example, the table-non-table that is like and not like another piece of furniture in one instance nestled between a couch and a bed just in front of a mirror. The materials and size allow it to fit yet not disappear into the environment (see Figure 14). With the Indoor Weather Stations, the Light Collector in one home is ensconced on a window ledge in among other artifacts like plants and fruits that benefitted from proximity to daylight (see Figure 15). In such cases, where there is a balance between novelty and comfort, an artifact can be lived with such that relationships can be formed and evolve over time. Indoor Weather Stations for example endured a lengthy participant study and many commented on their attachment to the artifacts despite having little explicit use for them. Most tellingly one participant commented: “They had become part of the home’s background and in a desirable way” (Gaver et al., 2013, p. 3458).
Designing for emergence over time is central to the Discovery-Driven Prototypes. With no intended purpose, meaning and interactions were discovered or emerged. Discoveries can be seen as transformations in that the nature of the artifact and its relations to other artifacts, people and the environment change. For example, the movement of table-non-table is so subtle that it can be very hard to detect even after living with it for some time. When motion is “discovered”, the nature of the table-non-table changes reframing its potential contribution to goodness of fit. A telling example of the transformation in meaning of unselfconscious interaction is the painted portrait of the Light Collector (LC in the quote) (see Figure 16):
The stations ultimately did not surprise people, a condition that led to initial disappointment, but for some a more subtle surprise, or at least awareness, built up over time. Tim described this slow creep of surprise when he related how he had made an oil portrait of the LC. In painting the LC, Tim described having to study it, seeing things that might have been unnoticed and to think about it for an extended period. He likened the process as similar to what any painter does, and how the act of painting transforms the object (Gaver et al., 2013, p. 3457).

5.3 Tensions

In Section 5.2 we explained how the relationships among supporting qualities and motivation are dynamic. The differences in the range may be fine but it is a balance that can easily snap or break, hence we refer to this relationship as a tension. The tension between the supporting quality of open-ended and the motivation of goodness of fit can be described as the balance between an artifact being familiar and alien with respect to interaction. The artifact needs to embody both aspects yet with the right degree of tension. Familiarity makes the artifact approachable and sensible. Appearing alien creates feelings of otherness and curiosity. If an artifact is too familiar, its interaction qualities and potential are framed and confined by known experiences that limit creativity and exploration. If it is too alien, it remains incomprehensible and lacks meaning. The balance between sensible and
otherworldly creates a catalyst for incremental engagements or interactions that are potentially open-ended and supportive of the motivation for equilibrium and or transformation.

The tension between the supporting quality of *lived-with* and the motivation of *goodness of fit* can be described as the balance between an artifact being passive and active. A passive interaction design artifact paces the interaction over time and becomes part of the environment. An active interaction design artifact creates a presence and solicits attention. Again, too much in either direction works against the supporting quality of *lived-with*. An artifact that is too passive fades into the background disappearing and one that is too active is very difficult to live with over a period of time.

Negotiating these tensions requires designerly judgment. It is not a matter of quantification but requires the qualitative crafting of artifact and concept to the point of balance. Mediating these tensions and finding the particular sweet spot is the role of the interaction designer, it is at this point that the designer modulates through design and computation the successful or unsuccessful experiences of *unselfconscious interaction*.

5.1 Purposeful Purposeless Design

Interaction design acts as a catalyst that motivates ongoing incremental engagements within *unselfconscious interaction*. Implicitly, we discussed in the preceding sections, under motivations, supporting qualities, and tensions, how interaction design shapes catalytic interaction through materials, form, and computing. For example, the movement of the table-non-table is shaped through computing to find the balance between the artifact being familiar and alien as well as between passive and active. One of the owners of a table-non-table only realized that the artifact moves after a week of living with it. In a variation of Alexander’s idea of *misfit* (Alexander, 1964), our participant notes that his “architect eyes were unhappy to see that the thing was always crooked and not parallel to the couch!” However, rather than repair the *misfit* in the sense that Alexander’s theory would expect, this led to the discovery of the artifact’s constant but very subtle movement. As a result, the table-non-table was moved to the center of the living space to replace the coffee table to see what could arise from this new quality.

This exemplifies a principle in designing for *unselfconscious interaction*: interaction design artifacts are purposely designed with non-existent or weak use goals or what we refer to as *purposeful purposeless* design. Our understanding of use goals is a use situation or known goal of users, e.g. composing and sending an email or managing project tasks of a group. User goals are not only not required in *unselfconscious interaction* they are not desired. However, an alternative to no user goal is a weak user goal. For example, chairs are designed with a weak user goal. The ostensible goal is to design an artifact to support sitting. Yet few chair designers except in the case of designing special purpose chairs like office chairs pay attention to the goal of sitting. Little time if any is spent studying the requirements of sitting. The weak goal allows other design goals to take hold that go beyond use like cultural meanings through form and materials, aesthetics, sustainability, craftsmanship, and livability as some of the many possible design goals.

We should be clear that we do not intend to confuse lack of a use goal with lack of functionality. Each artifact is functional yet to what end the functionality serves remains ambiguous.

The benefit of foregoing or weakening use goals in *unselfconscious interaction* is that an explicit or constantly reinforced use goal restrains the open-ended and lived with qualities.
Use goals minimize alternative interpretations and use. Use goals also restrict interactions to being discrete and utilitarian rather than lived with.

*Purposeful purposeless* in the design of the concept artifacts we discussed bring to light the qualities of crafting and design that are essential to manifesting the construct. These research and theoretical artifacts will serve as good examples to help us articulate the idea but it is important to note that *purposeful purposeless* is intended to apply to the future practice of designing for *unselfconscious interaction* rather than research. We consider *purposeful purposeless* as a high-level design strategy that is bound to or is integral to the construct. The strategy requires purposeful design with a design goal that should not be confused with a use goal, purposeful crafting of the artifact, and a purposeful aesthetic. Combined together these forms of purposing create a quality artifact that will be accepted into environments alongside other designed artifacts.

Each of the concept artifacts was purposefully designed. The aim of the Discovery-Driven Prototypes (Lim et al., 2013) is to let users creatively discover a use for each of the prototypes. The Indoor Weather Stations (Gaver et al., 2013) aim through ludic design a playful and reflective engagement with environmental concerns that is an alternative to utilitarian or persuasive approaches to sustainability. Our table-non-table is designed as a design resource for everyday designers in which their competences, know-how of materials, and motivations can be creatively engaged.

The purposeful crafting of an artifact employs an equally rigorous design process to that of crafting a traditional interaction design artifact despite not knowing the use or particular requirements of a use situation. For example, the Indoor Weather Stations endured an involved design process (Jarvis et al., 2012) that included multiple iterations and variations of form studies realized as 3D printed studies. Design workbooks were generated to document the process and provide formative and ongoing reflections/evaluations of the design decisions and moves. Great attention was given to the assembly and integration of electronics while at the same time; aspects of the devices were made by hand in addition to 3D plastic fabrication (see Figure 17).

Figure 17. Various design studies, iterations, and variations of the design elements of the Indoor Weather Stations (Jarvis et al., 2012)
The table-non-table focused its efforts on the possible proportions and material qualities of the artifact. Several types and weights of white paper were explored, as were multiple cardboard mockups to determine the proportions of the stack, dimensions of the paper, and height from the floor. We explored different types of movement to refine the pattern, distance, and pace to establish the right balance of passiveness and activeness. The chassis was fabricated in aluminum and after several iterations it was decided that a single square aluminum post with a centered die cut in the paper would be designed to hold the stack in place yet allow for simple removal and placement of the paper (see Figure 18).

![Figure 18](image1.png)

Figure 18. (Clockwise from upper left) cardboard mockups of table-non-table for different proportions; different sized aluminum squares for the chassis; early prototype for movement studies; filing aluminum square for die cut tests

The purposeful aesthetics of each artifact is precise and with clear intent. The Discovery-Driven Prototypes utilized aesthetics as a counterpoint to the “unpredictability” of the use and meanings of the prototypes: “with unpredictability, the ‘clarity’ requirement becomes aesthetically pleasing. In other words, despite its simplicity, the prototype becomes engaging and provocative” (Lim et al. 2013 p. 75). Each of the Indoor Weather Stations selected at least one feature that is “noticeably detailed to indicate the purposefulness of the overall aesthetic” (Gaver et al. 2013 p. 3454). The designers of the weather stations referenced Dieter Rams’ Braun Pocket Radio T-41 as an inspiration and aesthetic point of reference. Coincidentally, the table-non-table, references and is inspired by Florence Knoll’s sofa and chair set in which upholstered seating rests upon an aluminum frame that gives the appearance of floating above the floor similar to the table-non-table. The aesthetic purpose of the table-non-table is to provide a structurally coherent and minimal object that intentionally utilizes materials with little transformation in the studio, e.g. non-anodized aluminum and common paper stock, to create a sense of existing as a potential resource rather than a finished product.
The cumulative results of the purposeful design, crafting, and aesthetics creates an identity and quality such that the value of clarity of use is replaced by the value of richness of potential. This potential is warranted by the investment of design effort. For example, the designers wanted the intentional crafting of the weather stations to be noticed and to make participants aware of the design effort and work done by the studio (Gaver et al. 2013 p.3457). The designers of the Discovery-Driven Prototypes state, they “carefully controlled the prototypes’ physical properties so people could think creatively” (Lim et al. 2012 p. 78). The benefit of controlling for identity and quality is that the artifacts stand a better chance of engaging in the dynamic of goodness of fit by being adopted by people even if the reasons for doing so are not clear.

6 DISCUSSION
A discussion of our contributions is admittedly constrained by the length of this article and moreover the breadth of concerns that, we believe, our construct and methodological additions imply. We also believe that our efforts are best spent fully articulating the construct and demonstrating the methodological refinements as best we can. Nevertheless, we would like to sketch out a discussion of two broad issues that relate to the contributions of this article. The first is the implied assumption that we are advocating for the design of a new type of interaction design artifact. The second is to comment on the role of generative theory in relation to empirical investigations and critical design.

As we have stated, our focus here is on contributions to theories of interaction. We privilege the role of artifacts and crafting of artifacts as manifestations of theoretical concepts within the design theory methods we have adopted. This leaves open questions of the interaction design artifacts themselves and the implications for HCI. To pursue this question we follow the lead of Daniel Fallman (2011) who framed a similar question with the work of philosophers of technology Don Ihde and Albert Borgmann.

Ihde’s (1990) essential point is the non-neutrality of technology. For example, human-technology relations can be embodied such that they change and over time to become part of our perception of the world like eyeglasses; or hermeneutical in which technologies interpret the world on our behalf and we come to perceive the interpretation as the world like a speedometer or a clock; and alterity in which technology is considered as partially other in the way in which we compete with a computer in a game for example (Ihde, 1990). In no circumstances is technology neutral or a tool in the sense that it acts exclusively under our agency. Rather technology shapes that agency and our world.

Borgmann (1984) is perhaps even clearer on this point in his articulation of devices and things. As an example, Borgmann describes a central heating system as a device. It makes all of the mechanisms of heating a home invisible leaving only a single aspect that commoditizes the relationship between us and heating, e.g. a thermostat switch with choices of degrees of heat. In contrast, a fireplace makes all aspects of the mechanics of heating a home visible and positions us within the mechanics thus bringing together the relations between us, the trees outside our home, the making of the home, the competences and motivations of keeping a home, and responding to the human needs of shelter in a larger world of changing seasons and variance in temperature. Borgmann sees things as engaging for us in mind, body, and spirit in a way that grounds us and connects us to the world we inhabit. Devices disengage us and fragment our connections in the world.

Fallman believes these views hold “solemn implications for HCI” yet despite some discussions among HCI researchers there has been little serious traction “in part because of the rather persistent ‘tool’ perspective” (Fallman, 2011, p. 1058). According to Fallman this does not diminish the problematic of an unconsidered underlying ‘good’: “if one knowingly
designs for ambiguity with intent of creating room for experiences that should last or even grow for many years while remaining mysterious or partly unknown, usability may be counterproductive on many levels” (Fallman, 2011, p. 1053). This comment directly relates to the work in this article and one may see the implications as the need to find a new “good” other than usability—critiques of usability and efficiency are well underway in HCI—or the multiplicity of values that we imply with our selection of concept artifacts like discovery, play, and everyday design or emergent within a theories of social practice view of HCI as an example (Pierce et al, 2013).

We see our work broadly situated within these matters of concern. In addition to Fallman, Pierce (2012) investigated the notion of technology negation through the undesign of technology. In this work, Pierce draws on Ihde’s theory of “micro-perception” (1990) in which technology can be seen to simultaneously amplify and reduce human perception. For example an increase of human speed decreases the perceptions of our surrounding. As such the negation is concealed as a byproduct of amplification. One wonders if designing for reduction leads to uncovering amplification as in the considered simplicity of the concept artifacts like table-non-table. Similarly, negation comes to play with slow technology, which we briefly reviewed in section 2.2. Peter-Paul Verbeek discusses how technology mediates actions by invitation and inhibition (2005), a duality exploited by slow technology as a critical stance. The design of today’s technology asymmetrically mediates by constantly inviting us to be connected in ways that inhibit other actions that are never made visible. It can be said that Hallnäs and Redström (2001) invite us to reassert the mediating duality by utilizing technology to invite inhibitions such as inviting us to slow down and inhibiting us from going too fast. This exploration has parallels with unselfconscious interaction points of intersection such as a focus on the object as a subject of enquiry as both a spatial and temporal form (Mazé & Redström, 2005), designing across generations (Friedman & Nathan, 2010), and meaningfulness of things (Odom et al., 2009; Odom et al., in press). The point of this discussion is that a corollary of unselfconscious interaction and in line with the investigations above is the potential for new kind of interaction design artifact.

The second issue we would like to raise is one we have suggested throughout this article: the methodological limits and the compatibility of design theory with empirical investigation and critical design. We realize that theory holds a wide variety of meanings and that we have not defined it for our purposes. In short, as design researchers we seek theory that is a formulation of concepts underlying the dynamic nature of designing artifacts and its implications. We see this as a form of theory among others that we refer to as a generative theory. In some sense, this returns to Stolterman and Wiberg (2010). They recognize the traditional criteria: “theory as abstracted knowledge that tells us something about fundamental entities at the core of a discipline” (2010, p. 99) yet they argue that design needs to have its own type of theorizing that addresses its dynamic nature and involves concrete sense-making along with subjective reasoning. The reason for this is that design is speculative and future-oriented in which there is little (not none cf. (Dourish & Bell, 2011)) stable ground on which to traditionally validate ideas. As Gaver (2012) argues, design theory should offer multiple alternatives. The validity of the theory is the integrity and quality of its construction. Its purpose is to advance theoretical insights in words, craft, and artifacts that enable actualizing desired improvements to our world.

We believe our methodological contribution demonstrates a path to generative theory. Our initial starting point for this investigation is rooted in the numerous empirical investigations of various everyday practices such as family life (Wakkary & Maestri, 2007), repair (Maestri & Wakkary, 2011), sustainability (Wakkary, et al., 2013; Wakkary & Tanenbaum, 2009), hobbyists (Desjardins & Wakkary, 2013), steampunk (Tanenbaum et al., 2012) and skateboarding (Hauser et al., 2013) from which we were able to construct a descriptive
theory we call everyday design. It is a descriptive theory because we could point to the phenomena of appropriation, design-in-use, creative reuse, and complex design making that existed and continues to exist. What we could not do with the theory of everyday design is construct things (actual things) that did not exist.

Implicit in everyday design is a critique of current assumptions and aims of traditional HCI and interaction design. This is often the domain of what has been referred to as critical design (Dunne, 2008). Critical design utilizes design to skeptically and critically engage the world around it and self-reflexively question the role of design itself. Design (and HCI) is worthy of critique for its traditional assumptions of neutrality and autonomy of design practices. As such, critical design runs counter to assumptions in design (and the world at large) that through critique raises issues to the level of theoretical reflection. For example, Indoor Weather Stations critique sustainable HCI approaches of utility (informational awareness) and persuasion (behavior change) for the assumptions of both design and sustainable behavior that those approaches hold. A critical failing of these approaches is their lack of adoption or effect (DiSalvo et al., 2010). As Gaver et al. (2013) report, the Indoor Weather Stations established a long-term meaningful relationship and effect, albeit intangible. Yet, the weather stations are very much like Borgmann’s concept of things, connecting people to their focal points and practice (Borgmann, 1984) from which sustainability will arguably be more effectively engaged.

The limit of critical design, of which the Indoor Weather Stations bears connections with, is the degree to which it can elevate the critique from reflective theory to generative theory. That is to move to a position independent of the position it critiques (Bardzell & Bardzell, 2013). The value of generative theory is the ability to construct notions that move past the point of origin and see insights independent of the contexts of critique that in fact may constrain its potential insights and deeper expression of ideas. We view critical design as an important strategy en route to theorizing, particularly with the addition of generative theories.

7 CONCLUSION
Our first contribution in this paper is our definition and description of a new construct for interaction in the home: unselfconscious interaction. We were motivated by the idea of exploring a construct that allows for computational artifacts to have a role in achieving goodness of fit in the home.

Through the careful selection and analysis of three concept artifacts: the Indoor Weather Stations by Gaver et al. (2013), the Discovery-Driven Prototypes by Lim et al. (2013), and our own table-non-table as well as with the motivation of “goodness of fit” by Alexander (1964), we were able to develop the construct of unselfconscious interaction in an explorative way. We present unselfconscious interaction as a form of interaction with computational artifacts that over time, and through ongoing incremental engagements, open to subjective and subtle improvements in the relationships between artifacts, environments, and people. Goodness of fit is achieved through simplicity mapped to skills and competences in the home. In addition, we have argued that goodness of fit also needs to be supported by a quality of open-ended and lived with qualities. Unselfconscious interaction is then a combination of those qualities, along with the tensions that exist between them, the balance between active and passive as well as the balance between familiar and alien.

Moreover, we discussed how the role for interaction design is to act as a catalyst that animates ongoing incremental engagements. To achieve this, interaction design artifacts are
purposely designed as resources with non-existent or weak use goals. We call this a high-
level design strategy of purposeful purposeless.

In addition to developing the construct of unselfconscious interaction, we also presented our
second contribution: methodological refinement and expansion of concept-driven interaction
design research (Stolterman & Wiberg, 2010) and strong concepts (Höök & Löwgren, 2012).
We characterize a construct as a theoretical order above concepts. A construct is built and
described from a series of concepts and concept artifacts that work as an argument for the
quality of the proposed concept. We also argued that a careful crafting of both, the concept
artifacts as well as the underlying theoretical ideas, concepts and artifacts, is necessary for
the development of the construct.

In conclusion, our hope is that this paper will trigger more discussions surrounding the
practice of theory making in interaction design research and that others will articulate
varied interaction constructs that build on concept artifacts. We are also optimistic in seeing
and discovering more concept artifacts and interaction design artifacts that arise from the
construct of unselfconscious interaction.

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