

Unselfconscious Interaction: A Conceptual Construct

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In this article, we present unselfconscious interaction, a conceptual construct that describes a form of interaction with computational artifacts animated by incremental intersections that lead to improvements in the relationships among artifacts, environments and people. We draw on Christopher Alexander's notion of goodness of fit and unselfconscious culture, and utilize Erik Stolterman and Mikael Wiberg's concept-driven interaction research to analyze three interaction design concept artifacts to develop the construct of unselfconscious interaction for human-computer interaction. The resulting construct is comprised of the motivation of goodness of fit that is supported by two design qualities we name open-endedness and lived-with. We describe tensions within the construct, the notion of purposeful purposelessness in design and discuss the features that derive from Alexander's unselfconscious culture and are to be considered when designing for goodness of fit: resources, adaptation, ensembles, time and anonymity. Our main contribution in this article lies in the articulation of the construct of unselfconscious interaction.

RESEARCH HIGHLIGHTS

- Our main contribution is the conceptual construct of unselfconscious interaction. It theorizes how interaction design artifacts can enable ongoing and incremental improvements to everyday settings in ways that are similar but ultimately new and different than analog artifacts.
- We elaborate on concept-driven interaction research (Stolterman and Wiberg, 2010) by developing criteria for a conceptual construct.

Keywords: interaction paradigms: novel interaction paradigms; interaction devices: novel interaction paradigms; interaction design theory, concepts and paradigms; interface design prototyping

Editorial Board Member: Jeffrey Bardzell

Received 1 August 2014; Revised 26 May 2015; Accepted 8 June 2015

1. INTRODUCTION

In this article, we define a new conceptual construct we call unselfconscious interaction. We describe this conceptual construct as a form of interaction animated by incremental intersections with interaction design artifacts that over time and even unknowingly lead to improvements in our everyday settings.

The design ethnography studies of families by Wakkary and colleagues (Maestri and Wakkary, 2011; Wakkary and Maestri, 2007; Wakkary and Tanenbaum, 2009) served as background for this investigation. This research described an ongoing process of resourcefully using and repurposing everyday artifacts to improve the home and daily routines.

One example of this process is the constant knowing and unknowing adjustments to furniture, household items and other objects to create a room that fits the patterns of our everyday life and subjective needs. Another unique and more elaborate example of such incremental design is the recruitment of everyday objects like a bowl, walls, chalkboard and a refrigerator door to create an ensemble of things and environment for family messaging (Wakkary and Maestri, 2007). Importantly for human-computer interaction (HCI) and interaction design research, the researchers also found that interaction design or computational artifacts rarely contributed to this process. Our contribution with the conceptual construct of unselfconscious interaction is to theorize how interaction

design artifacts can enable such ongoing and incremental improvements to everyday settings in ways that are similar but ultimately new and different than analog artifacts.

Theorizing a new role for interaction design artifacts was inspired by Christopher Alexander's (1964) theory of unselfconscious culture and specifically the concept of goodness of fit. Alexander describes the process of incremental and unknowing interactions and corrections that over time lead to improvements in everyday life or what he refers to as goodness of fit. The combination of the unknowing nature of the interactions and that design in this manner is anonymous, i.e. not done by professional designers, led Alexander to refer to the process as unselfconscious.

Alexander's examples typically feature raw materials but imply that unselfconscious designers can treat designed artifacts similarly to resources much like raw materials. In the development of our construct, we explicitly consider designed artifacts as everyday resources; in fact this is central to our claim. Further, we situate computation as an integral aspect of the artifacts at play within our construct. Our pursuit is to re-interpret unselfconscious culture from an HCI perspective. In order to do so we develop our conceptual construct through an analysis of three interaction design artifacts that we consider as concept artifacts. Stolterman and Wiberg (2010) explain a concept artifact as a crafted artifact that manifests a theoretical concept similar to how Alan Kay's Dynabook embodied the notion of portable computing (Kay, 2011). The three artifacts we chose are the Discovery-Driven Prototypes (Lim *et al.*, 2013), the Indoor Weather Stations (Gaver *et al.*, 2013) and our own table-non-table. The resulting construct is comprised of the motivation of goodness of fit that is supported by two design qualities we name open-endedness and lived-with.

Our investigation in this article adopts concept-driven interaction research (Stolterman and Wiberg, 2010) to theorize generic qualities and characteristics that emerge through an understanding of the crafting of design artifacts. Our motivation for utilizing this type of theoretical argumentation is to articulate or uncover new forms of interaction experiences and computational artifacts that empirical analysis alone cannot achieve. Empirical research focuses on what already exists rather than what will exist. Our methodological aim is to extend past descriptive and analytical research in ways that are generative and productively speculative.

Our article is comprised of six sections. After this introduction, we provide a section of related literature that includes a concise summary of Alexander's (1964) unselfconscious culture and related theories of interaction. We follow this with an introduction to concept-driven interaction design research by Stolterman and Wiberg (2010). Our aim in this section of the paper is to communicate our methodological approach and explain what we mean by a conceptual construct. We then present three interaction design artifacts and their related theories. We treat each as

a concept artifact and based on Alexander's unselfconscious culture we analyze the concept artifacts together to develop our unselfconscious interaction construct. We follow this with an in depth discussion of the construct and detail the structure behind it which are goodness of fit and the supporting design qualities of open-ended and lived-with. We also describe the tensions that balance the relationships between the supporting design qualities and the motivation. We conclude this section with a description of our notion of a purposeful purposeless design strategy. The article closes with a discussion of the differences and adaptations between unselfconscious interaction and unselfconscious cultures and future challenges with respect to unselfconscious interaction.

2. RELATED LITERATURE

2.1. Unselfconscious culture and goodness of fit

In this investigation, we act upon our initial resonance with the architect Christopher Alexander's (1964) description of goodness of fit and his idea of unselfconscious culture we experienced when conducting prior studies on design artifacts in the home. 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. This is in opposition to what he refers to as selfconscious culture in which making is learned academically and governed by explicit rules and knowingly aims at improvements and innovations (idem, 1964, p. 36).

Alexander's notion of an 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 an ensemble of form and context. 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 (idem, 1964, pp. 46–47). In each case, these examples demonstrate an ensemble of resources that are of a lived-with quality or from the context in which the builders inhabit, for example, the black goatskin used for the Bedouin tents or sod used in the houses of the Hebrides. Further, these resources are easily manipulated so that the ensembles can be constantly improved upon over time to achieve a balance and quality. We argue, that these qualities speak to five main features of unselfconscious culture that enable goodness of fit: (i) resources, (ii) adaptation, (iii) ensembles, (iv) time and (v) anonymity.

- (i) Resources and materials are ready at hand and to be found in nearby surroundings like the aforementioned sod, grass and straw used by the Hebridean crofter or black goatskin of Bedouin herder (idem, 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.
- (ii) 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’ (idem, 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 (idem, 1964, pp. 22–23). What allows unselfconscious design to consistently achieve goodness of fit is the motivation to constantly attend to misfits.
- (iii) Goodness of fit is achieved at the level of ensembles, not a single artifact, since the design is the relationship between forms and between forms and context.
- (iv) Time is the essential 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.
- (v) Alexander articulates anonymity of making as a further distinction between unselfconscious and selfconscious design. He argues that contemporary professions or selfconscious cultures of making are established on individual achievements and recognition whereas the anonymous maker of unselfconscious cultures for all intents and purposes goes unnoticed (idem, 1964, pp. 33–34). In addition, unselfconscious cultures do not distinguish nor reflect on design as a separate entity from daily living; as such there is no specialization of labor or expertise, each person is ones own builder.

These distinctive features of unselfconscious cultures get to the crux of the matter for Alexander. Goodness of fit is a goal for all good design and this was readily achieved by unselfconscious cultures; however, the rise of selfconscious design erased or abandoned the features that made unselfconscious cultures successful. In selfconscious design, rules became abstracted into universal principles rather than embodied local practices learned tacitly and experientially. Design resources and materials became generic and portable rather than lived-with and situated. Design forms became the sole focus separate from their ensembles. And the most fundamental change was that design and making became the providence of the specialized and expertise labor of the designer rather than everyone. The qualities of unselfconscious design created what Alexander referred to as a homeostatic or self-organizing structure that allowed it to consistently achieve goodness of fit, yet it is these very qualities that are minimized in selfconscious design. As a consequence, he argues that the processes of selfconscious design or professional design are broken (Alexander, 1964, pp. 37–38). The reification of the process, thinking and roles in selfconscious design, work against the organic relationships of unselfconscious cultures that as a result lack the ongoing balancing that fosters goodness of fit.

Alexander characterized contemporary architecture (he is an architect by training) as unable to consistently achieve goodness of fit and in large part the notion of selfconscious and unselfconscious cultures is a theoretical critique and explanation of the malaise he saw in the profession. In many respects, we see a similar challenge in professional interaction design and HCI. In other words, many of the current assumptions of interaction design (e.g. interaction design is the domain of professional experts or interaction design artifacts are designed for expert repair or replacement) work against or minimize qualities of unselfconscious cultures that better lead to goodness of fit. Alexander’s notion of unselfconscious culture serves as a starting point for understanding goodness of fit within the context of HCI. The development of our construct of unselfconscious interaction addresses the need to understand the role interaction design artifacts can potentially play in the process of achieving goodness of fit.

2.2. Related theories of interaction

Within the view of exploring people’s experiences of living with interactive technologies over time and in everyday contexts, we found prior work in HCI that we see as related to Alexander’s (1964) idea of unselfconscious culture and the notion of goodness of fit. In what immediately follows, we review this related research.

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 specialists 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 of ubiquitous computing in the home. In large part, their work is a critique of the techno-centrism of ubiquitous computing. Based on ethnomethodologically informed analysis 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 philosopher John Dewey and literary theorist and philosopher 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 work place, 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.

When people experience and live with artifacts in an everyday setting it becomes clear that artifacts are interpreted and appropriated in their practical context in ways that designers cannot foresee or control. Ihde (2008) a contemporary philosopher of technology, terms this the 'designer's fallacy' and proposes that designers should take into account unintended uses and their consequences. This idea of fostering the unknowns and creative misuse in designed artifacts as a resource quality is present in some HCI related works. Redström (2006) supports the idea of 'unintended use by unintended users' as it 'is close to impossible to take into account at least systematically speaking and designs are constantly being

used in unintended ways and this is not a bad thing' (p. 130). In fact, appropriation is often seen as a sign of acceptance of a technology. Dix (2007) advocated for awareness of this type of creative misuse and proposed guidelines for designing for appropriation. Dix points out, 'whilst you cannot design for the unexpected, you can design so that people are more likely to be able to use what you produce for the unexpected' (p. 28). However, 'design for appropriation is not always what is desired' (p. 28) since some products are designed with a very specific purpose like an espresso machine. Embracing appropriation offers a new way of understanding the user. Wakkary and Maestri (2008) found appropriation to be 'a key action in everyday design' (p. 479) looking at four families and how they appropriated artifacts to design everyday household systems. Moreover, Gaver *et al.* (2003) showed how ambiguity can be seen as an opportunity as well as an esthetic and conceptual resource for design. Allowing ambiguity, which is present in our everyday world (Ihde, 1979), 'to be reflected in design has several advantages' (Gaver *et al.*, 2003, p. 233). For instance, in Gaver *et al.*'s view, '[t]he ability for ambiguity to evoke personal relationships with technologies is particularly relevant as digital technologies are designed to support activities outside of work. Traditional concerns for clarity and precision are superseded in such systems by the need to provide rich resources for experience that can be appropriated by users' (ibid, p. 233). On a general level, the appropriation of artifacts aligns with Alexander's articulations of the activities in unselfconscious culture and the goal of goodness of fit. In our view, unselfconscious interaction embraces the unknowns in designed artifacts as a resource quality.

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 and 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 and 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. More recently, Odom *et al.* (2014) conducted a long-term study that placed a slow technology called 'Photobox' for 14 months in multiple homes that randomly and infrequently prints out photos. The research explored the experiences over time witnessing a trajectory from frustration and a desire for more control toward an

acceptance and ‘pleasurable anticipation’. Speaking about the design of the Photobox, Odom *et al.* (2012) describe the notion of creating design artifacts intentionally with ‘lived-with’ qualities in describing rationale for using a chest with patina as opposed to a more ambiguous or unfamiliar form. Our work on unselfconscious interaction relates to slow technology and aims to contribute to this research. However, we emphasize a set of interrelated factors in addition to time, including a more direct even if unknowing engagement with artifacts and an experience that may have little or no reflection.

3. CONCEPT-DRIVEN INTERACTION RESEARCH AND CONCEPTUAL CONSTRUCTS

In this section, our aim is to communicate our methodological approach drawn from concept-driven interaction research (Stolterman and Wiberg, 2010). We explain our characteristics of a construct and describe our process for developing the construct. We also discuss related alternatives in design research, including, Höök and Löwgren’s (2012) strong concepts, and annotated portfolios by Gaver and Bowers (Bowers, 2012; Gaver and Bowers, 2012).

3.1. Concept-driven interaction research

As stated earlier, Stolterman and Wiberg (2010) argue that concept artifacts are the careful crafting of artifacts that embody desired theoretical ideas of interaction qualities and characteristics within a synthesized composition. They discuss examples of concepts to help illustrate their ideas. One example is the Dynabook by Alan Kay and researchers at the Xerox Palo Alto Research Center. The Dynabook is a concept design that Stolterman and Wiberg (2010, p. 106) claim inspired the design of the contemporary laptop computer. In creating the design concept the researchers had to describe new forms of interaction, interfaces, physical forms, software and technology. Another example of a concept artifact that the authors discuss is Active Badges (Want *et al.*, 1992) that conceptualized the notion of interpersonal awareness systems and similar to the Dynabook spawned many instances and variations of the concept.

A key claim of concept-driven interaction design research is the need to theorize through the creation of interaction design artifacts outside of relying on ‘user studies’ or more traditional modes of empirical evaluation. The core point is that a conceptual construct frames the creation of concept artifacts, which themselves are explorations of new forms that do not yet exist. Through this process 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 and Wiberg, 2010, p. 99). We draw on and extend this reasoning in the approach we adopt described in this article.

The basic principles of concept-driven interaction design research are as follows (Stolterman and Wiberg, 2010, p. 99):

- (i) ‘Concept design research means to design and create a concept and an artifact that manifests desired theoretical ideas as a compositional whole’.
- (ii) ‘The final artifact has the potential power to function as an argument for the quality of the proposed concept and the intended theoretical argument’.
- (iii) ‘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’.
- (iv) ‘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’.

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. Thus, concept-driven interaction design research is a matter of simultaneous ‘theoretical grounding’ and ‘artifact crafting’ (Stolterman and 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’ (*idem*, p. 101). The value of concept-driven interaction design research is the mobilization of designerly competences to research challenges not design problems.

The making of design artifacts whether with emphasis on theory or use is a series of divergent and convergent paths that make it difficult for practices to be reductive or instrumental. Given this, we read the last principle of concept artifacts (Stolterman and Wiberg, 2010, p. 111) that expresses the crafting of the essential characteristics of the concept more generously to mean an emphasis on the theoretical qualities filtering out the inevitable other concerns and effects of the design artifact and its making.

3.2. Developing the conceptual construct of unselfconscious interaction

Stolterman and Wiberg (2010, p. 112) articulate the need to eventually combine concept artifacts into broader theoretical

notions they refer to as conceptual constructs. They do not give an example of a conceptual construct and this in part motivated our inquiry. However, Stolterman and Wiberg do explain that 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.

In our use and interpretation of concept artifacts in the role of constructs, we are not concerned with the simultaneity of ‘theoretical grounding’ and ‘artifact crafting’ at the time of making. In fact, a theoretical claim can be made after the fact in that a well-crafted artifact can precede a theoretical claim and vice versa. In part, this is because the exactitudes of the relationships between making and theorizing will likely be unknown to those making the argument for a construct. More importantly, these details are irrelevant if concepts and artifacts can be tightly read together as a well-reasoned argument at the time of arguing for a construct. What follows from this is that artifacts may initially be crafted with only a seed of a theoretical idea in mind or none at all and that subsequently or iteratively, the concept emerges more clearly and is further refined in the form of the artifact or series of artifacts. Conversely, a designer may have a clear theoretical idea that is to be designed and embodied in an artifact.

We set about developing our construct by analyzing three different concept artifacts that together advance the theoretical idea of unselfconscious interaction. The claim behind this construct is that it 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 its potential for theoretical insights. This approach is jointly informed by theoretical and designerly knowledge and competences.

While Stolterman and Wiberg only lightly touch on the idea of a construct at the end of their article, we extend their ideas to our definition of a conceptual construct. The following are our characteristics of a conceptual construct. A conceptual construct:

- (i) relies on a synthesized analysis of a collection of concept artifacts or equal manifestations of design artifacts and theories;
- (ii) is a non-empirical approach to discovering or constructing new intermediate-level knowledge;
- (iii) is an intermediate level knowledge understanding of phenomena regardless of the phenomenon’s relevance to design, design practice, interaction or any other known domain.

Our strategy to develop the construct of unselfconscious interaction followed four logical steps. First, we chose the three different concept artifacts: the Discovery-Driven Prototypes (Lim *et al.*, 2013), the Indoor Weather Stations (Gaver *et al.*, 2013) and our own table-non-table. Our selection was based on

a review of literature in the field of interaction design and HCI in the past years, with an eye toward highly resolved prototypes deployed in everyday settings that resonated with the concept of unselfconscious culture as described by Alexander. Once our choice was made, we did a thorough analysis of the artifacts to reveal their design qualities and their interaction qualities (see Section 5 for a summary of each artifact). The qualities were extracted from the way their authors presented them in publications, as well as our own reading of the objects, grounded in the tradition of design critique. The qualities of each artifact were then combined into a larger affinity diagram that illustrated the commonalities and differences between the three artifacts. Through multiple iterations and refinements, our understanding of the clusters in the affinity diagram led us to the higher-level model of the concept of unselfconscious interaction. In Section 6, we present the result in our description of the construct.

3.3. Related alternatives to concept-driven interaction

We chose concept-driven interaction research among related alternatives, namely strong concepts (Höök and Löwgren, 2012) and annotated portfolios (Bowers, 2012; Gaver and Bowers, 2012). Strong concepts (Höök and Löwgren, 2012) can be seen as a concrete elaboration on Stolterman and Wiberg’s (2010) concept artifacts. Annotated portfolios (Bowers, 2012; Gaver and Bowers, 2012) are a collection of artifacts with specific and linked commentary explaining related comments, ideas, and critiques. Collectively, these approaches to theoretical analyses in interaction design research are part of a broader set of analytical strategies for design from pattern languages (Erickson, 2000), design criticism (Bardzell, 2009), critical approaches to design (Dunne, 2008; Sengers *et al.*, 2005) to longstanding efforts to develop models and guidelines (e.g. Carroll, 2003). More broadly, our approach is also related to research through design since both are concerned with the design and analysis of design artifacts with the goal of generating new interaction design knowledge (Frayling, 1993; Zimmerman *et al.*, 2007).

Concept-driven interaction research, strong concepts and annotated portfolios are arguably the most advanced articulations of theorizing in interaction design research. They offer a shared understanding of knowledge production in design research, which we leverage and aim to directly build on. Specifically, these approaches aim to articulate a type of design knowledge that lies between theories and design instances. Höök and Löwgren (2012) explicitly characterize this as intermediate-level of knowledge. Stolterman and Wiberg (2010, p. 112) see their work as addressing a gap in design theory between practical guidelines and checklists and grander theories imported from other disciplines, namely the social and behavioral sciences. Bowers (2012) defines annotated portfolios as design knowledge with limited rationality that relates strongly to the notion of an intermediate-level

knowledge in design. As such, intermediate level knowledge makes no claims to universality (Gaver, 2012).

A second distinction among these approaches is that designed artifacts and the crafting of these artifacts are the central concern and the crucial point of departure for the inquiry. Similar to research through design, concept-driven interaction research assumes that design artifacts embody the many choices made by designers and materialize implicit theories whether they be philosophical, functional, social or esthetic (Gaver, 2012). With strong concepts, the authors concentrate on the artifact's 'interactive behavior' (Höök and 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 and Wiberg, 2010, p. 100). Annotated portfolios inextricably link annotations to design artifacts (Bowers, 2012; Gaver and Bowers, 2012).

Despite these commonalities, we chose concept-driven interaction since it suggested the furthest degree of abstraction that nonetheless still adheres to the notion of intermediate-level knowledge. While strong concepts directly relate to concept-driven interaction, Höök and Löwgren focus too narrowly for our purposes on use situations and interface elements (Höök and Löwgren, 2012, pp. 23:5–23:6). Similarly, annotated portfolios see the link between annotations and the artifacts as direct. To understand the entirety of what an annotated portfolio is communicating, it is necessary to see the linkages between artifacts and their annotations and understand how they mutually inform and illustrate each other (Gaver and Bowers, 2012). This indexical link between artifact and annotation is typically presented graphically and benefits from knowledge of the process of designing the artifacts (not to mention designing the portfolio itself). Concept-driven interaction and the idea of conceptual constructs are one step removed from the artifacts in that constructs utilize artifacts already synthesized with concepts or some level of theoretical knowledge. It is this knowledge from which another level of interpretation or formalization occurs.

Our selection notwithstanding, we would argue that either strong concepts or annotated portfolios could have been utilized in a similar type of theorizing as our own. We speculate that the results would likely be different however not significantly or with some degree of overlap.

4. 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.

Each of the three concept artifacts exemplifies a theoretical concept: discovery and openness for the Discovery-Driven Prototypes, ludic design for the Indoor Weather Stations

and everyday design for the table-non-table. As previously discussed, the relationship between concept and artifact is non-hierarchical and not reductive, and so it is not a concern for us how one informed the other. More importantly, the concept artifacts can be read together, as acknowledged by the designers themselves who explicitly identify the concepts in relation to the artifacts discussed below. Additionally, constructs are retrospective reasoning on concept artifacts and so it is not expected or relevant whether designers of the concept artifacts were aware of or expected to be aware of unselfconscious interaction, since the role of a construct is to uncover new ideas and formulations not yet articulated. A construct is of course only one form of analysis of a concept artifact.

4.1. Discovery-Driven Prototypes

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

Aeng-aeng-ye 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-ye 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, what we later refer to as a 'weak' goal, is to encourage communication between family members and the generic shape is intended to allow people to use Deol-deol-ye 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.

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 new possibilities of use. The design aim is to create an open-endedness and incompleteness for users that allows for unpredictable explorations of unknown use scenarios and possible physical and conceptual alterations that would extend the ideas behind the prototypes.



Figure 1. The Discovery-Driven Prototypes (Lim *et al.*, 2013) consist of three artifacts: (from L to R): Aeng-aeng-ye is a music timer; Deol-deol-ye is communication device and Tong is a sound recorder.

The Discovery-Driven Prototypes conceptualize discovery and creativity. These concepts are 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 *et al.*, 1999), Lim and her colleagues' approach (2013) 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 desire themselves, through their interactions with a prototype *in situ*. The 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.

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 discoveries. The functionality of each prototype is purposely very simple. The artifacts bear the concepts of discovery and creativity of users.

4.2. 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 Fig. 2). The weather



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. ©Interaction Research Studio, Goldsmiths.

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).

The Temperature Tape consists of two 2.5-m 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 thermo chromatic ink change color depending on the temperature, shifting from yellow (15°C) to red (25°C).

The Light Collector is a cylindrical container topped with a funnel lined with copper leaf. It 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 5 min, 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 2 h.

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.

Conceptually, the Indoor Weather Stations embody the concept of ludic design. Ludic design presents 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’ (idem, 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 (Gaver *et al.*, 2003; Sengers and 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 important elements to engage with complex and serious issues (Gaver *et al.*, 2013).

In summary, the Indoor Weather Stations aimed to playfully explore environmental matters in contrast with utilitarian or persuasive approaches to sustainability. They carry or embody the concepts of ludic design.

4.3. Table-non-table

Our third concept artifact is the result of our own approach to design for everyday competences. In previous studies, we looked at practices of everyday design and their composition of material, competences and meaning (Wakkary *et al.*, 2013). 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 slow and random moving stack of paper (see Fig. 3) supported by a motorized aluminum chassis on wheels. 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



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

heavy objects on it and even a person sitting or standing on it. The paper sheets can easily be removed, drawn on, folded, cut or manipulated like any 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 main functionality, so to speak, is movement. The movement is random yet it stays within an area of less than a meter square. The movement is nearly imperceptible, however, over a period of time of living with the artifact, it becomes noticeable.

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. The concept of everyday design emerged in studies by Wakkary and colleagues of various everyday practices such as family life (Wakkary and Maestri, 2007), repair (Maestri and Wakkary, 2011), sustainability (Wakkary and Tanenbaum, 2009; Wakkary *et al.*, 2013) and hobbyists (Desjardins and Wakkary, 2013). In essence, this research argues that everyone is a designer. The implications of this claim for professional interaction design and designers are directly discussed in (Wakkary and Tanenbaum, 2009), and especially in (Wakkary *et al.*, 2013) where the term ‘hybrid designer’ is explored. Nevertheless, design in everyday design is comprised of a multiplicity of practices that within their respective and different abilities 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.

In summary, the table-non-table aimed to explore the relations between everyday competences and people for cumulative interactions over time. The table-non-table embodies the concept of everyday design.

5. THE CONSTRUCT OF UNSELFCONSCIOUS INTERACTION

In this section, we discuss how the analyzed concept artifacts form our conceptual construct.

5.1. Description of the construct

Unselfconscious interaction as a construct is composed of a motivation and two supporting design qualities (see Fig. 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 of articulating one path in which interaction design artifacts can better achieve goodness of fit. Supporting design qualities of the construct include open-ended and lived-with. These design qualities are desired theoretical attributes, which are manifested in the artifacts and are essential to the construct.

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

Lastly, in understanding the crafting of an unselfconscious interaction artifact, we present the idea of purposeful purposelessness. This notion defines the need for purposeful design, crafting and esthetics that expresses the potential value of an artifact even when its purpose of use is unclear or undefined. We explain further the idea of purposeful purposelessness in Section 5.4.

5.1.1. The motivation: goodness of fit

As Alexander (1964) makes clear, it is often the inhabitants who dwell in the environment they change that best achieve

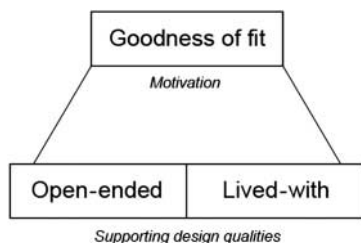


Figure 4. The construct is comprised of a motivation, goodness of fit and supporting design qualities, open-ended and lived-with.

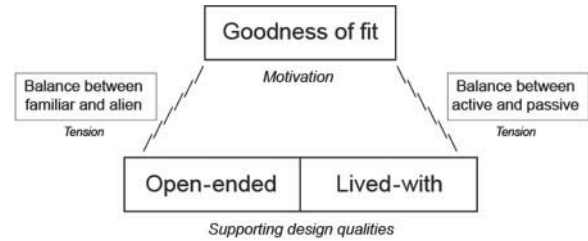


Figure 5. The relationship between supporting design qualities and motivations are described as tensions in which opposing attributes are balanced.

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 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, goodness of fit 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 an adequate level of social and cultural knowledge.

As we discussed, goodness of fit 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 with interaction design artifacts. One such sign is the incremental combination of interaction design artifacts with other artifacts as forms of interaction and engagement in what we refer to as an ensemble based on Alexander (1964). 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). For the table-non-table (see Fig. 6), books and other objects are readily placed on top of the artifact. The deol-deol-ye of the Discovery-Driven Prototypes is attached to a TV remote control with a rubber

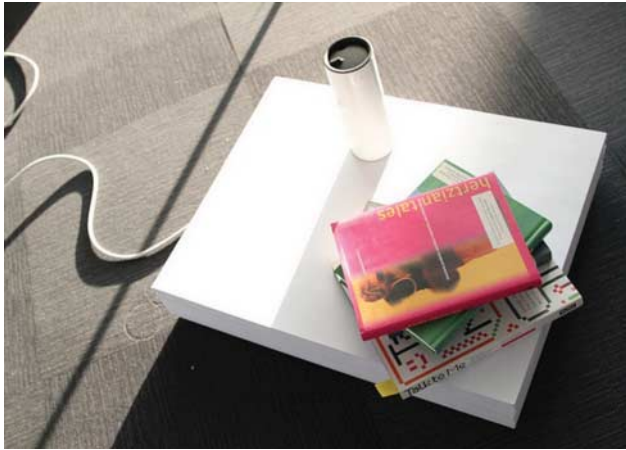


Figure 6. Books and other objects on the table-non-table.



Figure 7. Discovery-Driven Prototype Deol-deol-ye combined with a TV remote and a seatbelt (Lim *et al.*, 2013).

band in case it is lost and in another case it is used together with a seatbelt to keep a driver alert (Lim *et al.*, 2013) (see Fig. 7).

In the case of unselfconscious interactions, it is often 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 crucial and without it, unselfconscious interaction might 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 able, ready and



Figure 8. The on/off button and timer dial of the Aeng-aeng-ye (Lim *et al.*, 2013).

quickly 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 elaborate computational user interface; there is only an electrical cord. One of its owners added to it an electric power bar to give it an easy switch for turning it on and off. A more 'complex' computational interface among the Discovery-Driven Prototypes (Lim *et al.*, 2013) can be found in the Aeng-aeng-ye music player that includes an on/off button, a timer dial, and a light sensor indicator (see Fig. 8). The Light Collector from the Indoor Weather Stations (Gaver *et al.*, 2013) has a screen 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 Fig. 9).

Simplicity is such an obvious concept that it is often overlooked or considered without precision. Interaction 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 can be seen to achieve 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 viability.

5.1.2. Supporting design qualities: open-ended and lived-with

Simplicity mapped to everyday competences and skills together form a very important design criterion for



Figure 9. The screen display on the Light Collector (Jarvis *et al.*, 2012). ©Interaction Research Studio, Goldsmiths.

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.

5.1.2.1. Open-ended quality: Open-ended interaction shifts the nature of the interaction design artifacts to be resources for new and unknown interactions or intersections rather than prescribed means to an intended interaction. This speaks again to Alexander's (1964) idea of readily available materials and resources for unselfconscious culture. Like many everyday things 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 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—this was evident in our analyzed concept artifacts.

Open-endedness 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 adapting 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 Fig. 10). The Indoor Weather Stations explore representation and output in that its displays play between accuracy and



Figure 10. The Tong used as a sound amplifier (Lim *et al.*, 2013).



Figure 11. The Temperature Tape with fabric tape striped with thermo chromatic ink, a needle dial and hooks on either of the fabric tape (Cameron *et al.*, 2014). ©Interaction Research Studio, Goldsmiths.

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 Fig. 11).

The table-non-table is simple in its form and purposelessness which invites openness. 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 Fig. 12). The cat became a surrogate for their own curiosity and its manipulation of the table-non-table. By



Figure 12. Owner's cat inspecting, playing with and tearing the table-non-table.

tearing and removing sheets of paper the cat gave the owners 'permission' to remove sheets to fold and cut into large paper snowflakes (see Fig. 13)!

Open-ended quality in unselfconscious interaction does not stand on its own since it requires time for the qualities to emerge. The resourceful opportunities of the artifacts show themselves through a degree of familiarity as well as opportunity that arises from having lived-with the resources, similar to the goatskins of the Bedouin tents or sods of the roofs of the Hebidrean houses (Alexander, 1964). While these are raw materials and we are examining designed interaction artifacts, notions of simplicity, open-endedness and lived-with qualities are common to both. Additionally, the ongoing designing over lifetimes and generations in unselfconscious cultures strongly implies the role designed elements play as resources and sources for adaptation. We explore the temporal and familiarity aspects in the next section on lived-with quality that also reveals how together, open-endedness and time lead to goodness of fit.

5.1.2.2. 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



Figure 13. We remembered how to make snowflakes' says an owner with a paper snowflake made from the table-non-table.

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 environments. As we discussed in Section 2.1, time is an essential condition for goodness of fit and the cumulative progress toward equilibrium and transformative designs in Alexander's (1964) unselfconscious culture. This is equally true of unselfconscious interaction.

Designing for unselfconscious interaction means to focus on the experience of being lived with. A key consideration is how an artifact would co-inhabit our environment, such as how the table-non-table unlike any another piece of furniture is 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 Fig. 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 Fig. 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 and an artifact can become parts of ensembles. 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 the 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



Figure 14. Table-non-table nestled in front of the mirror between the couch and the bed.



Figure 15. Light Collector from Indoor Weather Stations ensconced on a window ledge (Gaver *et al.*, 2013). ©Interaction Research Studio, Goldsmiths.

interaction is the painted portrait of the Light Collector in the quote (see Fig. 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 [Light Collector]. In painting the [Light Collector], 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).

5.2. Tensions

In Section 5.1, we explained how the relationships among supporting qualities and motivation are dynamic. The differences



Figure 16. Light Collector from Indoor Weather Stations next to a painted portrait (Cameron *et al.*, 2014). ©Interaction Research Studio, Goldsmiths.

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, intersection 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. However, it is very important to note that the mediating of tensions by the interaction designer is experienced and in varying degrees reasoned upon by unselfconscious designers or ‘users’. In this sense, mediation of tensions is a tandem relationship between selfconscious and unselfconscious designerly judgments.

5.3. Intersections

Throughout this paper, we have made references to engagements, interactions and intersections with artifacts and ensembles. To clarify, we use the term engagement to refer to any general consideration of a relationship with an artifact, whether simple reflections to a direct interaction. Interaction is used in the common sense of a knowing manipulation with an artifact. Intersections refer to the unknowing or unnoticed crossing of paths of artifacts and people in which a manipulation may or may not occur. Unlike engagements and interactions, intersections lack awareness or knowing of the relationship between person and artifact. Our construct encompasses engagements, interactions, and intersections.

5.4. Purposeful purposelessness in design

Interaction design acts as a catalyst that motivates ongoing incremental engagements and intersections within unselfconscious interaction. Implicitly, we discussed in the preceding sections, under motivations, supporting design 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 (1964) idea of misfit, 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 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 newly discovered quality.

This exemplifies a principle in designing for unselfconscious interaction: interaction design artifacts are designed with non-existent or weak use goals while being designed with purpose. Our understanding of use goals is a use situation or known goal of potential users, e.g. composing and sending an email or managing project tasks of a group. Use goals are not only not required in unselfconscious interaction they are not desired. However, an alternative to no use goal is a weakened use goal. For example, often chairs are designed with a weakened use goal. The ostensible goal is to design an artifact to support sitting. Yet some chair designers except in the case of special purpose chairs like office chairs pay more attention to other design goals like materials, fabrication, fashion and expression. Little time is spent studying the requirements of sitting.

Purposeful purposelessness 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. 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 esthetic. 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 Fig. 17).

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



Figure 17. Various design studies, iterations and variations of the design elements of the Indoor Weather Stations (Jarvis *et al.*, 2012). ©Interaction Research Studio, Goldsmiths.

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 after different materials were considered 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 Fig. 18).

The purposeful esthetics of each artifact is precise and with clear intent. The Discovery-Driven Prototypes utilized esthetics as a counterpoint to the ‘unpredictability’ of the use and meanings of the prototypes: ‘with unpredictability, the ‘clarity’ requirement becomes esthetically 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 esthetic’ (Gaver *et al.*, 2013, p. 3454). The designers of the Indoor Weather Stations referenced Dieter Rams’ Braun Pocket Radio T-41 as an inspiration and esthetic 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 esthetic 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 both a potential resource and a complete product.

The cumulative results of the purposeful design, crafting and esthetics 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 Indoor 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.*, 2013, 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.

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. This concept relates to the common, broader idea of appropriation in HCI (see Section 3.2). However, our focus here is on the specific strategy of purposefully designing with weak use goals in mind, which we see in all three of the concept artifacts presented in this article. In parallel to this strategy, Seok *et al.* (2014) have focused on and unpacked the notion of ‘non-finito’ products in the context of HCI. Borrowing the term non-finito from deliberately unresolved artworks originating

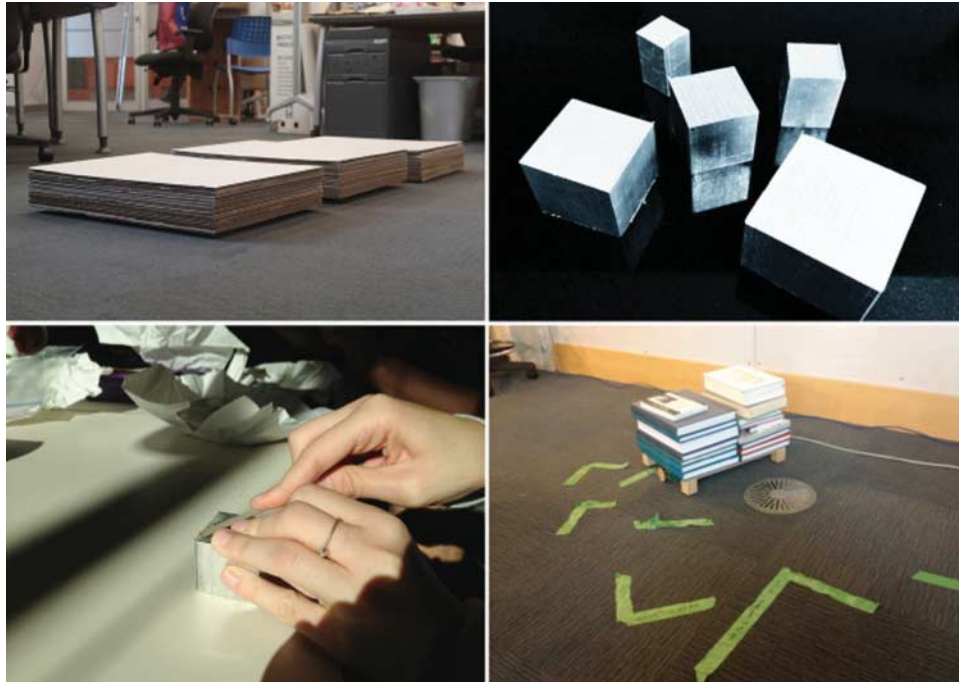


Figure 18. (Clockwise from upper left) cardboard mockups of table-non-table for different proportions; different sized aluminum squares for the chassis; early prototype for movement studies; filing aluminum square for die cut tests.

in the Renaissance, they define non-finito products in HCI as ‘intentionally unfinished products, fostering new creations by end-users in their actual instances of usage for their personal user experiences’ (Seok *et al.*, 2014, p. 659). The authors argue that non-finito products are characterized by the balance of purposelessness with clear functionality.

We also see continuity between the articulation of purposeful purposelessness in design and non-finito products, and the well-known argument presented by Sengers and Gaver (2006) on multiple interpretations, where they define purpose as one’s understanding of an object’s embodied values and socio-cultural meanings—how it reflects the identity of the person using it. The authors propose strategies to design toward multiple interpretations, including specifying usability but not use. This implies that how the system works and how it can be controlled is clear, but that the higher level purpose of the system is open to subjective meaning and a variety of different uses (*idem*, p. 102).

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 design qualities. By being precise and defined, use goals minimize alternative uses. By purposely designing without a purpose, designers can aim to reach the middle ground between familiar and alien and between active and passive. Purposeful purposelessness is a tool to balance the tensions that are inherent in the construct of unselfconscious interaction.

6. DISCUSSION

At this stage of the paper, we come full circle to review our unselfconscious interaction construct in light of the five features of unselfconscious culture we highlighted at the outset (see Section 2.1): (i) resources, (ii) adaptation, (iii) ensembles, (iv) time and (v) anonymity. This exercise helps us understand the commonalities between unselfconscious interaction and unselfconscious cultures but more importantly the necessary differences and adaptations required in considering designing for goodness of fit with computation and interaction design in mind. This exercise also reveals future challenges with respect to unselfconscious interaction.

In unselfconscious interaction, resources are the interaction design artifacts that are ready at hand; found within the nearby ensembles of form and context. These computational artifacts have the qualities of resources designed into them (e.g. open-ended and lived-with) rather than being raw resources like the sod and grass in Alexander’s unselfconscious cultures. One might consider open source, end-user programming or DIY electronic prototyping as modern day computational equivalents to working with raw materials. However, none of these practices manifest in an unselfconscious manner, in an everyday sense, due to the specialized skills required. In many respects, these practices are complementary to unselfconscious interaction but arise from replicating selfconscious practices of experts in amateur form rather than unselfconscious practices.

Adaptations in unselfconscious interaction are the dynamic of misfits, good fit and design with computation. Similar to Alexander, the misfit of a given aspect of an ensemble is motivation to fix the misfit or adapt it to achieve fit. However, only interaction design artifacts with the qualities of open-endedness—to support manipulation and change—and the lived with qualities—to allow for emergence of equilibrium—will participate within the dynamic of misfits and good fit. In contrast to raw materials, interaction design artifacts, as both designed and computational artifacts, hold an advantage in that they can serve as intentional catalysts. In unselfconscious interaction, there is a role for designers to shape the form and computation of artifacts to not only become enjoined in ensembles but to actively engage in supporting goodness of fit. Like we see in the Discovery Driven Prototypes, the Indoor Weather Stations and the table-non-table, the design of the form and computation purposely mobilized both curious engagements and unconscious intersections by mediating alien or defamiliarizing qualities. In this respect, unselfconscious interaction is active whereas unselfconscious cultures are passive with respect to adaptation.

Ensembles in unselfconscious interaction are virtually the same in unselfconscious cultures. Interaction design artifacts contribute to goodness of fit not individually but within an ecology of forms and context, an ensemble. In order for interaction design artifacts to participate in unselfconscious interactions, it is necessary but not sufficient to become part of an ensemble. Without enjoining an ensemble the artifact is essentially rejected or abandoned with no potential to contribute to goodness of fit.

Time plays a similar role in unselfconscious interaction; it is the crucial condition by which equilibrium of fit occurs. Similar to unselfconscious cultures, without time the ensembles of forms will not create cumulative progress and improvement. However, the active role of interaction design artifacts affects the incremental dynamic of achieving goodness of fit by accelerating the pace of increments or inducing creative leaps between increments in ways unselfconscious cultures were not capable¹. Whereas active adaptation may accelerate the change within an ensemble, the current limitations of computation and design, limit our understanding of the potential of a generational time scale of unselfconscious cultures in unselfconscious interaction.

Anonymity is an essential feature of unselfconscious interaction as in unselfconscious cultures. However, anonymity is more constrained within unselfconscious interaction. It speaks to the anonymous shaping of interaction design artifacts that is creative in the sense of achieving goodness of fit. As we discussed with adaptation, there is a role

¹ Alexander believed that in unselfconscious cultures creative knowledge came in the form of traditions that were passed on from generation to generation. This was a weakness that dismantled most unselfconscious cultures since they were unable to keep up with the pace of change in materials, technologies and skills in modern time (Alexander, 1964).

for a designer, a selfconscious one that is intentful and reflective, drawing upon abstracted knowledge and specialized skills. While selfconscious, a designer who designs for unselfconscious interaction is not a traditional designer. He or she makes significant space within their making for the realization of the artifact's purpose and engagement through the anonymous creativity and participation in ensembles. The designer embraces what Don Ihde refers to as the designer fallacy (Ihde, 2008) (see Section 2.2). An unselfconscious interaction designer deeply understands the agency of a design is distributed among other artifacts, contexts and anonymous creators. Moreover, the significant difference is that to design for unselfconscious interaction is to design for the gap between designer, anonymous maker and ensembles such that it is bridged through the relations and intersections that the artifact supports and creates.

7. CONCLUSION

Our contribution in this article is our definition and description of a new conceptual construct for interaction: 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.

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 and the notions of goodness of fit and unselfconscious culture by Alexander (1964), we developed the construct of unselfconscious interaction. We presented unselfconscious interaction as a form of interaction with computational artifacts that over time, and through ongoing incremental intersections, opens to subjective and subtle improvements in the relationships between artifacts, environments and people. We have argued that the motivation behind our construct, goodness of fit needs to be supported by the two design qualities of open-ended and lived-with. Unselfconscious interaction is then a combination of those qualities, along with the tensions that exist between them, balancing between active and passive as well as between familiar and alien.

We discussed how the role for interaction design is to become part of an ensemble of forms and context and to act as a catalyst that animates ongoing incremental engagements. To achieve this, interaction design artifacts are purposely designed with non-existent or weak use goals. We called this high-level design strategy purposeful purposelessness.

In addition to developing the conceptual construct of unselfconscious interaction, we elaborated on the notion of construct within concept-driven interaction design research (Stolterman and Wiberg, 2010). Moreover, in our view constructs are not bounded by the practical goal of improving artifacts, design practices or use situations, but rather aim at

contributing to our understanding of the relationships between artifacts, people and the world.

In conclusion, our hope is that unselfconscious interaction offers a useful lens that leads interaction designers to emphasize design qualities that enable goodness of fit in interaction design artifacts rather than a sole focus on improving use situations.

ACKNOWLEDGEMENTS

We would like to acknowledge the valuable feedback from Youn-Kyung Lim and Erik Stolterman, and our colleagues in the Everyday Design Studio at Simon Fraser University. We are grateful to the reviewers and editor for their invaluable suggestions and questions that substantially improved this article and refined our thinking. We thank the Interaction Research Studio, Goldsmiths, for permission to use their images.

FUNDING

The Natural Sciences and Engineering Research Council (NSERC) of Canada and the Social Sciences and Humanities Research Council (SSHRC) of Canada supported this research.

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